CURRENT ELECTRICITY

Electric Conduction, Ohm's Law and Resistance

1. Electric field (E) and current density (J) have relation **[Kerala PMT 2005; MP PMT 2009, 10]**

(a) $E \propto J^{-1}$ (b) $E \propto J$

(c) $E \propto \frac{1}{J^2}$ (d) $E^2 \propto \frac{1}{J}$

2. When the current i is flowing through a conductor, the drift velocity is v. If $2i$ current is flowed through the same metal but having double the area of cross-section, then the drift velocity will be **[Similar Kerala PET 2007]**

(a) $v/4$ (b) $v/2$

(c) v (d) $4v$

3. Pick out the wrong feature about carbon resistors **[Kerala PET 2012]**

(a) Compact

(b) Inexpensive

(c) Relatively sensitive to temperature

(d) Mostly used for higher resistor values

(e) Colour codes express their resistor values

4. Ohm's law is valid if **[Kerala PMT 2012]**

(a) V is directly proportional to I^3

(b) The relation between V and I depends on the sign of V for the same absolute value of V

(c) The relation between V and I is non-unique

(d) V is directly proportional to I^2

(e) V depends on I linearly

5. The current flowing through a wire depends on time as $I = 3t^2 + 2t + 5$. The charge flowing through the cross-section of the wire in time from $t = 0$ to $t = 2$ sec. is **[WB-JEE 2009]**

(a) 22 C (b) 20 C

(c) 18 C (d) 5 C

6. Resistance of a wire at $20°C$ is $20\,\Omega$ and at $500°C$ is $60\,\Omega$. At what temperature its resistance is $25\,\Omega$ **[Odisha JEE 2009; Similar AMU (Engg.) 2010]**

(a) $160°C$ (b) $250°C$

(c) $100°C$ (d) $80°C$

7. The specific resistance of manganin is $50 \times 10^{-8}\, ohm \times m$. The resistance of a cube of length $50\, cm$ will be

(a) $10^{-6}\, ohm$ (b) $2.5 \times 10^{-5}\, ohm$

(c) $10^{-8}\, ohm$ (d) $5 \times 10^{-4}\, ohm$

8. The resistivity of iron is 1×10^{-7} $ohm-m$. The resistance of a iron wire of particular length and thickness is 1 ohm. If the length and the diameter of wire both are doubled, then the resistivity in $ohm-m$ will be **[CPMT 1983; DPMT 1999]**

(a) 1×10^{-7} (b) 2×10^{-7}

(c) 4×10^{-7} (d) 8×10^{-7}

9. The temperature coefficient of resistance for a wire is $0.00125/°C$. At $300K$ its resistance is 1 ohm. The temperature at which the resistance becomes 2 ohm is

[IIT 1980; MP PMT 2001; MP PET 2002; Odisha JEE 2002; KCET 2003; AIEEE 2006; Similar AMU PMT 2009; KCET 2009]

(a) 1154 K (b) 1100 K

(c) 1400 K (d) 1127 K

10. Consider a copper wire of length L, cross-sectional area A. It has n number of free electrons per unit volume. Which of the following is the correct expression of drift velocity of the electrons when the wire carries a steady current I **[J & K CET 2012]**

(a) $\frac{I}{neL}$ (b) $\frac{I}{n^2eL}$

(c) $\frac{I}{neA}$ (d) $\frac{I}{ne^2LA}$

11. The resistance of a wire is 20 ohm. It is so stretched that the length becomes three times, then the new resistance of the wire will be

[MP PET 1989; Similar WB-JEE 2009; NEET 2013]

(a) 6.67 ohm (b) 60.0 ohm

(c) 120 ohm (d) 180.0 ohm

12. The resistivity of a wire **[MP PMT 1984; DPMT 1982]**

(a) Increases with the length of the wire

(b) Decreases with the area of cross-section

(c) Decreases with the length and increases with the cross-section of wire

(d) None of the above statement is correct

13. *Ohm's* law is true

(a) For metallic conductors at low temperature

(b) For metallic conductors at high temperature

(c) For electrolytes when current passes through them

(d) For diode when current flows

14. A wire of a certain material is stretched slowly by ten percent. Its new resistance and specific resistance become respectively **[CBSE PMT 2008; Similar MP PMT 2013]**

(a) Both remain the same (b) 1.1 times, 1.1 times

(c) 1.2 times, 1.1 times (d) 1.21 times, same

15. Drift velocity v_d varies with the intensity of electric field as per the relation **[CPMT 1981; BVP 2003]**

(a) $v_d \propto E$ (b) $v_d \propto \frac{1}{E}$

(c) v_d = constant (d) $v_d \propto E^2$

16. Which of the following statement is correct **[MP PET 2008]**

(a) Electric field is zero on the surface of current carrying wire

(b) Electric field is non-zero on the axis of hollow current carrying wire.

(c) Surface integral of magnetic field for any closed surface is equal to μ_0 times of total algebraic sum of current which are crossing through the closed surface.

(d) None

17. An electric cell of e.m.f. E is connected across a copper wire of diameter d and length l. The drift velocity of electrons in the wire is v_d. If the length of the wire is changed to $2l$, the new drift velocity of electrons in the copper wire will be **[WB-JEE 2013]**

(a) v_d (b) $2v_d$

(c) $v_d/2$ (d) $v_d/4$

18. In a conductor if 3000 coulomb of charge enters and 3000 coulomb of charge exits in time 10 minutes, then the current is **[Odisha JEE 2011]**

(a) 5 ampere (b) 10 ampere

(c) 2.5 ampere (d) Zero

19. 62.5×10^{18} electrons per second are flowing through a wire of area of cross-section $0.1\,m^2$, the value of current flowing will be **[CPMT 1984; Similar Kerala PET 2012]**

(a) 1 A (b) 0.1 A

(c) 10 A (d) 0.11 A

20. In a closed circuit, the current I (in ampere) at an instant of time t (in second) is given by $I = 4 - 0.08t$. The number of electrons flowing in $50s$ through the cross section of the conductor is **[Kerala PET 2007]**

(a) 1.25×10^{19} (b) 6.25×10^{20}

(c) 5.25×10^{19} (d) 2.55×10^{20}

21. When a piece of aluminium wire of finite length is drawn through a series of dies to reduce its diameter to half its original value, its resistance will become **[AIIMS 1997; MH CET 2000; UPSEAT 2001; CBSE PMT 2002]**

(a) Two times (b) Four times

(c) Eight times (d) Sixteen times

22. A wire 100 cm long and 2.0 mm diameter has a resistance of 0.7 ohm, the electrical resistivity of the material is **[Similar BHU 2006]**

(a) $4.4\times10^{-6}\,ohm\times m$ (b) $2.2\times10^{-6}\,ohm\times m$

(c) $1.1\times10^{-6}\,ohm\times m$ (d) $0.22\times10^{-6}\,ohm\times m$

23. A certain wire has a resistance R. The resistance of another wire identical with the first except having twice its diameter is **[CPMT 1999]**

(a) $2R$ (b) $0.25R$

(c) $4R$ (d) $0.5R$

24. In hydrogen atom, the electron makes 6.6×10^{15} revolutions per second around the nucleus in an orbit of radius $0.5\times10^{-10}m$. It is equivalent to a current nearly

(a) 1 A (b) 1 mA

(c) 1 μA (d) $1.6\times10^{-19}A$

25. A wire of length $5\,m$ and radius $1\,mm$ has a resistance of 1 *ohm*. What length of the wire of the same material at the same temperature and of radius $2\,mm$ will also have a resistance of 1 *ohm*

(a) $1.25\,m$ (b) $2.5\,m$

(c) $10\,m$ (d) $20\,m$

26. Metals have **[J & K CET 2008]**

(a) Zero resistivity (b) High resistivity

(c) Low resistivity (d) Infinite resistivity

27. Consider a rectangular slab of length L and area of cross section A. A current I is passed through it. If the length is doubled, the potential drop across the end faces **[J & K CET 2008]**

(a) Becomes half of the initial value

(b) Becomes one-fourth of the initial value

(c) Becomes double the initial value

(d) Remains same

28. A wire of resistance R is elongated $n-$fold to make a new uniform wire. The resistance of new wire **[WB-JEE 2010]**

(a) nR (b) n^2R

(c) $2nR$ (d) $2n^2R$

29. A metallic block has no potential difference applied across it, then the mean velocity of free electrons is (T = absolute temperature of the block)

(a) Proportional to T

(b) Proportional to $\sqrt{T}$

(c) Zero

(d) Finite but independent of temperature

30. The drift velocity of the electrons in a copper wire of length $2m$ under the application of a potential difference of $200\,V$ is $0.5\,ms^{-1}$. Their mobility is (in $m^2V^{-1}s^{-1}$) **[Kerala PET 2008]**

(a) 2.5×10^{-3} (b) 2.5×10^{-2}

(c) 5×10^{2} (d) 5×10^{-3}

(e) 5×10^{-2}

31. The resistance of a metal increases with increasing temperature because **[VITEEE 2008]**

(a) The collisions of the conducting electrons with the electrons increase

(b) The collisions of the conducting electrons with the lattice consisting of the ions of the metal increase

(c) The number of conduction electrons decreases

(d) The number of conduction electrons increases

32. In the absence of applied potential, the electric current flowing through a metallic wire is zero because **[VITEEE 2008]**

(a) The electrons remain stationary

(b) The electrons are drifted in random direction with a speed of the order of $10^{-2}\,cm/s$

(c) The electrons move in random direction with a speed of the order close to that of velocity of light

(d) Electrons and ions move in opposite direction

33. If a wire is stretched to make it 0.1% longer, its resistance will **[AIEEE 2011]**

(a) Increase by 0.05% (b) Increase by 0.2%

(c) Decrease by 0.2% (d) Decrease by 0.05%

34. On increasing the temperature of a conductor, its resistance increases because the **[Kerala PMT 2011]**

(a) Relaxation time increases

(b) Mass of electron increases

(c) Electron density decreases

(d) Relaxation time decreases

(e) Relaxation time remains constant

35. When an electrical appliance is switched on, it responds almost immediately, because **[VITEEE 2008]**

(a) The electrons in the connecting wires move with the speed of light

(b) The electrical signal is carried by electromagnetic waves moving with the speed of light

(c) The electrons move with speed which is close to but less than speed of light

(d) The electron are stagnant

36. The electric intensity E, current density j and specific resistance k are related to each other by the relation **[DPMT 2001]**

(a) $E = j/k$ (b) $E = jk$

(c) $E = k/j$ (d) $k = jE$

37. The resistance of a wire of uniform diameter d and length L is R. The resistance of another wire of the same material but diameter $2d$ and length $4L$ will be **[CPMT 1984; MP PET 2002; Similar MP PMT 1993]**

(a) $2R$ (b) R

(c) $R/2$ (d) $R/4$

38. There is a current of 1.344 *amp* in a copper wire whose area of cross-section normal to the length of the wire is $1\,mm^2$. If the number of free electrons per cm^3 is 8.4×10^{22}, then the drift velocity would be **[CPMT 1990; Similar Pb. PMT 2001; KCET 2012]**

(a) $1.0\,mm/sec$ (b) $1.0\,m/sec$

(c) $0.1\,mm/sec$ (d) $0.01\,mm/sec$

39. It is easier to start a car engine on a hot day than on a cold day. This is because the internal resistance of the car battery

(a) Decreases with rise in temperature

(b) Increases with rise in temperature

(c) Decreases with a fall in temperature

(d) Does not change with a change in temperature

40. 5 *ampere* of current is passed through a metallic conductor. The charge flowing in one minute in coulomb will be **[MP PET 1984; Similar RPMT 1997]**

(a) 5 (b) 12

(c) 1/12 (d) 300

41. A metal wire is subjected to a constant potential difference. When the temperature of the metal wire increases, the drift velocity of the electron in it **[KCET 2008]**

(a) Increases, thermal velocity of the electron increases

(b) Decreases, thermal velocity of the electron increases

(c) Increases, thermal velocity of the electron decreases

(d) Decreases, thermal velocity of the electron decreases

42. Two identical conductors maintained at same temperatures are given potential differences in the ratio $1:2$ Then the ratio of their drift velocities is **[Kerala PMT 2011]**

(a) $1:2$ (b) $3:2$

(c) $1:1$ (d) $1:2^{1/2}$

(e) $1:4$

43. The tolerance level of a resistor with the colour code red, blue, orange, gold is **[Kerala PET 2011]**

(a) $\pm 5\%$ (b) $\pm 10\%$

(c) $\pm 20\%$ (d) $\pm 40\%$

(e) $\pm 30\%$

44. Find the TRUE statement **[Kerala PET 2011]**

(a) Ohm's law is applicable to all conductors of electricity

(b) In an electrolyte solution, the electric current is mainly due to the movement of electrons

(c) The resistance of an incandescent lamp is lesser when the lamp is switched on

(d) Specific resistance of a wire depends upon its dimension

(e) The resistance of carbon decreases with the increase of temperature

45. A colour coded carbon resistor has the colours orange, blue, green and silver. Its resistance value and tolerance percentage respectively are

[AMU (Med.) 2010; Similar Kerala PMT 2012]

(a) $36\times10^5\Omega$ and 10% (b) $36\times10^4\Omega$ and 5%

(c) $63\times10^5\Omega$ and 10% (d) $35\times10^6\Omega$ and 5%

46. The colour sequence in a carbon resistor is red, brown, orange and silver. The resistance of the resistor is

[DCE 2004; Similar Kerala PMT 2008; J&K CET 2012]

(a) $21\times10^3\pm10\%$ (b) $23\times10^1\pm10\%$

(c) $21\times10^3\pm5\%$ (d) $12\times10^3\pm5\%$

47. The relaxation time in conductors **[DPMT 2003]**

(a) Increases with the increase of temperature

(b) Decreases with the increase of temperature

(c) It does not depend on temperature

(d) All of sudden changes at 400 *K*

48. Which of the following statements is correct

(a) Liquids obey fully the *ohm*'s law

(b) Liquids obey partially the *ohm*'s law

(c) There is no relation between current and p.d. for liquids

(d) None of the above

49. A certain piece of silver of given mass is to be made like a wire. Which of the following combinations of length (L) and the area of cross-section (A) will lead to the smallest resistance **[MP PMT 1995; CBSE PMT 1997]**

(a) L and A

(b) $2L$ and $A/2$

(c) $L/2$ and $2A$

(d) Any of the above, because volume of silver remains same

50. The resistance of a wire is 10Ω. Its length is increased by 10% by stretching. The new resistance will now be

[CPMT 2000; Pb PET 2004; J & K CET 2010; Kerala PET 2011]

(a) 12Ω (b) 1.2Ω

(c) 13Ω (d) 11Ω

51. Resistance of tungsten wire at $150°C$ is 133Ω. Its resistance temperature coefficient is $0.0045/°C$. The resistance of this wire at $500°C$ will be

[DPMT 2004; Similar KCET 1999]

(a) 180Ω (b) 225Ω

(c) 258Ω (d) 317Ω

52. The following four wires are made of the same material and are at the same temperature. Which one of them has highest electrical resistance **[UPSEAT 2004; Similar VITEEE 2008]**

(a) Length = 50 *cm*, diameter = 0.5 *mm*

(b) Length = 100 *cm*, diameter = 1 *mm*

(c) Length = 200 *cm*, diameter = 2 *mm*

(d) Length = 300 *cm*, diameter = 3 *mm*

53. A wire of diameter 0.02 *metre* contains 10^{28} free electrons per cubic metre. For an electrical current of 100 *A*, the drift velocity of the free electrons in the wire is nearly

[UPSEAT 2004]

(a) $1\times10^{-19}\ m/s$ (b) $5\times10^{-10}\ m/s$

(c) $2\times10^{-4}\ m/s$ (d) $8\times10^{3}\ m/s$

54. For a metallic wire, the ratio V/i (V = the applied potential difference, i = current flowing) is **[MP PMT 1994; BVP 2003]**

(a) Independent of temperature

(b) Increases as the temperature rises

(c) Decreases as the temperature rises

(d) Increases or decreases as temperature rises, depending upon the metal

55. The resistance of a wire is R. If the length of the wire is doubled by stretching, then the new resistance will be

[Roorkee 1992; KCET 1993; AFMC 1995; AMU (Med.) 1999; CBSE PMT 1999; MP PET 2001; UPSEAT 2001; Similar ISM Dhanbad 1994; BHU 2002; UPSEAT 2003; J & K CET 2004; Pb. PMT 2004; Kerala PMT 2008]

(a) $2R$ (b) $4R$

(c) R (d) $\frac{R}{4}$

56. The electric resistance of a certain wire of iron is R. If its length and radius are both doubled, then **[CBSE PMT 2004]**

(a) The resistance will be doubled and the specific resistance will be halved

(b) The resistance will be halved and the specific resistance will remain unchanged

(c) The resistance will be halved and the specific resistance will be doubled

(d) The resistance and the specific resistance, will both remain unchanged

57. The reciprocal of resistance is **[AFMC 1995]**

(a) Conductance (b) Resistivity

(c) Voltage (d) None of the above

58. When a potential difference is applied across the ends of a linear metallic conductor **[MP PET 1997]**

(a) The free electrons are accelerated continuously from the lower potential end to the higher potential end of the conductor

(b) The free electrons are accelerated continuously from the higher potential end to the lower potential end of the conductor

(c) The free electrons acquire a constant drift velocity from the lower potential end to the higher potential end of the conductor

(d) The free electrons are set in motion from their position of rest

59. All of the following statements are true except **[Manipal MEE 1995]**

(a) Conductance is the reciprocal of resistance and is measured in *Siemen*

(b) *Ohm*'s law is not applicable at very low and very high temperatures

(c) *Ohm*'s law is applicable to semiconductors

(d) *Ohm*'s law is not applicable to electron tubes, discharge tubes and electrolytes

60. The alloys constantan and manganin are used to make standard resistance because they have **[NCERT 1990; MH CET 2000; Similar DUMET 2009]**

(a) Low resistivity

(b) High resistivity

(c) Low temperature coefficient of resistance

(d) Both (b) and (c)

61. If the resistance of a conductor is 5 Ω at 50°*C* and 7 Ω at 100°*C* then the mean temperature coefficient of resistance of the material is **[Pb. PET 2000; Similar VITEEE 2006; MP PET 2007; J & K CET 2012]**

(a) 0.008/°*C* (b) 0.006/°*C*

(c) 0.004/°*C* (d) 0.001/°*C*

62. The resistance of a discharge tube is **[AFMC 1996; CBSE PMT 1999]**

(a) *Ohmic* (b) Non-*ohmic*

(c) Both (a) and (b) (d) Zero

63. We are able to obtain fairly large currents in a conductor because **[Haryana CEE 1996]**

(a) The electron drift speed is usually very large

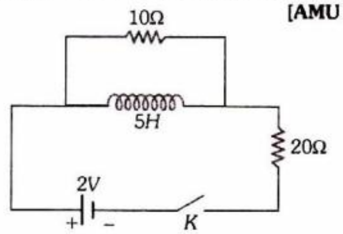
(b) The number density of free electrons is very high and this can compensate for the low values of the electron drift speed and the very small magnitude of the electron charge

(c) The number density of free electrons as well as the electron drift speeds are very large and these compensate for the very small magnitude of the electron charge

(d) The very small magnitude of the electron charge has to be divided by the still smaller product of the number density and drift speed to get the electric current

64. Two resistances of 10 Ω and 20 Ω and an inductor of inductance 5 *H* are connected to a battery of 2 *V* through a key k as shown in the figure. At time $t = 0$,

when the key k is closed the initial current through the battery is **[AMU PMT 2009]**



(a) 0.2 *A* (b) $\frac{2}{15}A$

(c) $\frac{1}{15}A$ (d) 0

65. In a wire of circular cross-section with radius *r*, free electrons travel with a drift velocity *V* when a current *I* flows through the wire. What is the current in another wire of half the radius and of the same material when the drift velocity is 2*V* **[MP PET 1997]**

(a) 2*I* (b) *I*

(c) $I/2$ (d) $I/4$

66. The resistivity of a wire depends on its **[MP PMT/PET 1998]**

(a) Length (b) Area of cross-section

(c) Shape (d) Material

67. The conductivity of a superconductor is **[Similar to KCET 1993; MP PMT/PET 1998]**

(a) Infinite (b) Very large

(c) Very small (d) Zero

68. In a neon discharge tube $2.9\times10^{18}\ Ne^{+}$ ions move to the right each *second* while 1.2×10^{18} electrons move to the left per *second*. Electron charge is $1.6\times10^{-19}C$. The current in the discharge tube **[AFMC 1996; MP PET 1999]**

(a) 1 *A* towards right (b) 0.66 *A* towards right

(c) 0.66 *A* towards left (d) Zero

69. A steady current flows in a metallic conductor of non-uniform cross-section. The quantity/ quantities constant along the length of the conductor is/are **[KCET 1994, IIT 1997 Cancelled; CBSE PMT 2001]**

(a) Current, electric field and drift speed

(b) Drift speed only

(c) Current and drift speed

(d) Current only

70. The lead wires should have **[Pb. PMT 2000]**

(a) Larger diameter and low resistance

(b) Smaller diameter and high resistance

(c) Smaller diameter and low resistance

(d) Larger diameter and high resistance

71. Two wires *A* and *B* of same material and same mass have radii 2*r* and *r* respectively. If resistance of wire *A* is $34\,\Omega$, then resistance of *B* will be **[RPET 1997; Similar WB-JEE 2009]**

(a) $544\,\Omega$ (b) $272\,\Omega$

(c) $68\,\Omega$ (d) $17\,\Omega$

72. Two rods of same material and length have their electric resistances in ratio $1:2$. When both rods are dipped in water, the correct statement will be **[RPMT 1997]**

(a) *A* has more loss of weight

(b) *B* has more loss of weight

(c) Both have same loss of weight

(d) Loss of weight will be in the ratio $1:2$

73. Two different conductors have same resistance at 0°*C*. It is found that the resistance of the first conductor at t_1°*C* is equal to the resistance of the second conductor at t_2°*C*. The ratio of the temperature coefficients of resistance of the conductors, α_1/α_2 is **[Kerala PET 2009]**

(a) $\frac{t_1}{t_2}$ (b) $\frac{t_2-t_1}{t_2}$

(c) $\frac{t_2-t_1}{t_1}$ (d) $\frac{t_2}{t_1}$

(e) $\frac{t_2}{t_2-t_1}$

74. The resistance of a wire at room temperature $30°C$ is found to be 10Ω. Now to increase the resistance by 10%, the temperature of the wire must be [The temperature coefficient of resistance of the material of the wire is 0.002 per $°C$] **[Kerala PET 2007]**

(a) $36°C$ (b) $83°C$

(c) $63°C$ (d) $33°C$

75. The colour code for a resistor of resistance $3.5k\Omega$ with 5% tolerance is **[Kerala PMT 2007]**

(a) Orange, green, red and gold

(b) Red, yellow, black and gold

(c) Orange, green, orange and silver

(d) Orange, green, red and silver

76. A current I is passing through a wire having two sections P and Q of uniform diameters d and $d/2$ respectively. If the mean drift velocity of electrons in sections P and Q is denoted by v_P and v_Q respectively, then **[Roorkee 1999]**

(a) $v_P = v_Q$ (b) $v_P = \frac{1}{2} v_Q$

(c) $v_P = \frac{1}{4} v_Q$ (d) $v_P = 2\, v_Q$

77. If an electric current is passed through a nerve of a man, then man **[UPSEAT 1999]**

(a) Begins to laugh

(b) Begins to weep

(c) Is excited

(d) Becomes insensitive to pain

78. The mobility of free electrons (charge e, mass m and relaxation time τ) in a metal is proportional to **[J & K CET 2010]**

(a) $\frac{e}{m}\tau$ (b) $\frac{m}{e}\tau$

(c) $\frac{e}{m\tau}$ (d) $\frac{m}{e\tau}$

79. Masses of three wires of copper are in the ratio of 1 : 3 : 5 and their lengths are in the ratio of 5 : 3 : 1. The ratio of their electrical resistances are

[AFMC 2000; Similar CPMT 2002; Kerala PET 2009]

(a) 1 : 3 : 5 (b) 5 : 3 : 1

(c) 1 : 15 : 125 (d) 125 : 15 : 1

80. Conductivity increases in the order of **[AFMC 2000]**

(a) *Al, Ag, Cu* (b) *Al, Cu, Ag*

(c) *Cu, Al, Ag* (d) *Ag, Cu, Al*

81. A uniform wire of resistance R is uniformly compressed along its length, until its radius becomes n times the original radius. Now resistance of the wire becomes

[KCET 2000; Similar KCET (Med.) 2001]

(a) $\frac{R}{n^4}$ (b) $\frac{R}{n^2}$

(c) $\frac{R}{n}$ (d) nR

82. The resistance of a conductor is 5 *ohm* at 50°C and 6 *ohm* at 100°C. Its resistance at 0°C is

[KCET 2000; AIEEE 2002, 07; RPMT 2006]

(a) 1 *ohm* (b) 2 *ohm*

(c) 3 *ohm* (d) 4 *ohm*

83. A block has dimensions 1 *cm*, 2 *cm*, 3 *cm*. Ratio of the maximum resistance to minimum resistance between any point of opposite faces of this block is **[J & K CET 2006]**

(a) 9 : 1 (b) 1 : 9

(c) 18 : 1 (d) 1 : 6

84. Equal potentials are applied on an iron and copper wire of same length. In order to have the same current flow in the two wires, the ratio r (iron)/r (copper) of their radii must be (Given that specific resistance of iron = 1.0×10^{-7} *ohm–m* and specific resistance of copper = 1.7×10^{-8} *ohm-m*)

[MP PMT 2000]

(a) About 1.2 (b) About 2.4

(c) About 3.6 (d) About 4.8

85. An electron (charge = 1.6×10^{-19} *coulomb*) is moving in a circle of radius $5.1 \times 10^{-11} m$ at a frequency of 6.8×10^{15} *revolutions/sec*. The equivalent current is approximately

[MP PET 2000; Similar EAMCET 2000; AMU PMT 2009]

(a) 5.1×10^{-3} *amp* (b) 6.8×10^{-3} *amp*

(c) 1.1×10^{-3} *amp* (d) 2.2×10^{-3} *amp*

86. A rod of a certain metal is 1.0 *m* long and 0.6 *cm* in diameter. Its resistance is 3.0×10^{-3} *ohm*. Another disc made of the same metal is 2.0 *cm* in diameter and 1.0 *mm* thick. What is the resistance between the round faces of the disc **[MP PET 2000]**

(a) 1.35×10^{-8} *ohm* (b) 2.70×10^{-7} *ohm*

(c) 4.05×10^{-6} *ohm* (d) 8.10×10^{-5} *ohm*

87. At what temperature will the resistance of a copper wire become three times its value at 0°C (Temperature coefficient of resistance for copper = 4×10^{-3} *per* °C)

[MP PET 2000]

(a) 400°C (b) 450°C

(c) 500°C (d) 550°C

88. An electron revolves 6×10^{15} *times/sec* in circular loop. The current in the loop is **[MNR 1995; UPSEAT 2000]**

(a) 0.96 *mA* (b) 0.96 μA

(c) 28.8 *A* (d) None of these

89. The electron drift speed is small and the charge of the electron is also small but still, we obtain large current in a conductor. This is due to **[KCET 2006]**

(a) The conducting property of the conductor

(b) The resistance of the conductor is small

(c) The electron number density of the conductor is small

(d) The electron number density of the conductor is enormous

90. If potential $V = 100 \pm 0.5\, Volt$ and current $I = 10 \pm 0.2$ *amp* are given to us, then what will be the value of resistance **[RPET 2001]**

(a) $10 \pm 0.7\, ohm$ (b) $5 \pm 2\, ohm$

(c) $0.1 \pm 0.2 ohm$ (d) None of these

91. A nichrome wire 50 *cm* long and one square *millimetre* cross-section carries a current of 4*A* when connected to a 2*V* battery. The resistivity of nichrome wire in *ohm metre* is

[EAMCET 2001]

(a) 1×10^{-6} (b) 4×10^{-7}

(c) 3×10^{-7} (d) 2×10^{-7}

92. If an observer is moving with respect to a stationary electron, then he observes **[DCE 2001]**

(a) Only magnetic field (b) Only electric field

(c) Both (a) and (b) (d) None of the above

93. Calculate the amount of charge flowing in 2 *minutes* in a wire of resistance 10 Ω when a potential difference of 20 *V* is applied between its ends **[Kerala (Engg.) 2001]**

(a) 120 *C* (b) 240 *C*

(c) 20 *C* (d) 4 *C*

94. The number of free electrons per 100*mm* of ordinary copper wire is 2×10^{21}. Average drift speed of electrons is $0.25\,mm/s$. The current flowing is **[MP PET 2006]**

(a) 5 *A* (b) 80 *A*

(c) 8 *A* (d) 0.8 *A*

95. The drift velocity does not depend upon **[BHU 2001]**

(a) Cross-section of the wire (b) Length of the wire

(c) Number of free electrons (d) Magnitude of the current

96. If the ratio of the concentration of electron to that of holes in a semiconductor is $\frac{7}{5}$ and the ratio of current is $\frac{7}{4}$, then what is the ratio of their drift velocities **[AIEEE 2006]**

(a) 4/5 (b) 5/4

(c) 4/7 (d) 5/8

97. At room temperature, copper has free electron density of 8.4×10^{28} per m^3. The copper conductor has a cross-section of $10^{-6}\ m^2$ and carries a current of 5.4 *A*. The electron drift velocity in copper is

[UPSEAT 2002; Similar AMU (Med.) 2002; VITEEE 2006; KCET 2007]

(a) 400 *m/s* (b) 0.4 *m/s*

(c) 0.4 *mm/s* (d) 72 *m/s*

98. The resistance of a 5 *cm* long wire is 10 Ω. It is uniformly stretched so that its length becomes 20 *cm*. The resistance of the wire is **[MH CET 2002]**

(a) 160 Ω (b) 80 Ω

(c) 40 Ω (d) 20 Ω

99. The resistance of an incandescent lamp is **[KCET 2002]**

(a) Greater when switched off

(b) Smaller when switched on

(c) Greater when switched on

(d) The same whether it is switched off or switched on

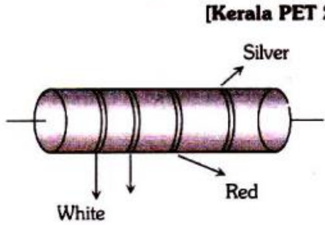
100. In the figure a carbon resistor has bands of different colours on its body as mentioned in the figure. The value of the resistance is **[Kerala PET 2002]**

(a) 2.2 *k*Ω

(b) 3.3 *k*Ω

(c) 5.6 *k*Ω

(d) 9.1 *k*Ω



101. By increasing the temperature, the specific resistance of a conductor and a semiconductor **[AIEEE 2002; MP PET 2007]**

(a) Increases for both

(b) Decreases for both

(c) Increases, decreases

(d) Decreases, increases

102. Which of the following is vector quantity **[AFMC 2002]**

(a) Current density (b) Current

(c) Wattless current (d) Power

103. A material 'B' has twice the specific resistance of 'A'. A circular wire made of 'B' has twice the diameter of a wire made of 'A'. Then for the two wires to have the same resistance, the ratio $\frac{l_B}{l_A}$ of their respective lengths must be **[AIEEE 2006]**

(a) 1/2 (b) 1/4

(c) 2 (d) 1

104. A current of 1 *mA* is flowing through a copper wire. How many electrons will pass a given point in one *second* [$e = 1.6\times10^{-19}$ *Coulomb*] **[RPMT 2000; MP PMT 2002; Similar CPMT 1986; RPMT 1999; AMU (Med.) 2000]**

(a) 6.25×10^{19} (b) 6.25×10^{15}

(c) 6.25×10^{31} (d) 6.25×10^{8}

105. The drift velocity of free electrons in a conductor is 'v' when a current 'i' is flowing in it. If both the radius and current are doubled, then drift velocity will be **[BHU 2002]**

(a) v (b) $v/2$

(c) $v/4$ (d) $v/8$

106. If σ_1, σ_2 and σ_3 are the conductances of three conductors, then their equivalent conductance, when they are joined in series, will be **[CPMT 2002]**

(a) $\sigma_1+\sigma_2+\sigma_3$ (b) $\frac{1}{\sigma_1}+\frac{1}{\sigma_2}+\frac{1}{\sigma_3}$

(c) $\frac{\sigma_1\sigma_2\sigma_3}{\sigma_1+\sigma_2+\sigma_3}$ (d) None of these

107. The resistance of a conductor increases with **[CBSE PMT 2002]**

(a) Increase in length

(b) Increase in temperature

(c) Decrease in cross–sectional area

(d) All of these

108. Two wires that are made up of two different materials whose specific resistance are in the ratio 2 : 3, length 3 : 4 and area 4 : 5. The ratio of their resistances is **[Kerala PMT 2005]**

(a) 6 : 5 (b) 6 : 8

(c) 5 : 8 (d) 1 : 2

109. Two wires of same material have length *L* and 2*L* and cross–sectional areas 4*A* and *A* respectively. The ratio of their specific resistances would be **[MHCET 2002]**

(a) 1 : 2 (b) 8 : 1

(c) 1 : 8 (d) 1 : 1

110. When a current flows through a conductor its temperature **[MHCET 2002]**

(a) May increase or decrease

(b) Remains same

(c) Decreases

(d) Increases

111. What length of the wire of specific resistance $48\times10^{-8}\ \Omega\ m$ is needed to make a resistance of $4.2\ \Omega$ (diameter of wire = $0.4\ mm$) **[CBSE PMT 2000; Pb. PMT 2002]**

(a) $4.1\ m$ (b) $3.1\ m$
(c) $2.1\ m$ (d) $1.1\ m$

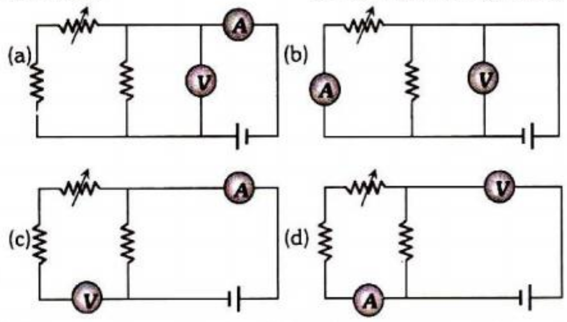
112. A strip of copper and another of germanium are cooled from room temperature to $80\ K$. The resistance of **[AIEEE 2003]**

(a) Each of these increases
(b) Each of these decreases
(c) Copper strip increases and that of germanium decreases
(d) Copper strip decreases and that of germanium increases

113. The length of a given cylindrical wire is increased by 100 %. Due to the consequent decrease in diameter the change in the resistance of the wire will be **[AIEEE 2003; Similar MNR 1990; MP PMT 1996, 2000; UPSEAT 1999]**

(a) 300 % (b) 200 %
(c) 100 % (d) 50 %

114. Express which of the following setups can be used to verify Ohm's law **[IIT-JEE (Screening) 2003]**



115. We have two wires A and B of same mass and same material. The diameter of the wire A is half of that B. If the resistance of wire A is 24 *ohm* then the resistance of wire B will be **[CPMT 2003]**

(a) 12 *Ohm* (b) 3.0 *Ohm*
(c) 1.5 *Ohm* (d) None of the above

116. The graph between resistivity and temperature, for a limited range of temperatures, is a straight line for a material like **[Kerala PET 2010]**

(a) Copper (b) Nichrome
(c) Silicon (d) Mercury
(e) Gallium arsenide

117. A steady current i is flowing through a conductor of uniform cross-section. Any segment of the conductor has **[MP PET 1996]**

(a) Zero charge
(b) Only positive charge
(c) Only negative charge
(d) Charge proportional to current i

118. The length of the wire is doubled. Its conductance will be **[Kerala PMT 2004]**

(a) Unchanged (b) Halved
(c) Quadrupled (d) 1/4 of the original value

119. A source of e.m.f. $E = 15\ V$ and having negligible internal resistance is connected to a variable resistance so that the current in the circuit increases with time as $i = 1.2\ t + 3$. Then, the total charge that will flow in first five seconds will be **[Kerala PMT 2004; J & K CET 2004]**

(a) $10\ C$ (b) $20\ C$
(c) $30\ C$ (d) $40\ C$

120. The density of copper is $9\times10^3 kg/m^3$ and its atomic mass is $63.5u$. Each copper atom provides one free electron. Estimate the number of free electrons per cubic meter in copper **[AMU (Engg.) 2010]**

(a) 10^{19} (b) 10^{23}
(c) 10^{25} (d) 10^{29}

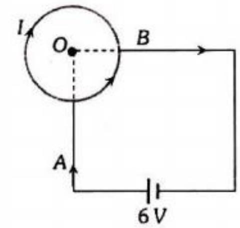
121. A thick wire is stretched so that its length becomes two times. Assuming that there is no change in its density, what is the ratio of change in resistance of wire to the initial resistance of wire **[MH CET 2004]**

(a) $2:1$ (b) $4:1$
(c) $3:1$ (d) $1:4$

122. What is the resistance of a carbon resistance which has bands of colours brown, black and brown **[DCE 1999]**

(a) $100\ \Omega$ (b) $1000\ \Omega$
(c) $10\ \Omega$ (d) $1\ \Omega$

123. A wire is bent in the form of circle of radius $2m$. Resistance per unit length of wire is $1/\pi\ \Omega/m$. Battery of $6V$ is connected between A & B. $\angle AOB = 90°$. Find the current through the battery **[GUJCET 2014]**



(a) $8A$ (b) $4A$
(c) $3A$ (d) $9A$

124. The carbon resistor has orange bands. The maximum value of resistance offered by the resistor will be **[GUJCET 2014]**

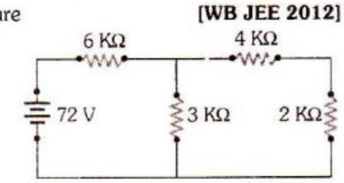
(a) $49.9\ K\Omega$ (b) $39.6\ K\Omega$
(c) $33\ K\Omega$ (d) $26.4\ K\Omega$

125. Two wires of same material having length and radii in the ratio 3 : 4 and 3 : 2 respectively are connected in parallel with a potential source of $6V$. The ratio of currents flowing through them, $I_1 : I_2 =$ **[MP PMT 1994; Similar GUJCET 2014]**

(a) $1:3$ (b) $3:1$
(c) $1:2$ (d) $2:1$

Grouping of Resistances

1. What current will flow through the $2\,K\Omega$ resistor in the circuit shown in the figure **[WB JEE 2012]**



(a) $3\,mA$
(b) $6\,mA$
(c) $12\,mA$
(d) $36\,mA$

2. Two resistors of resistance R_1 and R_2 having $R_1 > R_2$ are connected in parallel. For equivalent resistance R, the correct statement is **[CPMT 1978; KCET (Med.) 2000]**

(a) $R > R_1 + R_2$ (b) $R_1 < R < R_2$
(c) $R_2 < R < (R_1 + R_2)$ (d) $R < R_1$

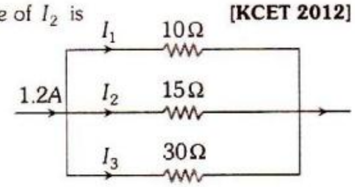
3. A wire of resistance R is divided in 10 equal parts. These parts are connected in parallel, the equivalent resistance of such connection will be **[CPMT 1973, 91]**

(a) $0.01\,R$ (b) $0.1\,R$
(c) $10\,R$ (d) $100\,R$

4. A wire of resistance 12 ohms per meter is bent to form a complete circle of radius 10 *cm*. The resistance between its two diametrically opposite points *A* and *B* as shown in the figure, is **[CBSE PMT 2009]**

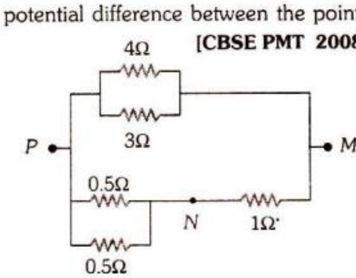
(a) $0.6\,\pi\,\Omega$ (b) $3\,\Omega$
(c) $6\,\pi\,\Omega$ (d) $6\,\Omega$

5. In this circuit, the value of I_2 is **[KCET 2012]**



(a) $0.2\,A$
(b) $0.3\,A$
(c) $0.4\,A$
(d) $0.6\,A$

6. In the circuit shown, the current through the $4\,\Omega$ resistor is 1 amp when the points *P* and *M* are connected to a d.c. voltage source. The potential difference between the points *M* and *N* is **[CBSE PMT 2008]**

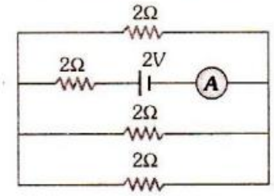


(a) $0.5\,V$
(b) $3.2\,V$
(c) $1.5\,V$
(d) $1.0\,V$

7. The lowest resistance which can be obtained by connecting 10 resistors each of 1/10 *ohm* is **[MP PMT 1984; EAMCET 1994]**

(a) $1/250\,\Omega$ (b) $1/200\,\Omega$
(c) $1/100\,\Omega$ (d) $1/10\,\Omega$

8. The reading of the ammeter as per figure shown is **[Similar MP PET 2006; WB-JEE 2010]**



(a) $\frac{1}{8}A$
(b) $\frac{3}{4}A$
(c) $\frac{1}{2}A$
(d) $2\,A$

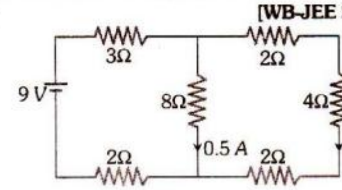
9. Three resistors each of 2 *ohm* are connected together in a triangular shape. The resistance between any two vertices will be **[CPMT 1983; MP PET 1990; MP PMT 1993; DCE 2004]**

(a) 4/3 *ohm* (b) 3/4 *ohm*
(c) 3 *ohm* (d) 6 *ohm*

10. There are n similar conductors each of resistance R. The resultant resistance comes out to be x when connected in parallel. If they are connected in series, the resistance comes out to be **[DPMT 2004]**

(a) x/n^2 (b) n^2x
(c) x/n (d) nx

11. In the electrical circuit shown in figure, the current through the 4Ω resistor is **[WB-JEE 2013]**

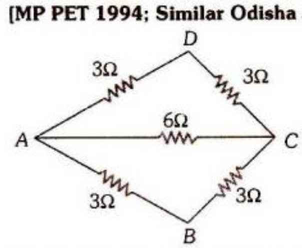


(a) $1\,A$
(b) $0.5\,A$
(c) $0.25\,A$
(d) $0.1\,A$

12. How many minimum number of 2Ω resistance can be connected to have an effective resistance of 1.5Ω **[Odisha JEE 2008]**

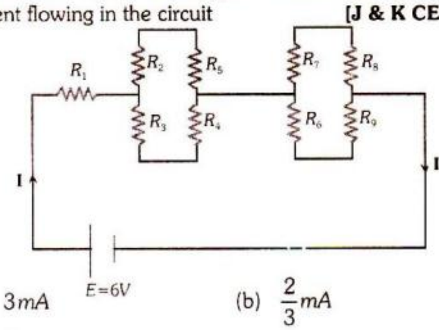
(a) 3 (b) 2
(c) 6 (d) 4

13. The effective resistance between the points *A* and *B* in the figure is **[MP PET 1994; Similar Odisha JEE 2012]**



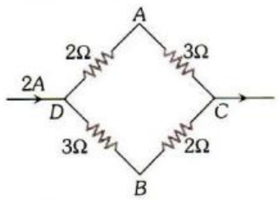
(a) 5Ω
(b) 2Ω
(c) 3Ω
(d) 4Ω

14. Nine resistors each of $1\,k\Omega$ are connected to a battery of 6 *V* as shown in the circuit given below. What is the total current flowing in the circuit **[J & K CET 2008]**



(a) $3mA$ (b) $\frac{2}{3}mA$
(c) $\frac{3}{2}mA$ (d) $2mA$

15. A current of 2 A flows in a system of conductors as shown. The potential difference $(V_A - V_B)$ will be **[CPMT 1975, 76; Odisha JEE 2011; Similar Odisha JEE 2012]**



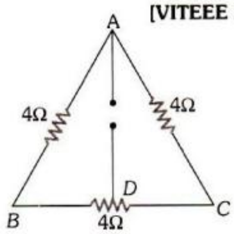
(a) $+2V$

(b) $+1V$

(c) $-1V$

(d) $-2V$

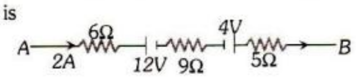
16. Three resistances of 4 Ω each are connected as shown in figure. If the point D divides the resistance into two equal halves, the resistance between point A and D will be **[VITEEE 2008; Kerala PMT 2010]**



(a) 12 Ω (b) 6 Ω

(c) 3 Ω (d) 1/3 Ω

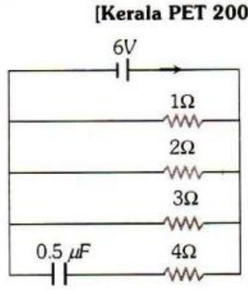
17. The potential difference between A and B in the following figure is **[KCET 2008]**



(a) 24 V (b) 14 V

(c) 32 V (d) 48 V

18. In the given circuit diagram the current through the battery and the charge on the capacitor respectively in steady state are **[Kerala PET 2009; J & K CET 2010]**



(a) 1A and $3\mu C$ (b) 17 A and $0\mu C$

(c) $\frac{6}{7}$A and $\frac{12}{7}\mu C$ (d) 6 A and $0\mu C$

(e) 11A and $3\mu C$

19. A metallic wire of resistance of 12Ω is bent to form a square. The resistance between two diagonal points would be **[DCE 2009]**

(a) 12Ω (b) 24Ω

(c) 6Ω (d) 3Ω

20. The equivalent resistance of resistors connected in series is always **[CPMT 1984; MP PMT 1999]**

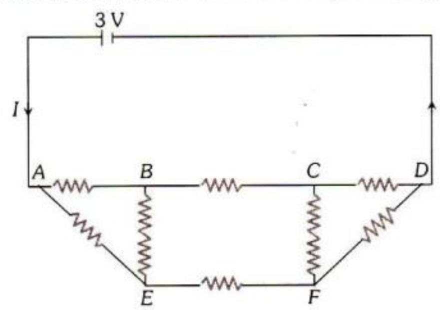
(a) Equal to the mean of component resistors

(b) Less than the lowest of component resistors

(c) In between the lowest and the highest of component resistors

(d) Equal to sum of component resistors

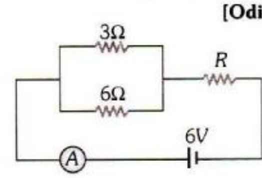
21. Figure shows a network of eight resistors, each equal to 2Ω, connected to a 3 V battery of negligible internal resistance. The current I in the circuit is **[AMU (Engg.) 2009]**



(a) 0.25 A (b) 0.50 A

(c) 0.75 A (d) 1.0 A

22. If the ammeter in the given circuit reads 2 A, the resistance R is **[Odisha JEE 2003]**



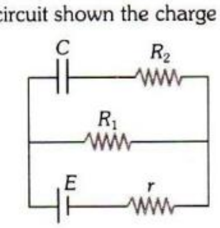
(a) 1 *ohm*

(b) 2 *ohm*

(c) 3 *ohm*

(d) 4 *ohm*

23. For the circuit shown the charge on the capacitor will be **[MP PMT 2013]**



(a) CE (b) $\frac{CER_1}{R_1 + r}$

(c) $\frac{CER_2}{R_1 + r}$ (d) $\frac{CER_1}{R_2 + r}$

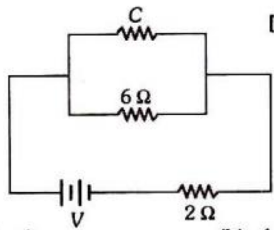
24. Resistors of 1, 2, 3 *ohm* are connected in the form of a triangle. If a 1.5 volt cell of negligible internal resistance is connected across 3 *ohm* resistor, the current flowing through this resistance will be **[CPMT 1984; Similar KCET 2009]**

(a) 0.25 *amp* (b) 0.5 *amp*

(c) 1.0 *amp* (d) 1.5 *amp*

25. If power dissipated in the $9\ \Omega$ resistor in the circuit shown is 36 Watt, the potential difference across the 2Ω resistor is

[CBSE PMT (Pre.) 2011]

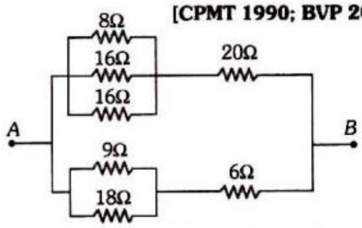


(a) 2 *volt* (b) 4 *volt*

(c) 8 *volt* (d) 10 *volt*

26. The equivalent resistance of the arrangement of resistances shown in adjoining figure between the points *A* and *B* is

[CPMT 1990; BVP 2003]



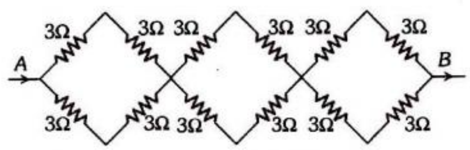
(a) 6 *ohm*

(b) 8 *ohm*

(c) 16 *ohm*

(d) 24 *ohm*

27. In the network of resistors shown in the adjoining figure, the equivalent resistance between *A* and *B* is



(a) 54 *ohm* (b) 18 *ohm*

(c) 36 *ohm* (d) 9 *ohm*

28. A wire is broken in four equal parts. A packet is formed by keeping the four wires together. The resistance of the packet in comparison to the resistance of the wire will be

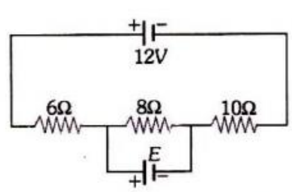
[MP PET 1985; AFMC 2005]

(a) Equal (b) One fourth

(c) One eight (d) $\frac{1}{16}th$

29. In the circuit shown, the current through 8 ohm is same before and after connecting *E*. The value of *E* is

[Kerala PET 2010]



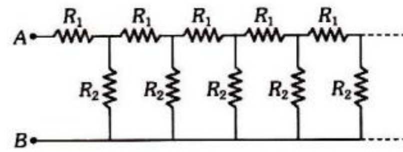
(a) 12 *V* (b) 6 *V*

(c) 4 *V* (d) 2 *V*

(e) 8 *V*

30. An infinite sequence of resistances is shown in the figure. The resultant resistance between *A* and *B* will be, when $R_1 = 1 ohm$ and $R_2 = 2 ohm$ **[MP PET 1993;**

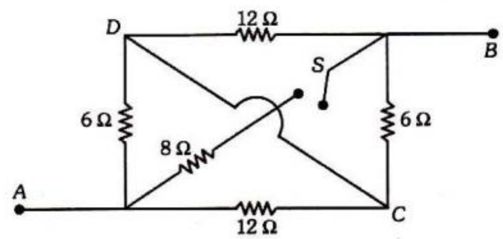
Similar Haryana CEE 1996; AMU (Med.) 1999]



(a) Infinity (b) 1Ω

(c) 2Ω (d) 1.5Ω

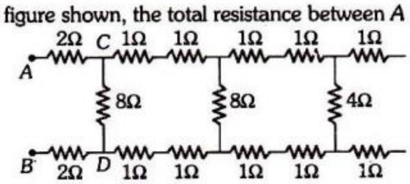
31. The equivalent resistance between points *A* and *B* with switch S open and closed are respectively **[Odisha JEE 2010]**



(a) 4 Ω, 8 Ω (b) 8 Ω, 4 Ω

(c) 6 Ω, 9 Ω (d) 9 Ω, 6 Ω

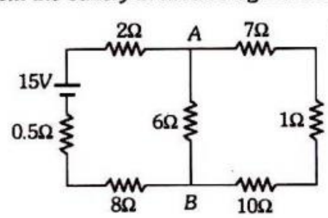
32. In the figure shown, the total resistance between *A* and *B* is



(a) 12Ω (b) 4Ω

(c) 6Ω (d) 8Ω

33. The current from the battery in circuit diagram shown is **[IIT 1989**



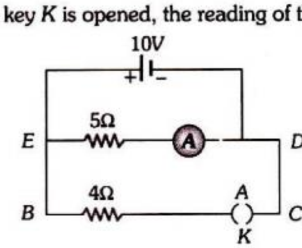
(a) 1 *A*

(b) 2 *A*

(c) 1.5 *A*

(d) 3 *A*

34. In the given figure, when key *K* is opened, the reading of the ammeter *A* will be



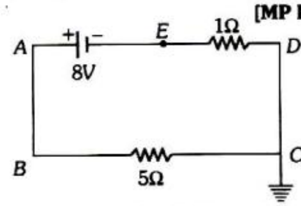
(a) 50 *A*

(b) 2 *A*

(c) 0.5 *A*

(d) $\frac{10}{9}A$

35. In the given circuit, the potential of the point E is **[MP PMT 2003]**



(a) Zero

(b) $-8\,V$

(c) $-4/3\,V$

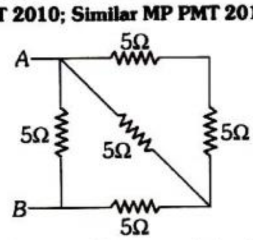
(d) 4/3 V

36. Three resistance P, Q, R each of 2Ω and an unknown resistance S form the four arms of a wheatstone bridge circuit. When a resistance of 6Ω is connected in parallel to S the bridge gets balanced. What is the value of S **[CBSE PMT 2007]**

(a) $2\,\Omega$ (b) $3\,\Omega$

(c) $6\,\Omega$ (d) $1\,\Omega$

37. The equivalent resistance between the points A and B in the following circuit is **[DUMET 2010; Similar MP PMT 2013]**



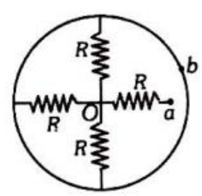
(a) 3.12Ω

(b) 1.56Ω

(c) 6.24Ω

(d) 12.48Ω

38. The equivalent resistance between points a and b of a network shown in the figure is given by **[MP PET 2011]**



(a) $\frac{3}{4}R$

(b) $\frac{4}{3}R$

(c) $\frac{5}{4}R$

(d) $\frac{4}{5}R$

39. Three resistances each of 1 *ohm*, are joined in parallel. Three such combinations are put in series, then the resultant resistance will be **[MP PMT 1994; Similar MP PMT 2012]**

(a) 9 *ohm* (b) 3 *ohm*

(c) 1 *ohm* (d) $\frac{1}{3}$*ohm*

40. A parallel combination of two resistors of 1 Ω each, is connected in series with a 1.5 Ω resistor. The total combination is connected across a 10 V battery. The current flowing in the circuit is **[DCE 2004]**

(a) 5 A (b) 20 A

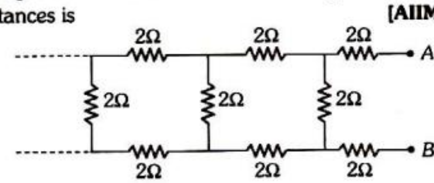
(c) 0.2 A (d) 0.4 A

41. Two wires of same metal have the same length but their cross-sections are in the ratio $3:1$. They are joined in series. The resistance of the thicker wire is 10Ω. The total resistance of the combination will be **[CBSE PMT 1995]**

(a) 40Ω (b) $\frac{40}{3}\Omega$

(c) $\frac{5}{2}\Omega$ (d) 100Ω

42. The equivalent resistance of the following infinite network of resistances is **[AIIMS 1995]**



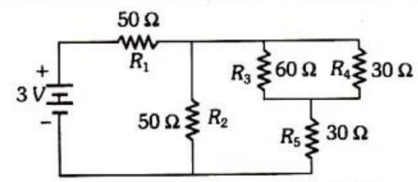
(a) Less than 4Ω

(b) 4Ω

(c) More than 4Ω but less than 12Ω

(d) 12Ω

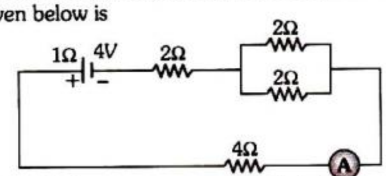
43. In circuit shown below, the resistances are given in ohm and the battery is assumed ideal with emf equal to 3 *volt*. The voltage across the resistance R_4 is **[UPSEAT 2004; Kerala PMT 2004]**



(a) 0.4 V (b) 0.6 V

(c) 1.2 V (d) 1.5 V

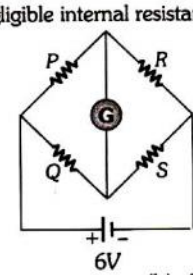
44. The current passing through the ideal ammeter in the circuit given below is **[KCET 2007]**



(a) 1.25 A (b) 1 A

(c) 0.75 A (d) 0.5 A

45. In the Wheatstone's network given, $P = 10\Omega$, $Q = 20\Omega$, $R = 15\Omega$, $S = 30\Omega$. The current passing through the battery (of negligible internal resistance) is **[KCET 2007]**



(a) 0.36 A (b) 0 A

(c) 0.18 A (d) 0.72 A

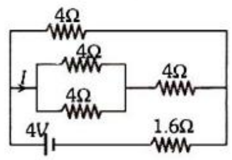
46. A copper wire of resistance R is cut into ten parts of equal length. Two pieces each are joined in series and then five such combinations are joined in parallel. The new combination will have a resistance **[MP PET 1996]**

(a) R (b) $\frac{R}{4}$

(c) $\frac{R}{5}$ (d) $\frac{R}{25}$

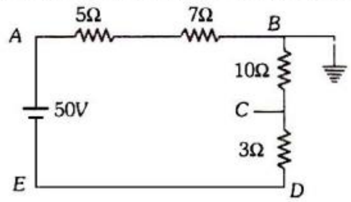
47. In the circuit shown the value of I in ampere is **[KCET 2006]**

(a) 1
(b) 0.60
(c) 0.4
(d) 1.5



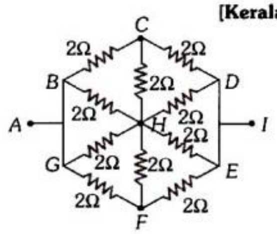
48. In the circuit shown, the point 'B' is earthed. The potential at the point 'A' is

(a) 14 V
(b) 24 V
(c) 26 V
(d) 50 V



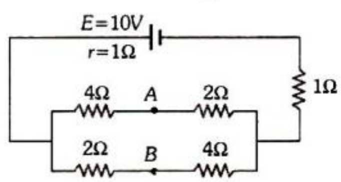
49. The effective resistance across the points A and I is **[Kerala PMT 2006]**

(a) 2 Ω
(b) 1 Ω
(c) 0.5 Ω
(d) 5 Ω



50. In the circuit shown below, the cell has an e.m.f. of 10 V and internal resistance of 1 *ohm*. The other resistances are shown in the figure. The potential difference $V_A - V_B$ is **[MP PMT 1997]**

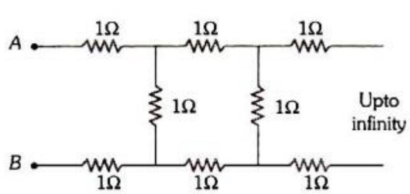
(a) 6 V
(b) 4 V
(c) 2 V
(d) –2 V



51. A wire of resistance R is cut into 'n' equal parts. These parts are then connected in parallel. The equivalent resistance of the combination will be **[MP PMT/PET 1998; BHU 2005]**

(a) nR
(b) $\frac{R}{n}$
(c) $\frac{n}{R}$
(d) $\frac{R}{n^2}$

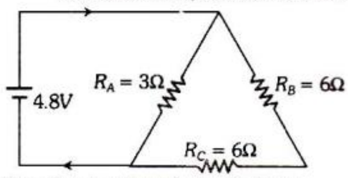
52. The resistance between the terminal points A and B of the given infinitely long circuit will be **[MP PMT/PET 1998; Similar Kerala PMT 2007; DUMET 2009]**



(a) $(\sqrt{3}-1)$
(b) $(1-\sqrt{3})$
(c) $(1+\sqrt{3})$
(d) $(2+\sqrt{3})$

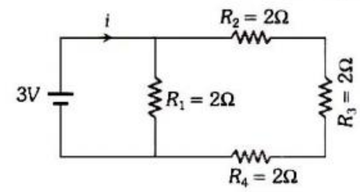
53. The current in the given circuit is **[CBSE PMT 1999; Similar CPMT 1991, 92; CBSE PMT 1997; MH CET 2002; Pb. PMT 2002; Kerala PMT 2004]**

(a) 8.31 A
(b) 6.82 A
(c) 4.92 A
(d) 2 A

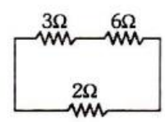


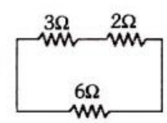
54. What is the current (i) in the circuit as shown in figure **[AIIMS 1998]**

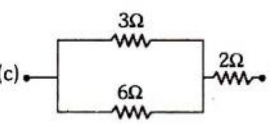
(a) 2 A
(b) 1.2 A
(c) 1 A
(d) 0.5 A



55. You are provided three resistances 2 Ω, 3 Ω and 6 Ω. How will you connect them so as to obtain the equivalent resistance of 4 Ω **[DPMT 2003]**

(a)


(b)


(c)


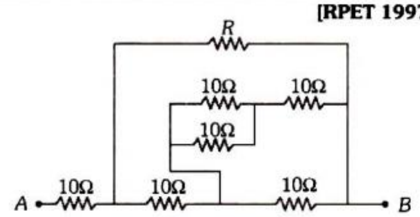
(d) None of these

56. If a rod has resistance 4 Ω and if rod is turned as half circle then the resistance along diameter **[BCECE 2004]**

(a) 1.56 Ω
(b) 2.44 Ω
(c) 4 Ω
(d) 2 Ω

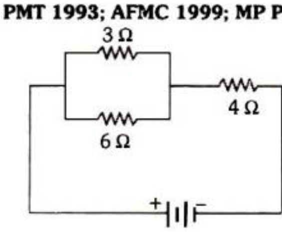
57. For what value of R the net resistance of the circuit will be 18 *ohms* **[RPET 1997]**

(a) 8 Ω
(b) 10 Ω
(c) 16 Ω
(d) 24 Ω



58. In the figure, current through the 3 Ω resistor is 0.8 *ampere*, then potential drop through 4 Ω resistor is **[CBSE PMT 1993; AFMC 1999; MP PMT 2004]**

(a) 9.6 V
(b) 2.6 V
(c) 4.8 V
(d) 1.2 V

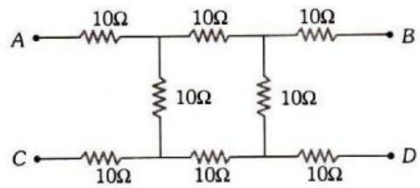


59. Three resistances $4\,\Omega$ each are connected in the form of an equilateral triangle. The effective resistance between two corners is **[CBSE PMT 1993]**

(a) $8\,\Omega$ (b) $12\,\Omega$

(c) $\frac{3}{8}\Omega$ (d) $\frac{8}{3}\Omega$

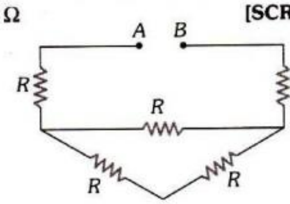
60. What will be the equivalent resistance between the two points A and D **[CBSE PMT 1996; Similar DCE 2009]**



(a) $10\,\Omega$ (b) $20\,\Omega$

(c) $30\,\Omega$ (d) $40\,\Omega$

61. What is the equivalent resistance between A and B in the figure below if $R = 3\,\Omega$ **[SCRA 1996]**



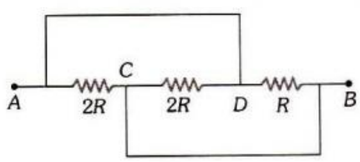
(a) $9\,\Omega$

(b) $12\,\Omega$

(c) $15\,\Omega$

(d) None of these

62. What is the equivalent resistance between A and B **[BHU 1997; MP PET 2001; Similar MP PET 1995, 2012; Pb. PMT 2003]**



(a) $\frac{2}{3}R$

(b) $\frac{3}{2}R$

(c) $R/2$

(d) $2R$

63. Three resistances of values 2Ω, 3Ω and 6Ω are to be connected to produce an effective resistance of 4Ω. This can be done by connecting. **[VITEEE 2006]**

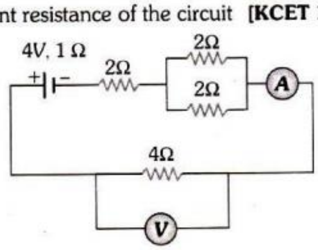
(a) 6Ω resistance in series with the parallel combination of 2Ω and 3Ω

(b) 3Ω resistance in series with the parallel combination of 2Ω and 6Ω

(c) 2Ω resistance in series with the parallel combination of 3Ω and 6Ω

(d) 2Ω resistance in parallel with the parallel combination of 3Ω and 6Ω

64. What is the equivalent resistance of the circuit **[KCET 1998]**



(a) $6\,\Omega$

(b) $7\,\Omega$

(c) $8\,\Omega$

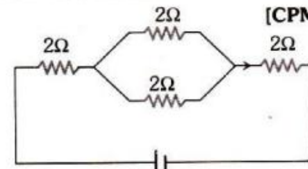
(d) $9\,\Omega$

65. 10 wires (same length, same area, same material) are connected in parallel and each has 1Ω resistance, then the equivalent resistance will be **[RPMT 1999; Similar KCET 2001; Pb. PMT 2004]**

(a) $10\,\Omega$ (b) $1\,\Omega$

(c) $0.1\,\Omega$ (d) $0.001\,\Omega$

66. The equivalent resistance of the circuit shown in the figure is **[CPMT 1999]**



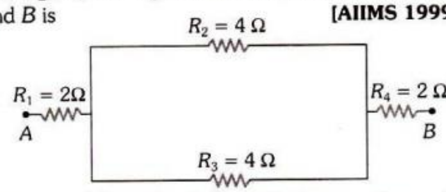
(a) $8\,\Omega$

(b) $6\,\Omega$

(c) $5\,\Omega$

(d) $4\,\Omega$

67. In the given figure, the equivalent resistance between the points A and B is **[AIIMS 1999]**



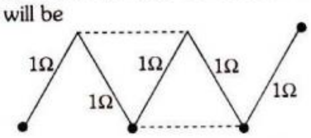
(a) $8\,\Omega$

(b) $6\,\Omega$

(c) $4\,\Omega$

(d) $2\,\Omega$

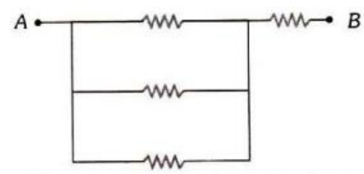
68. A circuit consists of five identical conductors as shown in figure. The two similar conductors are added as indicated by the dotted lines. The ratio of resistances before and after addition will be **[UP CPMT 2006]**



(a) 7 / 5 (b) 3 / 5

(c) 5 / 3 (d) 6 / 5

69. If all the resistors shown have the value 2 *ohm* each, the equivalent resistance over AB is **[JIPMER 1999]**



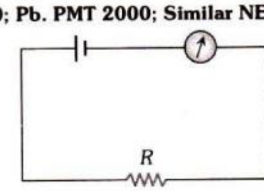
(a) 2 *ohm*

(b) 4 *ohm*

(c) $1\frac{2}{3}$ *ohm*

(d) $2\frac{2}{3}$ *ohm*

70. A battery of *emf* 10 V and internal resistance 3Ω is connected to a resistor as shown in the figure. If the current in the circuit is 0.5 A, then the resistance of the resistor will be **[MH CET 2000; Pb. PMT 2000; Similar NEET 2013]**



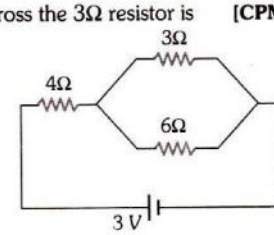
(a) $19\,\Omega$

(b) $17\,\Omega$

(c) $10\,\Omega$

(d) $12\,\Omega$

71. The potential drop across the 3Ω resistor is **[CPMT 2000]**



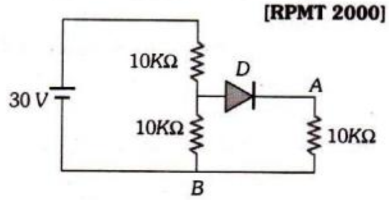
(a) 1 V

(b) 1.5 V

(c) 2 V

(d) 3 V

72. In the given figure, potential difference between A and B is **[RPMT 2000]**



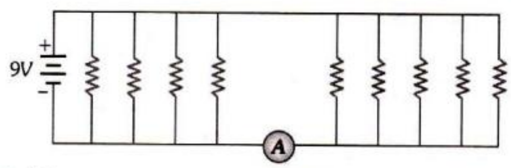
(a) 0

(b) 5 *volt*

(c) 10 *volt*

(d) 15 *volt*

73. If each resistance in the figure is of 9 Ω then reading of ammeter is **[RPMT 2000; Similar DCE 2006]**



(a) 5 A (b) 8 A

(c) 2 A (d) 9 A

74. Four resistances 10 Ω, 5 Ω, 7 Ω and 3 Ω are connected so that they form the sides of a rectangle AB, BC, CD and DA respectively. Another resistance of 10 Ω is connected across the diagonal AC. The equivalent resistance between A and B is **[EAMCET (Med.) 2000; MP PET 2009]**

(a) 2 Ω (b) 5 Ω

(c) 7 Ω (d) 10 Ω

75. Two wires of equal diameters, of resistivities ρ_1 and ρ_2 and lengths l_1 and l_2, respectively, are joined in series. The equivalent resistivity of the combination is **[EAMCET (Engg.) 2000]**

(a) $\frac{\rho_1 l_1 + \rho_2 l_2}{l_1 + l_2}$ (b) $\frac{\rho_1 l_2 + \rho_2 l_1}{l_1 - l_2}$

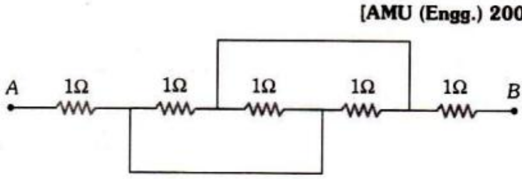
(c) $\frac{\rho_1 l_2 + \rho_2 l_1}{l_1 + l_2}$ (d) $\frac{\rho_1 l_1 - \rho_2 l_2}{l_1 - l_2}$

76. Four resistances of 100 Ω each are connected in the form of square. Then, the effective resistance along the diagonal points is **[MH CET 2000]**

(a) 200 Ω (b) 400 Ω

(c) 100 Ω (d) 150 Ω

77. Equivalent resistance between the points A and B is (in Ω) **[AMU (Engg.) 2000]**



(a) $\frac{1}{5}$ (b) $1\frac{1}{4}$

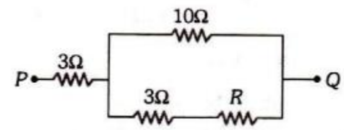
(c) $2\frac{1}{3}$ (d) $3\frac{1}{2}$

78. Two wires of the same material and equal length are joined in parallel combination. If one of them has half the thickness of the other and the thinner wire has a resistance of 8 *ohms*, the resistance of the combination is equal to **[AMU (Engg.) 2000]**

(a) $\frac{5}{8}$ *ohm* (b) $\frac{8}{5}$ *ohm*

(c) $\frac{3}{8}$ *ohm* (d) $\frac{8}{3}$ *ohm*

79. In the circuit shown here, what is the value of the unknown resistor R so that the total resistance of the circuit between points P and Q is also equal to R **[MP PET 2001]**



(a) 3 *ohm*

(b) $\sqrt{39}$ *ohm*

(c) $\sqrt{69}$ *ohm*

(d) 10 *ohm*

80. A uniform wire of resistance 9 Ω is cut into 3 equal parts. They are connected in the form of equilateral triangle ABC. A cell of e.m.f. 2 V and negligible internal resistance is connected across B and C. Potential difference across AB is **[Kerala (Engg.) 2001]**

(a) 1 V (b) 2 V

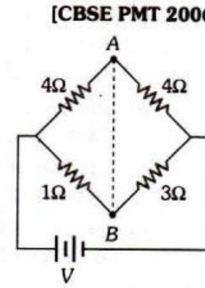
(c) 3 V (d) 0.5 V

81. Out of five resistances of resistance R Ω each 3 are connected in parallel and are joined to the rest 2 in series. Find the resultant resistance **[RPMT 2006]**

(a) $\left(\frac{3}{7}\right) R$ Ω (b) $\left(\frac{7}{3}\right) R$ Ω

(c) $\left(\frac{7}{8}\right) R$ Ω (d) $\left(\frac{8}{7}\right) R$ Ω

82. In the circuit shown, if a conducting wire is connected between points A and B, the current in this wire will **[CBSE PMT 2006]**



(a) Be zero

(b) Flow from B to A

(c) Flow from A to B

(d) Flow in the direction which will be decided by the value of V

83. The effective resistance of two resistors in parallel is $\frac{12}{7}$ Ω. If one of the resistors is disconnected the resistance becomes 4 Ω. The resistance of the other resistor is **[MH CET 2002]**

(a) 4 Ω (b) 3 Ω

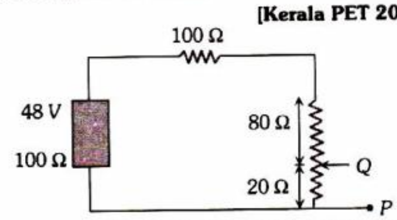
(c) $\frac{12}{7}$ Ω (d) $\frac{7}{12}$ Ω

84. Two resistance wires on joining in parallel the resultant resistance is $\frac{6}{5}$ *ohms*. One of the wire breaks, the effective resistance is 2 *ohms*. The resistance of the broken wire is **[MP PET 2001, 02]**

(a) $\frac{3}{5}$ *ohm* (b) 2 *ohm*

(c) $\frac{6}{5}$ *ohm* (d) 3 *ohm*

85. In the circuit, the potential difference across *PQ* will be nearest to **[Kerala PET 2002]**



(a) 9.6 V

(b) 6.6 V

(c) 4.8 V

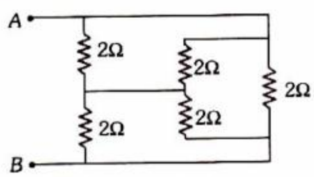
(d) 3.2 V

86. Three resistors are connected to form the sides of a triangle *ABC*, the resistance of the sides *AB*, *BC* and *CA* are 40 *ohm*, 60 *ohm* and 100 *ohm* respectively. The effective resistance between the points *A* and *B* in *ohm* will be **[JIPMER 2002]**

(a) 32 (b) 64

(c) 50 (d) 200

87. Find the equivalent resistance across *AB* **[Odisha JEE 2002]**



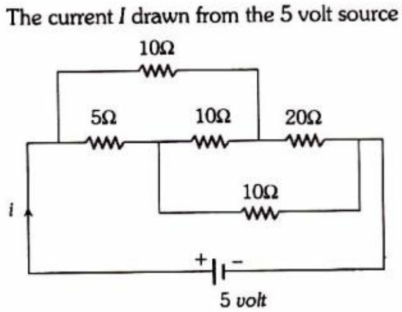
(a) 1 Ω

(b) 2 Ω

(c) 3 Ω

(d) 4 Ω

88. The current *I* drawn from the 5 volt source will be **[AIEEE 2006]**



(a) 0.5 A (b) 0.67 A

(c) 0.17 A (d) 0.33 A

89. In a Wheatstone's bridge, three resistance P, Q and R are connected in the three arms and the fourth arm is formed by two resistances S_1 and S_2 connected in parallel. The condition for the bridge to be balanced will be **[AIEEE 2006]**

(a) $\frac{P}{Q} = \frac{R(S_1 + S_2)}{S_1 S_2}$ (b) $\frac{P}{Q} = \frac{R(S_1 + S_2)}{2S_1 S_2}$

(c) $\frac{P}{Q} = \frac{R}{S_1 + S_2}$ (d) $\frac{P}{Q} = \frac{2R}{S_1 + S_2}$

90. Two wires of the same dimensions but resistivities ρ_1 and ρ_2 are connected in series. The equivalent resistivity of the combination is **[KCET 2003]**

(a) $\rho_1 + \rho_2$ (b) $\frac{\rho_1 + \rho_2}{2}$

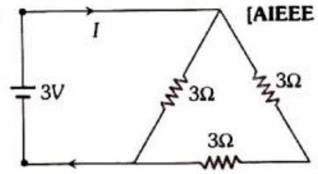
(c) $\sqrt{\rho_1 \rho_2}$ (d) $2(\rho_1 + \rho_2)$

91. Three unequal resistors in parallel are equivalent to a resistance 1 *ohm*. If two of them are in the ratio 1 : 2 and if no resistance value is fractional, the largest of the three resistances in *ohm* is **[EAMCET 2003]**

(a) 4 (b) 6

(c) 8 (d) 12

92. A 3*volt* battery with negligible internal resistance is connected in a circuit as shown in the figure. The current *I*, in the circuit will be **[AIEEE 2003]**



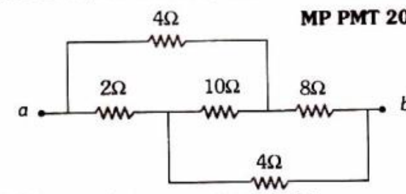
(a) 1/3 *A*

(b) 1 *A*

(c) 1.5 *A*

(d) 2 *A*

93. Find the equivalent resistance between the points *a* and *b* **[BHU 2003; CPMT 2004; Similar UPSEAT 2001; MP PMT 2002]**



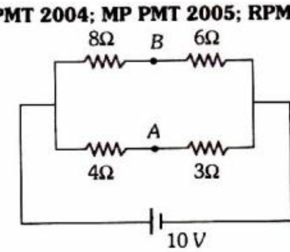
(a) 2 Ω

(b) 4 Ω

(c) 8 Ω

(d) 16 Ω

94. The potential difference between point *A* & *B* is **[BHU 2003; CPMT 2004; MP PMT 2005; RPMT 2006]**



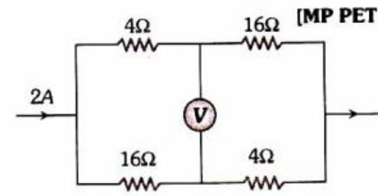
(a) $\frac{20}{7}$ V

(b) $\frac{40}{7}$ V

(c) $\frac{10}{7}$ V

(d) 0

95. In the circuit shown below, the reading of the voltmeter *V* is **[MP PET 2003]**



(a) 12 *V*

(b) 8 *V*

(c) 20 *V*

(d) 16 *V*

96. A wire has a resistance of 12 *ohm*. It is bent in the form of equilateral triangle. The effective resistance between any two corners of the triangle is

(a) 9 *ohm* (b) 12 *ohm*

(c) 6 *ohm* (d) 8/3 *ohm*

97. A series combination of two resistors 1 Ω each is connected to a 12 *V* battery of internal resistance 0.4 Ω. The current flowing through it will be **[MH CET (Med.) 1999]**

(a) 3.5 *A* (b) 5 *A*

(c) 6 *A* (d) 10 *A*

98. An electric current is passed through a circuit containing two wires of the same material, connected in parallel. If the lengths and radii of the wires are in the ratio of 4/3 and 2/3, then the ratio of the currents passing through the wire will be **[AIEEE 2004]**

(a) 3 (b) 1/3

(c) 8/9 (d) 2

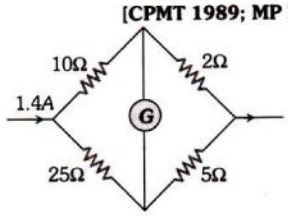
99. In the circuit shown in the figure, the current flowing in 2Ω resistance **[CPMT 1989; MP PMT 2004]**

(a) 1.4 *A*

(b) 1.2 *A*

(c) 0.4 *A*

(d) 1.0 *A*



100. By using only two resistance coils-singly, in series, or in parallel one should be able to obtain resistances of 3, 4, 12 and 16 *ohm*. The separate resistances of the coils are **[KCET 2005]**

(a) 3 and 4 (b) 4 and 12

(c) 12 and 16 (d) 16 and 3

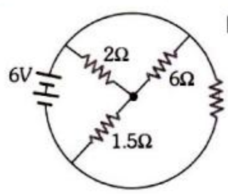
101. The total current supplied to the circuit by the battery is **[AIEEE 2004]**

(a) 1 *A*

(b) 2 *A*

(c) 4 *A*

(d) 6 *A*



102. The effective resistance between points A and B is

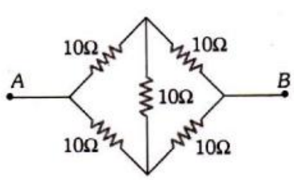
[NCERT 1974; MP PMT 2000, 02, 06; RPMT 2005 Similar MP PET 1996; MP PMT 1999; KCET 2001; BHU 2001, 05]

(a) 10Ω

(b) 20Ω

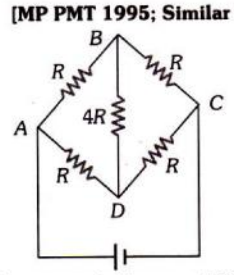
(c) 40Ω

(d) None of the above three values



103. Five resistors of given values are connected together as shown in the figure. The current in the arm *BD* will be

[MP PMT 1995; Similar RPET 2000; DCE 2001]



(a) Half the current in the arm *ABC*

(b) Zero

(c) Twice the current in the arm *ABC*

(d) Four times the current in the arm *ABC*

104. In the network shown in the figure, each of the resistance is equal to 2Ω. The resistance between the points *A* and *B* is

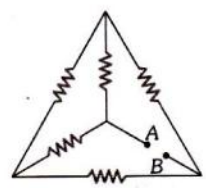
[CBSE PMT 1995; Similar KCET 2002; BHU 2006; MP PET 2013]

(a) 1Ω

(b) 4Ω

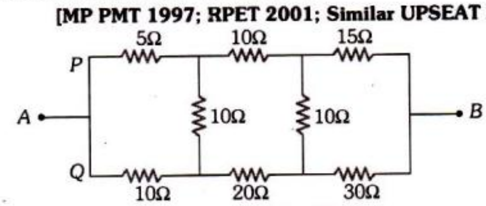
(c) 3Ω

(d) 2Ω



105. In the arrangement of resistances shown below, the effective resistance between points *A* and *B* is

[MP PMT 1997; RPET 2001; Similar UPSEAT 2001]



(a) 20Ω (b) 30Ω

(c) 90Ω (d) 110Ω

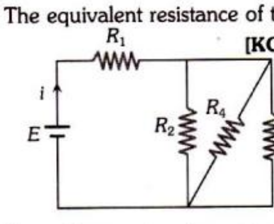
106. In the circuit given $E = 6.0\ V$, $R_1 = 100\ ohm$, $R_2 = R_3 = 50\ ohm$, $R_4 = 75\ ohm$. The equivalent resistance of the circuit, in *ohm*, is **[KCET 2005]**

(a) 11.875

(b) 26.31

(c) 118.75

(d) None of these



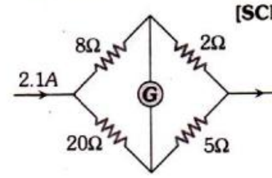
107. In the given figure, when galvanometer shows no deflection, the current (in ampere) flowing through 5Ω resistance will be **[SCRA 1994, 96]**

(a) 0.5

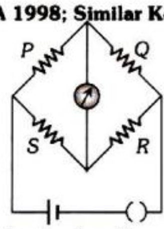
(b) 0.6

(c) 0.9

(d) 1.5

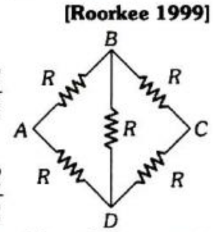


108. In the Wheatstone's bridge shown, $P = 2\,\Omega$, $Q = 3\,\Omega$, $R = 6\Omega$ and $S = 8\,\Omega$. In order to obtain balance, shunt resistance across 'S' must be **[SCRA 1998; Similar Kerala PMT 2007]**



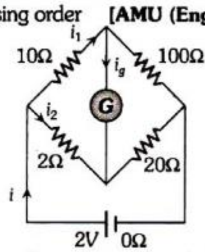
(a) 2Ω
(b) 3Ω
(c) 6Ω
(d) 8Ω

109. Five equal resistances each of value R are connected in a form shown alongside. The equivalent resistance of the network **[Roorkee 1999]**



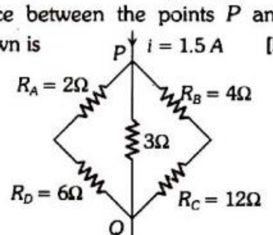
(a) Between the points B and D is R
(b) Between the points B and D is $\frac{R}{2}$
(c) Between the points A and C is R
(d) Between the points A and C is $\frac{R}{2}$

110. In the circuit shown below the resistance of the galvanometer is $20\ \Omega$. In which of the following alternatives are the currents arranged strictly in the decreasing order **[AMU (Engg.) 1999]**



(a) i, i_1, i_2, i_g
(b) i, i_2, i_1, i_g
(c) i, i_2, i_g, i_1
(d) i, i_1, i_g, i_2

111. Potential difference between the points P and Q in the electric circuit shown is **[KCET 1999]**

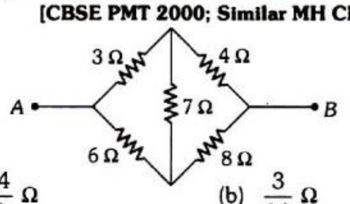


(a) $4.5\ V$
(b) $1.2\ V$
(c) $2.4\ V$
(d) $2.88\ V$

112. The current in a simple series circuit is 5.0 *amp*. When an additional resistance of 2.0 *ohm* is inserted, the current drops to 4.0 *amp*. The original resistance of the circuit in ohm was **[KCET 2005]**

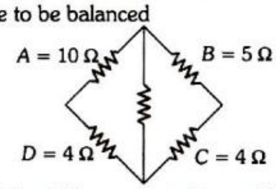
(a) 1.25 (b) 8
(c) 10 (d) 20

113. In the given figure, equivalent resistance between A and B will be **[CBSE PMT 2000; Similar MH CET (Med.) 2001; BCECE 2003]**



(a) $\frac{14}{3}\ \Omega$ (b) $\frac{3}{14}\ \Omega$
(c) $\frac{9}{14}\ \Omega$ (d) $\frac{14}{9}\ \Omega$

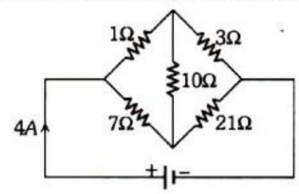
114. In a typical Wheatstone network, the resistances in cyclic order are $A = 10\ \Omega$, $B = 5\ \Omega$, $C = 4\ \Omega$ and $D = 4\ \Omega$. For the bridge to be balanced **[KCET 2000]**



(a) $10\ \Omega$ should be connected in parallel with A
(b) $10\ \Omega$ should be connected in series with A
(c) $5\ \Omega$ should be connected in series with B
(d) $5\ \Omega$ should be connected in parallel with B

115. In the circuit shown in figure, the current drawn from the battery is $4A$. If $10\ \Omega$ resistor is replaced by $20\ \Omega$ resistor, then current drawn from the circuit will be

[KCET 2000; CBSE PMT 2001; Similar Odisha JEE 2008]

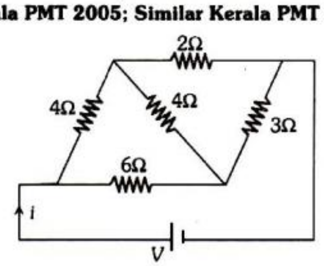


(a) $1\ A$
(b) $2\ A$
(c) $3\ A$
(d) $0\ A$

116. When a wire of uniform cross-section a, length l and resistance R is bent into a complete circle, resistance between any two of diametrically opposite points will be **[CBSE PMT 2005]**

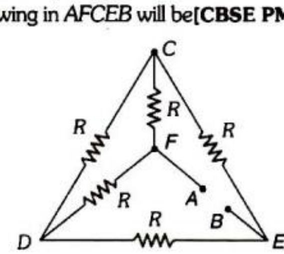
(a) $\frac{R}{4}$ (b) $\frac{R}{8}$
(c) $4R$ (d) $\frac{R}{2}$

117. For the network shown in the figure the value of the current i is **[Kerala PMT 2005; Similar Kerala PMT 2008]**



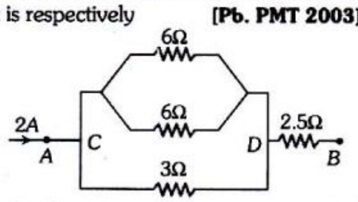
(a) $\frac{9V}{35}$
(b) $\frac{5V}{18}$
(c) $\frac{5V}{9}$
(d) $\frac{18V}{5}$

118. Five equal resistances each of resistance R are connected as shown in the figure. A battery of V volts is connected between A and B. The current flowing in $AFCEB$ will be **[CBSE PMT 2004]**



(a) $\frac{3V}{R}$
(b) $\frac{V}{R}$
(c) $\frac{V}{2R}$
(d) $\frac{2V}{R}$

119. The equivalent resistance and potential difference between A and B for the circuit is respectively **[Pb. PMT 2003]**



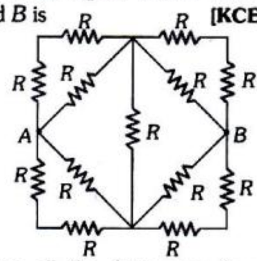
(a) $4\,\Omega, 8\,V$

(b) $8\,\Omega, 4\,V$

(c) $2\,\Omega, 2\,V$

(d) $16\,\Omega, 8\,V$

120. Thirteen resistances each of resistance R *ohm* are connected in the circuit as shown in the figure below. The effective resistance between A and B is **[KCET 2003]**



(a) $2R\,\Omega$

(b) $\frac{4R}{3}\,\Omega$

(c) $\frac{2R}{3}\,\Omega$

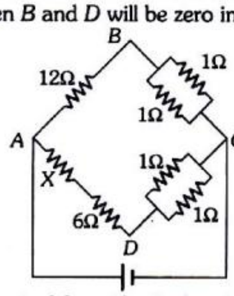
(d) $R\,\Omega$

121. In a Wheatstone's bridge all the four arms have equal resistance R. If the resistance of the galvanometer arm is also R, the equivalent resistance of the combination as seen by the battery is **[CBSE PMT 2003]**

(a) $R/2$ (b) R

(c) $2R$ (d) $R/4$

122. For what value of unknown resistance X, the potential difference between B and D will be zero in the circuit shown in the figure **[MP PMT 2004]**



(a) $4\,\Omega$

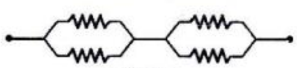
(b) $6\,\Omega$

(c) $2\,\Omega$

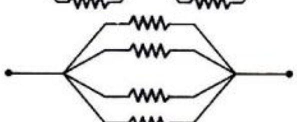
(d) $5\,\Omega$

123. Which arrangement of four identical resistances should be used to draw maximum energy from a cell of voltage V **[MP PMT 2004]**

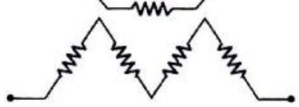
(a)



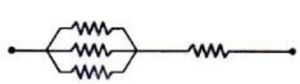
(b)



(c)



(d)



124. An unknown resistance R_1 is connected in series with a resistance of $10\,\Omega$. This combinations is connected to one gap of a metre bridge while a resistance R_2 is connected in the other gap. The balance point is at 50 *cm*. Now, when the $10\,\Omega$ resistance is removed the balance point shifts to 40 *cm*. The value of R_1 is (in *ohm*) **[KCET 2004]**

(a) 60 (b) 40

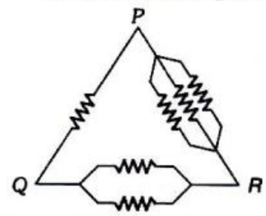
(c) 20 (d) 10

125. A wire has a resistance of $6\,\Omega$. It is cut into two parts and both half values are connected in parallel. The new resistance is .... **[KCET 2004]**

(a) $12\,\Omega$ (b) $1.5\,\Omega$

(c) $3\,\Omega$ (d) $6\,\Omega$

126. Six equal resistances are connected between points P, Q and R as shown in the figure. Then the net resistance will be maximum between **[IIT-JEE (Screening) 2004]**



(a) P and Q

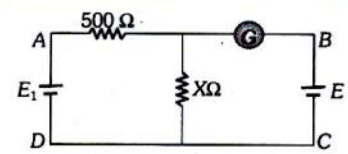
(b) Q and R

(c) P and R

(d) Any two points

Kirchhoff's Law, Cells

1. In the adjoining circuit, the battery E_1 has an *e.m.f.* of 12*volt* and zero internal resistance while the battery E has an *e.m.f.* of 2*volt*. If the galvanometer G reads zero, then the value of the resistance X in *ohm* is **[NCERT 1990; AIEEE 2005]**



(a) 10 (b) 100

(c) 500 (d) 200

2. A battery of emf 8 V with internal resistance $0.5\,\Omega$ is being charged by a 120 V d.c. supply using a series resistance of $15.5\,\Omega$. The terminal voltage of the battery is **[AMU (Engg.) 2012]**

(a) 20.5 V (b) 15.5 V

(c) 11.5 V (d) 2.5 V

3. A battery of *emf* E produces currents I_1 and I_2 when connected to external resistances R_1 and R_2 respectively. The internal resistance of the battery is **[Odisha JEE 2010]**

(a) $\frac{I_1R_2 - I_2R_1}{I_2 - I_1}$ (b) $\frac{I_1R_2 + I_2R_1}{I_1 - I_2}$

(c) $\frac{I_1R_1 + I_2R_2}{I_1 - I_2}$ (d) $\frac{I_1R_1 - I_2R_2}{I_2 - I_1}$

4. By a cell a current of 0.9 A flows through 2 *ohm* resistor and 0.3 A through 7 *ohm* resistor. The internal resistance of the cell is **[KCET 2003]**

(a) $0.5\,\Omega$ (b) $1.0\,\Omega$

(c) $1.2\,\Omega$ (d) $2.0\,\Omega$

5. A student measures the terminal potential difference (V) of a cell (of *emf* E and internal resistance r) as a function of the current (I) flowing through it. The slope, and intercept, of the graph between V and I, then, respectively, equal **[CBSE PMT 2009]**

(a) E and $-r$ (b) $-r$ and E

(c) r and $-E$ (d) $-E$ and r

6. A cell of e.m.f. E is connected with an external resistance R, then p.d. across cell is V. The internal resistance of cell will be **[MNR 1987; Kerala PMT 2002; MP PMT 2002]**

(a) $\frac{(E-V)R}{E}$ (b) $\frac{(E-V)R}{V}$

(c) $\frac{(V-E)R}{V}$ (d) $\frac{(V-E)R}{E}$

7. Two cells, each of e.m.f. E and internal resistance r are connected in parallel between the resistance R. The maximum energy given to the resistor will be, only when

[MNR 1988; MP PET 2000; UPSEAT 2001; WB-JEE 2009]

(a) $R = r/2$ (b) $R = r$

(c) $R = 2r$ (d) $R = 0$

8. Kirchhoff's first law *i.e.* $\Sigma i = 0$ at a junction is based on the law of conservation of **[CBSE PMT 1997; AIIMS 2000; RPMT 2001; MP PMT 2002; AFMC 2003; DPMT 2005]**

(a) Charge (b) Energy

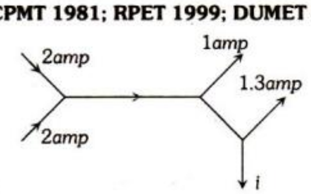
(c) Momentum (d) Angular momentum

9. Kirchhoff's second law is based on the law of conservation of **[MH CET 2001; RPET 2003; J & K CET 2008]**

(a) Charge (b) Energy

(c) Momentum (d) Sum of mass and energy

10. The figure below shows currents in a part of electric circuit. The current i is **[CPMT 1981; RPET 1999; DUMET 2010]**



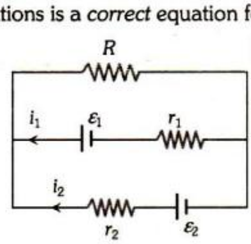
(a) 1.7 *amp*

(b) 3.7 *amp*

(c) 1.3 *amp*

(d) 1 *amp*

11. See the electrical circuit shown in this figure. Which of the following equations is a *correct* equation for it **[CBSE PMT 2009]**



(a) $\varepsilon_1 - (i_1 + i_2)R - i_1 r_1 = 0$

(b) $\varepsilon_2 - i_2 r_2 - \varepsilon_1 - i_1 r_1 = 0$

(c) $-\varepsilon_2 - (i_1 + i_2)R + i_2 r_2 = 0$

(d) $\varepsilon_1 - (i_1 + i_2)R + i_1 r_1 = 0$

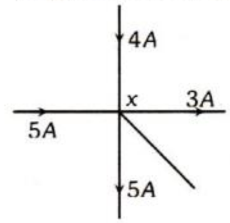
12. The potential difference across the terminals of a battery is 50V when 11A current is drawn and 60V when 1A current is drawn. The *e.m.f.* and the internal resistance of the battery are **[MP PET 2009]**

(a) 62V, 2Ω (b) 63V, 1Ω

(c) 61V, 1Ω (d) 64V, 2Ω

13. Five conductors are meeting at a point x as shown in the figure. What is the value of current in fifth conductor

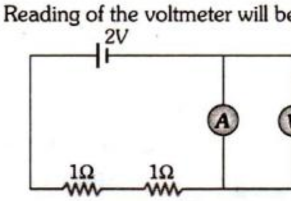
[Odisha JEE 2009; Similar Odisha PMT 2004]



(a) 3 *A* away from x (b) 1 *A* away from x

(c) 4 *A* away from x (d) 1 *A* towards x

14. In the circuit shown, A and V are ideal ammeter and voltmeter respectively. Reading of the voltmeter will be



(a) 2 V

(b) 1 V

(c) 0.5 V

(d) Zero

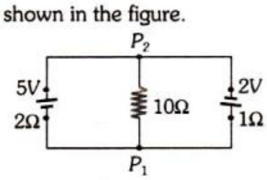
15. When a resistance of 2*ohm* is connected across the terminals of a cell, the current is 0.5 *ampere*. When the resistance is increased to 5 *ohm*, the current is 0.25 *ampere*. The internal resistance of the cell is

[MP PMT 1996; CBSE PMT (Pre.) 2011]

(a) 0.5 *ohm* (b) 1.0 *ohm*

(c) 1.5 *ohm* (d) 2.0 *ohm*

16. A 5 *V* battery with internal resistance 2 Ω and a 2 *V* battery with internal resistance 1 Ω are connected to a 10 Ω resistor as shown in the figure.



The current in the 10 Ω resistor is **[AIEEE 2008]**

(a) 0.03 A P_1 to P_2 (b) 0.03 A P_2 to P_1

(c) 0.27 A P_1 to P_2 (d) 0.27 A P_2 to P_1

17. A primary cell has an e.m.f. of 1.5 volt, when short-circuited it gives a current of 3 ampere. The internal resistance of the cell is **[CPMT 1976, 83]**

(a) 4.5 *ohm* (b) 2 *ohm*

(c) 0.5 *ohm* (d) 1/4.5 *ohm*

18. A 50V battery is connected across a 10 *ohm* resistor. The current is 4.5 *ampere*. The internal resistance of the battery is **[CPMT 1985; BHU 1997; Pb. PMT 2001]**

(a) Zero (b) 0.5 *ohm*

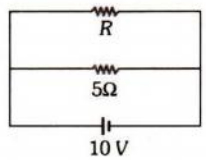
(c) 1.1 *ohm* (d) 5.0 *ohm*

19. The potential difference in open circuit for a cell is 2.2 *volt*. When a 4 *ohm* resistor is connected between its two electrodes the potential difference becomes 2 *volt*. The internal resistance of the cell will be **[MP PMT 1984; SCRA 1994; CBSE PMT 2002; Similar Odisha JEE 2010]**

(a) 1 *ohm* (b) 0.2 *ohm*

(c) 2.5 *ohm* (d) 0.4 *ohm*

20. The power dissipated in the circuit shown in the figure is 30 Watts. The value of R is **[CBSE PMT (Mains) 2012]**



(a) 20Ω

(b) 15Ω

(c) 10Ω

(d) 30Ω

21. A cell whose e.m.f. is 2 V and internal resistance is 0.1Ω, is connected with a resistance of 3.9Ω. The voltage across the cell terminal will be **[CPMT 1990; MP PET 1993; CBSE PMT 1999; AFMC 1999; Pb. PMT 2000; AIIMS 2001]**

(a) $0.50V$ (b) $1.90V$

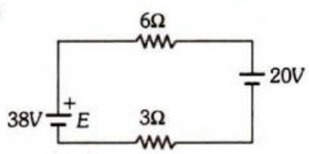
(c) $1.95V$ (d) $2.00V$

22. The reading of a high resistance voltmeter when a cell is connected across it is 2.2 V. When the terminals of the cell are also connected to a resistance of 5Ω the voltmeter reading drops to 1.8 V. Find the internal resistance of the cell **[KCET 2003; MP PMT 2003]**

(a) 1.2Ω (b) 1.3Ω

(c) 1.1Ω (d) 1.4Ω

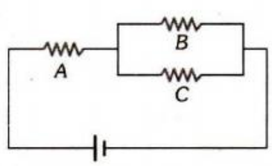
23. Calculate the value of E, for given circuit, when value of 2 amp current is either flowing in clockwise or anticlockwise direction **[MP PET 2008]**



(a) 3 V, 28 *Volt* (b) 38 V, 2 *Volt*

(c) 3 V, 30 *Volt* (d) 3 V, 2.8 *Volt*

24. Three identical resistances A, B and C are connected as shown in fig. **[MP PET 2008]**



The heat produced will be maximum

(a) In B (b) In B and C

(c) In A (d) Same for A, B and C

25. n identical cells each of e.m.f. E and internal resistance r are connected in series. An external resistance R is connected in series to this combination. The current through R is **[DPMT 2002]**

(a) $\dfrac{nE}{R+nr}$ (b) $\dfrac{nE}{nR+r}$

(c) $\dfrac{E}{R+nr}$ (d) $\dfrac{nE}{R+r}$

26. A cell of internal resistance r is connected to an external resistance R. The current will be maximum in R, if **[CPMT 1982; Similar WB-JEE 2008]**

(a) $R=r$ (b) $R<r$

(c) $R>r$ (d) $R=r/2$

27. To get the maximum current from a parallel combination of n identical cells each of internal resistance r and external resistance R, when **[DPMT 1999]**

(a) $R>>r$ (b) $R<<r$

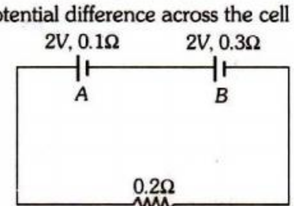
(c) $R=r$ (d) None of these

28. Two identical cells send the same current in 2Ω resistance, whether connected in series or in parallel. The internal resistance of the cell should be **[NCERT 1982; Kerala PMT 2002; Similar BHU 2006]**

(a) 1Ω (b) 2Ω

(c) $\frac{1}{2}\Omega$ (d) 2.5Ω

29. The internal resistances of two cells shown are 0.1Ω and 0.3Ω. If $R=0.2\Omega$, the potential difference across the cell



(a) B will be zero

(b) A will be zero

(c) A and B will be 2V

(d) A will be $>2V$ and B will be $<2V$

30. A voltmeter of resistance 280Ω reads the voltage across the terminals of an old dry cell to be $1.40V$, while a potentiometer reads its voltage equal to $1.55V$. To draw maximum power from the battery, the load resistance must have the value **[AMU (Med.) 2012]**

(a) 60Ω (b) 45Ω

(c) 35Ω (d) 30Ω

31. Which of the following is the correct Kirchhoff's loop rule **[J&K CET 2012]**

(a) The algebraic sum of the currents meeting at a junction is zero

(b) The algebraic sum of potential drops across all resistors in a circuit is zero

(c) The algebraic sum of the currents across all the resistors in a circuit is zero

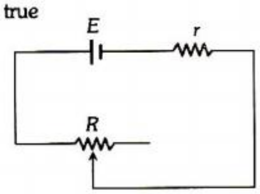
(d) The algebraic sum of potential drops across all resistors plus those across sources in a circuit is zero

32. Two resistors of 6Ω and 9Ω are connected in series to a 120 V source. The power consumed by 6Ω resistor is **[MP PMT 2013]**

(a) 384 W (b) 616 W

(c) 1500 W (d) 1800 W

33. A battery of e.m.f. E and internal resistance r is connected to a variable resistor R as shown here. Which one of the following is true **[MP PMT 1995]**



(a) Potential difference across the terminals of the battery is maximum when $R = r$

(b) Power delivered to the resistor is maximum when $R = r$

(c) Current in the circuit is maximum when $R = r$

(d) Current in the circuit is maximum when $R >> r$

34. Two cells having the internal resistance 0.2Ω and 0.4Ω are connected in parallel. The voltage across the battery terminal is 1.5 Volt. The e.m.f. of first cell is 1.2 Volt. The e.m.f. of the second cell is **[MP PET 2008]**

(a) 2.7 Volt (b) 2.1 Volt

(c) 3 Volt (d) 4.2 Volt

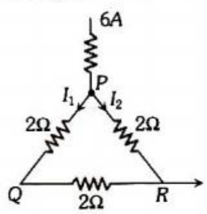
35. A current of $6A$ enters one corner P of an equilateral triangle PQR having 3 wires of resistances 2Ω each and leaves by the corner R. Then the current I_1 and I_2 are **[KCET 2006]**

(a) $2A, 4A$

(b) $4A, 2A$

(c) $1A, 2A$

(d) $2A, 3A$



36. A current of two ampere is flowing through a cell of e.m.f. 5 *volt* and internal resistance 0.5 *ohm* from negative to positive electrode. If the potential of negative electrode is $10V$, the potential of positive electrode will be **[MP PMT 1997]**

(a) $5\ V$ (b) $14\ V$

(c) $15\ V$ (d) $16\ V$

37. 100 cells each of e.m.f. $5\ V$ and internal resistance 1 *ohm* are to be arranged so as to produce maximum current in a 25 *ohm* resistance. Each row is to contain equal number of cells. The number of rows should be **[MP PMT 1997]**

(a) 2 (b) 4

(c) 5 (d) 10

38. The current in the arm CD of the circuit will be

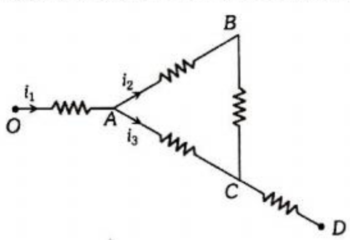
[MP PMT/PET 1998; MP PMT 2000; DPMT 2000]

(a) $i_1 + i_2$

(b) $i_2 + i_3$

(c) $i_1 + i_3$

(d) $i_1 - i_2 + i_3$



39. When a resistance of 2 *ohm* is connected across the terminals of a cell, the current is 0.5 A. When the resistance is increased to 5 *ohm*, the current is 0.25 A. The e.m.f. of the cell is

[MP PET 1999, 2000; MP PMT 2000; Pb. PMT 2002]

(a) $1.0\ V$ (b) $1.5\ V$

(c) $2.0\ V$ (d) $2.5\ V$

40. 4 cells each of emf $2\ V$ and internal resistance of 1Ω are connected in parallel to a load resistor of 2Ω. Then the current through the load resistor is **[Kerala PMT 2006]**

(a) $2\ A$ (b) $1.5\ A$

(c) $1\ A$ (d) $0.888\ A$

41. If six identical cells each having an e.m.f. of $6V$ are connected in parallel, the e.m.f. of the combination is

[EAMCET (Med.) 1995;

Pb. PMT 1999; CPMT 2000; Similar CPMT 1999]

(a) $1\ V$ (b) $36\ V$

(c) $\frac{1}{6}V$ (d) $6\ V$

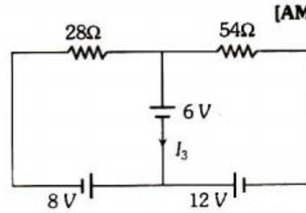
42. Consider the circuit shown in the figure. The current I_3 is equal to **[AMU 1995]**

(a) 5 *amp*

(b) 3 *amp*

(c) -3 *amp*

(d) $-5/6$ *amp*



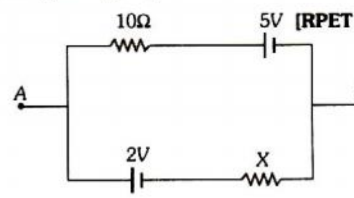
43. If $V_{AB} = 4V$ in the given figure, then resistance X will be **[RPET 1997]**

(a) 5Ω

(b) 10Ω

(c) 15Ω

(d) 20Ω



44. In the circuit shown, the current through the $5\ \Omega$ resistor is

[Kerala PET 2010]

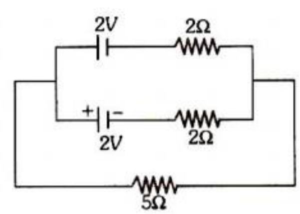
(a) $\frac{8}{3}A$

(b) $\frac{9}{13}A$

(c) $\frac{4}{13}A$

(d) $\frac{1}{3}A$

(e) $\frac{2}{3}A$



45. A storage battery has e.m.f. 15 *volt* and internal resistance 0.05 *ohm*. Its terminal voltage when it is delivering 10 *ampere* is **[JIPMER 1997;**

KCET 2006; Similar MP PET 2012]

(a) 30 *volt* (b) 1.00 *volt*

(c) 14.5 *volt* (d) 15.5 *volt*

46. The number of dry cells, each of e.m.f. 1.5 *volt* and internal resistance 0.5 *ohm* that must be joined in series with a resistance of 20 *ohm* so as to send a current of 0.6 *ampere* through the circuit is **[SCRA 1998]**

(a) 2 (b) 8
(c) 10 (d) 12

47. *Emf* is most closely related to **[DCE 1999; Similar MP PET 2013]**

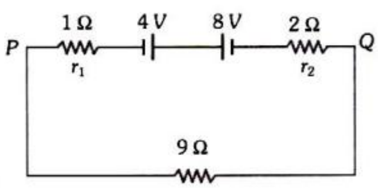
(a) Mechanical force (b) Potential difference
(c) Electric field (d) Magnetic field

48. For driving a current of 2 *A* for 6 *minutes* in a circuit, 1000 *J* of work is to be done. The e.m.f. of the source in the circuit is **[CPMT 1999]**

(a) 1.38 *V* (b) 1.68 *V*
(c) 2.04 *V* (d) 3.10 *V*

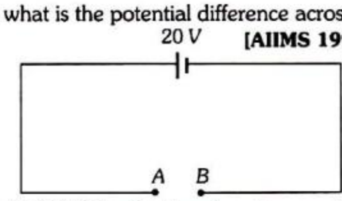
49. Two batteries of e.m.f. 4*V* and 8 *V* with internal resistances 1 Ω and 2 Ω are connected in a circuit with a resistance of 9 Ω as shown in figure. The current and potential difference between the points *P* and *Q* are **[AFMC 1999]**

(a) $\frac{1}{3}A$ and 3*V*
(b) $\frac{1}{6}A$ and 4*V*
(c) $\frac{1}{9}A$ and 9*V*
(d) $\frac{1}{2}A$ and 12*V*



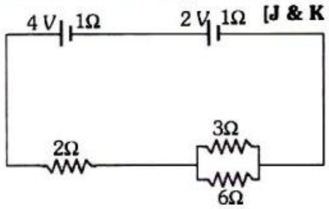
50. In the shown circuit, what is the potential difference across *A* and *B* **[AIIMS 1999]**

(a) 50 *V*
(b) 45 *V*
(c) 30 *V*
(d) 20 *V*



51. Two cells having e.m.f. 4 V, 2*V* and internal resistances 1Ω, 1Ω are connected as shown in figure. Current through 6Ω resistance is **[J & K CET 2006]**

(a) 1/3 *A*
(b) 2/3 *A*
(c) 1 *A*
(d) 2/9 *A*



52. Electromotive force is the force, which is able to maintain a constant **[Pb. PMT 1999]**

(a) Current (b) Resistance
(c) Power (d) Potential difference

53. A cell of *emf* 6 *V* and resistance 0.5 *ohm* is short circuited. The current in the cell is **[JIPMER 1999; Similar Haryana CEE 1996]**

(a) 3 *amp* (b) 12 *amp*
(c) 24 *amp* (d) 6 *amp*

54. A storage cell is charged by 5 *amp* D.C. for 18 *hours*. Its strength after charging will be **[JIPMER 1999]**

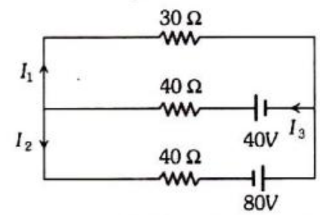
(a) 18 *AH* (b) 5 *AH*
(c) 90 *AH* (d) 15 *AH*

55. A battery having e.m.f. 5 *V* and internal resistance 0.5 Ω is connected with a resistance of 4.5 Ω then the voltage at the terminals of battery is **[RPMT 2000]**

(a) 4.5 *V* (b) 4 *V*
(c) 0 *V* (d) 2 *V*

56. In the given circuit the current I_1 is **[DCE 2000]**

(a) 0.4 *A*
(b) – 0.4 *A*
(c) 0.8 *A*
(d) – 0.8 *A*

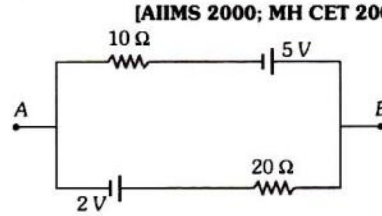


57. The internal resistance of a cell of e.m.f. 12*V* is $5\times10^{-2}\,\Omega$. It is connected across an unknown resistance. Voltage across the cell, when a current of 60 *A* is drawn from it, is **[CBSE PMT 2000]**

(a) 15 *V* (b) 12 *V*
(c) 9 *V* (d) 6 *V*

58. The current in the given circuit is **[AIIMS 2000; MH CET 2003]**

(a) 0.1 *A*
(b) 0.2 *A*
(c) 0.3 *A*
(d) 0.4 *A*



59. A current of 2.0 *ampere* passes through a cell of e.m.f. 1.5 *volt* having internal resistance of 0.15 *ohm*. The potential difference measured, in *volt*, across both the ends of the cell will be **[UPSEAT 1999, 2000]**

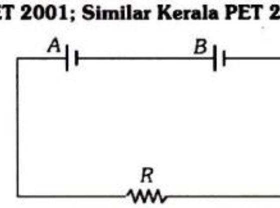
(a) 1.35 (b) 1.50
(c) 1.00 (d) 1.20

60. A battery has e.m.f. 4 *V* and internal resistance *r*. When this battery is connected to an external resistance of 2 *ohm*, a current of 1 *amp*. flows in the circuit. How much current will flow if the terminals of the battery are connected directly **[MP PET 2001]**

(a) 1 *amp* (b) 2 *amp*
(c) 4 *amp* (d) Infinite

61. Two batteries *A* and *B* each of e.m.f. 2 *V* are connected in series to an external resistance *R* = 1 *ohm*. If the internal resistance of battery *A* is 1.9 *ohm* and that of *B* is 0.9 *ohm*, what is the potential difference between the terminals of battery *A* **[MP PET 2001; Similar Kerala PET 2008]**

(a) 2 *V*
(b) 3.8 *V*
(c) Zero
(d) None of the above



62. When a resistor of 11 Ω is connected in series with an electric cell, the current flowing in it is 0.5 *A*. Instead, when a resistor of 5 Ω is connected to the same electric cell in series, the current increases by 0.4 *A*. The internal resistance of the cell is **[EAMCET 2001]**

(a) 1.5 Ω (b) 2 Ω
(c) 2.5 Ω (d) 3.5 Ω

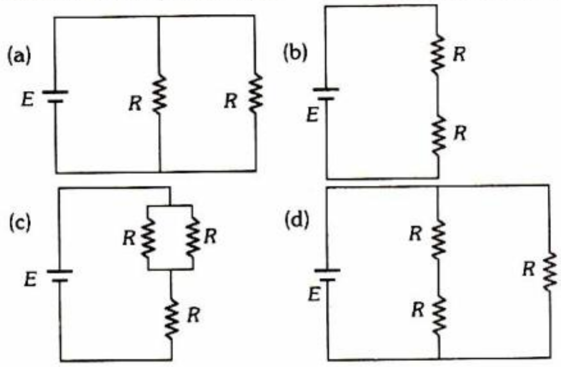
63. The internal resistance of a cell is the resistance of **[BHU 1999, 2000; AIIMS 2001]**

(a) Electrodes of the cell
(b) Vessel of the cell
(c) Electrolyte used in the cell
(d) Material used in the cell

64. How much work is required to carry a 6 μC charge from the negative terminal to the positive terminal of a 9 *V* battery **[KCET (Med.) 2001]**

(a) $54 \times 10^{-3} J$ (b) $54 \times 10^{-6} J$
(c) $54 \times 10^{-9} J$ (d) $54 \times 10^{-12} J$

65. Consider four circuits shown in the figure below. In which circuit power dissipated is greatest (Neglect the internal resistance of the power supply) **[Odisha JEE 2002]**



66. The *emf* of a battery is 2 *V* and its internal resistance is 0.5 Ω. The maximum power which it can deliver to any external circuit will be **[AMU (Med.) 2002]**

(a) 8 *Watt* (b) 4 *Watt*
(c) 2 *Watt* (d) None of the above

67. Kirchhoff's I law and II law of current, prove the **[CBSE PMT 1993, 2006, 10; BHU 2002; AFMC 2003; AIEEE 2006]**

(a) Conservation of charge and energy
(b) Conservation of current and energy
(c) Conservation of mass and charge
(d) None of these

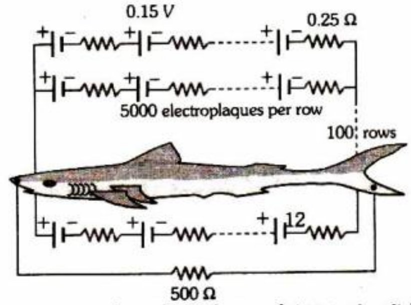
68. A cell of constant e.m.f. is first connected to a resistance R_1 and then connected to a resistance R_2. If power delivered in both cases is equal, then the internal resistance of the cell is **[Odisha JEE 2005]**

(a) $\sqrt{R_1 R_2}$ (b) $\sqrt{\dfrac{R_1}{R_2}}$
(c) $\dfrac{R_1 - R_2}{2}$ (d) $\dfrac{R_1 + R_2}{2}$

69. The *n* rows each containing *m* cells in series are joined in parallel. Maximum current is taken from this combination across an external resistance of 3Ω resistance. If the total number of cells used are 24 and internal resistance of each cell is 0.5 Ω then **[J & K CET 2005]**

(a) $m = 8, n = 3$ (b) $m = 6, n = 4$
(c) $m = 12, n = 2$ (d) $m = 2, n = 12$

70. Eels are able to generate current with biological cells called electroplaques. The electroplaques in an eel are arranged in 100 rows, each row stretching horizontally along the body of the fish containing 5000 electroplaques. The arrangement is suggestively shown below. Each electroplaque has an emf of 0.15 *V* and internal resistance of 0.25 Ω **[AIIMS 2004]**



The water surrounding the eel completes a circuit between the head and its tail. If the water surrounding it has a resistance of 500 Ω, the current an eel can produce in water is about

(a) 1.5 *A* (b) 3.0 *A*
(c) 15 *A* (d) 30 *A*

71. Current provided by a battery is maximum when **[AFMC 2004]**

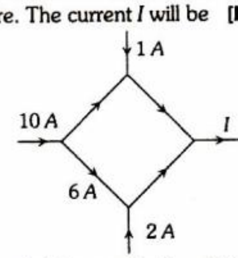
(a) Internal resistance equal to external resistance
(b) Internal resistance is greater than external resistance
(c) Internal resistance is less than external resistance
(d) None of these

72. A battery is charged at a potential of 15 *V* for 8 *hours* when the current flowing is 10 *A*. The battery on discharge supplies a current of 5 *A* for 15 *hours*. The mean terminal voltage during discharge is 14 *V*. The "*Watt-hour*" efficiency of the battery is **[CBSE PMT 2004]**

(a) 82.5% (b) 80 %
(c) 90% (d) 87.5%

73. The figure shows a network of currents. The magnitude of currents is shown here. The current *I* will be **[BCECE 2005]**

(a) 3 *A*
(b) 9 *A*
(c) 13 *A*
(d) 19 *A*



74. A capacitor is connected to a cell of emf *E* having some internal resistance *r*. The potential difference across the **[CPMT 2004; MP PMT 2005; RPMT 2006]**

(a) Cell is < *E* (b) Cell is *E*
(c) Capacitor is > *E* (d) Capacitor is < *E*

75. When the resistance of 9 Ω is connected at the ends of a battery, its potential difference decreases from 40 *volt* to 30 *volt*. The internal resistance of the battery is **[DPMT 2003]**

(a) 6 Ω (b) 3 Ω

(c) 9 Ω (d) 15 Ω

76. The maximum power drawn out of the cell from a source is given by (where *r* is internal resistance) **[DCE 2002]**

(a) $E^2/2r$ (b) $E^2/4r$

(c) E^2/r (d) $E^2/3r$

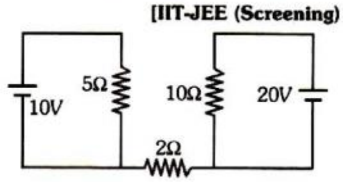
77. Find out the value of current through 2Ω resistance for the given circuit **[IIT-JEE (Screening) 2005]**

(a) 5 *A*

(b) 2 *A*

(c) Zero

(d) 4 *A*



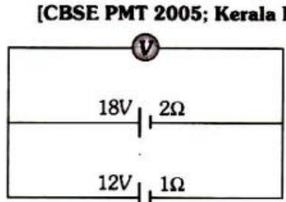
78. Two batteries, one of emf 18 *volt* and internal resistance 2Ω and the other of emf 12 *volt* and internal resistance 1Ω, are connected as shown. The voltmeter *V* will record a reading of **[CBSE PMT 2005; Kerala PMT 2011]**

(a) 15 *volt*

(b) 30 *volt*

(c) 14 *volt*

(d) 18 *volt*



79. Two sources of equal emf are connected to an external resistance *R*. The internal resistances of the two sources are R_1 and R_2 $(R_2 > R_1)$. If the potential difference across the source having internal resistance R_2 is zero, then **[AIEEE 2005; AIIMS 2008]**

(a) $R = R_1R_2/(R_1 + R_2)$

(b) $R = R_1R_2/(R_2 - R_1)$

(c) $R = R_2 \times (R_1 + R_2)/(R_2 - R_1)$

(d) $R = R_2 - R_1$

80. An energy source will supply a constant current into the load if its internal resistance is **[AIEEE 2005]**

(a) Zero

(b) Non-zero but less than the resistance of the load

(c) Equal to the resistance of the load

(d) Very large as compared to the load resistance

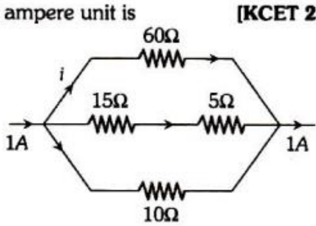
81. The magnitude of *i* in ampere unit is **[KCET 2005]**

(a) 0.1

(b) 0.3

(c) 0.6

(d) None of these



82. To draw maximum current from a combination of cells, how should the cells be grouped **[AFMC 2005]**

(a) Series

(b) Parallel

(c) Mixed

(d) Depends upon the relative values of external and internal resistance

83. A battery of emf *E* has an internal resistance 'r'. A variable resistance *R* is connected to the terminals of the battery. A current *I* is drawn from the battery. *V* is the terminal P.D. If *R* alone is gradually reduced to zero, which of the following best describes *I* and *V* **[KCET 2010]**

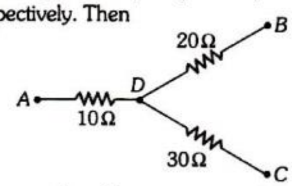
(a) *I* approaches zero, *V* approaches *E*

(b) *I* approaches *E/r*, *V* approaches zero

(c) *I* approaches *E/r*, *V* approaches *E*

(d) *I* approaches infinity, *V* approaches *E*

84. In the circuit given here, the points *A*, *B* and *C* are 70 V, zero, 10 *V* respectively. Then **[KCET 2010]**



(a) The point *D* will be at a potential of 60 *V*

(b) The point *D* will be at a potential of 20 *V*

(c) Currents in the paths *AD*, *DB* and *DC* are in the ratio of 1 : 2 : 3

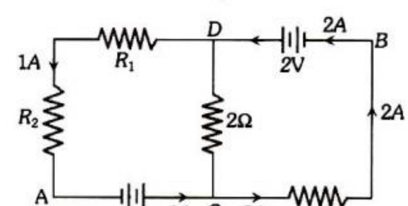
(d) Currents in the paths *AD*, *DB* and *DC* are in the ratio of 3 : 2 : 1

85. A current 2 *A* flows through a 2Ω resistor when connected across a battery. The same battery supplies a current 0.5 *A* when connected across a 9Ω resistor. The internal resistance of the battery is **[CBSE PMT (Pre.) 2011]**

(a) 1Ω (b) 0.5Ω

(c) 1/3Ω (d) 1/4Ω

86. In the circuit shown in the figure, if the potential at point *A* is taken to be zero, the potential at point *B* is **[CBSE PMT (Mains) 2011]**



(a) −2V (b) +1V

(c) −1V (d) +2V

87. 5 cells, each of emf 0.2*V* and internal resistance 1Ω are connected to an external circuit of resistance of 10Ω. Find the current through external circuit **[Odisha JEE 2011]**

(a) $\frac{1}{2.5}A$ (b) $\frac{1}{10}A$

(c) $\frac{1}{15}A$ (d) $\frac{1}{2}A$

88. Two cities are 150 km apart. Electric power is sent from one city to another city through copper wires. The fall of potential per km is 8 volt and the average resistance per km is 0.5 Ω. The power loss in the wire is **[CBSE PMT 2014]**

(a) 19.2 *J* (b) 12.2 *kW*
(c) 19.2 *W* (d) 19.2 *kW*

Different Measuring Instruments

1. In meter bridge or Wheatstone bridge for measurement of resistance, the known and the unknown resistances are interchanged. The error so removed is **[MNR 1988; MP PET 1995]**

(a) End correction
(b) Index error
(c) Due to temperature effect
(d) Random error

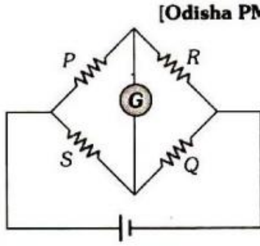
2. A galvanometer can be converted into an ammeter by connecting **[CPMT 1973, 75, 96, 2000; MP PMT 1987, 93; AFMC 1993, 95; MP PET 1994; RPET 2000; DCE 2000; RPMT 2005; Kerala PMT 2009]**

(a) Low resistance in series
(b) High resistance in parallel
(c) Low resistance in parallel
(d) High resistance in series

3. A galvanometer having a coil resistance of $60\,\Omega$ shows full scale deflection when a current of 1.0 amp passes through it. It can be converted into an ammeter to read currents upto 5.0 amp by **[CBSE PMT 2009]**

(a) Putting in parallel a resistance of $240\,\Omega$
(b) Putting in series a resistance of 15 Ω
(c) Putting in series a resistance of 240 Ω
(d) Putting in parallel a resistance of 15 Ω

4. In the circuit given, the correct relation to a balanced Wheatstone bridge is **[Odisha PMT 2004]**



(a) $\frac{P}{Q}=\frac{R}{S}$
(b) $\frac{P}{Q}=\frac{S}{R}$
(c) $\frac{P}{R}=\frac{S}{Q}$
(d) None of these

5. In a potentiometer of one metre length, an unknown *e.m.f.* voltage source is balanced at 60 cm length of potentiometer wire, while a 3 volt battery is balanced at 45 cm length. Then the *e.m.f.* of the unknown voltage source is **[MP PET 2009; AMU (Med.) 2010; Similar DCE 2009]**

(a) 3V (b) 2.25V
(c) 4V (d) 4.5V

6. A galvanometer connected with an unknown resistor and two identical cells in series each of emf 2 *V* shows a current of 1 *A*. If the cells are connected in parallel, it shows 0.8 *A*. Then the internal resistance of the cells is **[Kerala PET 2012]**

(a) $1\,\Omega$ (b) $0.5\,\Omega$
(c) $0.25\,\Omega$ (d) $0.33\,\Omega$
(e) $0.66\,\Omega$

7. The resistances in the four arms of a wheatstone network in cyclic order are $5\,\Omega$, $2\,\Omega$, $6\,\Omega$ and $15\,\Omega$. If a current of 2.8 *A* enters the junction of $5\,\Omega$ and $15\,\Omega$, then the current through $2\,\Omega$ resistor is **[Kerala PET 2012]**

(a) 1.5 *A* (b) 2.8 *A*
(c) 0.7 *A* (d) 1.4 *A*
(e) 2.1 *A*

8. The shunt resistance required to allow 4% of the main current through the galvanometer of resistance $48\,\Omega$ is **[Kerala PET 2012]**

(a) $1\,\Omega$ (b) $2\,\Omega$
(c) $3\,\Omega$ (d) $4\,\Omega$
(e) $5\,\Omega$

9. By ammeter, which of the following can be measured **[MP PET 1981; DPMT 2001]**

(a) Electric potential (b) Potential difference
(c) Current (d) Resistance

10. The resistance of 1 *A* ammeter is 0.018Ω. To convert it into 10 *A* ammeter, the shunt resistance required will be **[MP PET 1982; Similar EAMCET (Engg.) 1982; AIIMS 2007]**

(a) $0.18\,\Omega$ (b) $0.0018\,\Omega$
(c) $0.002\,\Omega$ (d) $0.12\,\Omega$

11. The accurate measurement of emf can be obtained using **[KCET 2009]**

(a) Multimeter (b) Voltmeter
(c) Voltameter (d) Potentiometer

12. In order to pass 10% of main current through a moving coil galvanometer of 99 *ohm*, the resistance of the required shunt is **[MP PET 1990, 99; MP PMT 1994; RPET 2001; KCET 2003, 05; Similar KCET 2009]**

(a) $9.9\,\Omega$ (b) $10\,\Omega$
(c) $11\,\Omega$ (d) $9\,\Omega$

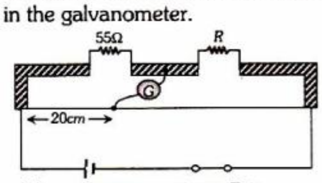
13. An ammeter of 5 *ohm* resistance can read 5 *mA*. If it is to be used to read 100 *volt*, how much resistance is to be connected in series **[MP PET 1991; MP PMT 1996, 2000]**

(a) $19.9995\,\Omega$ (b) 199.995Ω
(c) $1999.95\,\Omega$ (d) $19995\,\Omega$

14. Which one of the following is correct **[MP PMT 2012]**

(a) An ammeter is a galvanometer connected with a low resistance in parallel
(b) An ammeter is a galvanometer connected with a high resistance in parallel
(c) An ammeter is a galvanometer connected with a low resistance in series
(d) An ammeter is a galvanometer connected with a high resistance in series

15. Shown in the figure below is a meter-bridge set up with null deflection in the galvanometer.



The value of the unknown resistor R is **[AIEEE 2008]**

(a) $220\,\Omega$ (b) $110\,\Omega$

(c) $55\,\Omega$ (d) $13.75\,\Omega$

16. When a 12Ω resistor is connected with a moving coil galvanometer then its deflection reduces from 50 divisions to 10 divisions. The resistance of the galvanometer is

[CPMT 2002; DPMT 2003; Similar KCET 2008]

(a) $24\,\Omega$ (b) $36\,\Omega$

(c) $48\,\Omega$ (d) $60\,\Omega$

17. A galvanometer can be used as a voltmeter by connecting a

[AFMC 1993; MP PMT 1993, 95; CBSE PMT 2004; Similar CBSE PMT 2002; J & K CET 2008]

(a) High resistance in series (b) Low resistance in series

(c) High resistance in parallel (d) Low resistance in parallel

18. A Wheatstone bridge has the resistances $10\,\Omega$, $10\,\Omega$, $10\,\Omega$ and $30\,\Omega$ in its four arms. What resistance joined in parallel to the $30\,\Omega$ resistance will bring it to the balanced condition **[WB JEE 2012]**

(a) $2\,\Omega$ (b) $5\,\Omega$

(c) $10\,\Omega$ (d) $15\,\Omega$

19. In Wheatstone's bridge $P = 9\,ohm$, $Q = 11\,ohm$, $R = 4\,ohm$ and $S = 6\,ohm$. How much resistance must be put in parallel to the resistance S to balance the bridge

[DPMT 1999]

(a) $24\,ohm$ (b) $\frac{44}{9}\,ohm$

(c) $26.4\,ohm$ (d) $18.7\,ohm$

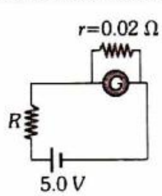
20. A Daniel cell is balanced on $125\,cm$ length of a potentiometer wire. Now the cell is short-circuited by a resistance $2\,ohm$ and the balance is obtained at $100\,cm$. The internal resistance of the Daniel cell is

[UPSEAT 2002; Similar Kerala PET 2008]

(a) $0.5\,ohm$ (b) $1.5\,ohm$

(c) $1.25\,ohm$ (d) $4/5\,ohm$

21. In the circuit shown, the galvanometer G of resistance $60\,\Omega$ is shunted by a resistance $r = 0.02\,\Omega$. The current through R is nearly $1\,A$. The value of resistance R is (in ohms) is nearly **[AMU (Engg.) 2012]**



(a) $1.00\,\Omega$ (b) $5.00\,\Omega$

(c) $11.0\,\Omega$ (d) $60.00\,\Omega$

22. Two resistances R_1 and another R_2 of the same material but twice the length and half the thickness are connected in series with a standard battery E of internal resistance r. The balancing point is **[VITEEE 2008]**

(a) $\frac{1}{8l}$ (b) $\frac{1}{4l}$

(c) $8l$ (d) $16l$

23. A battery of 6 volts is connected to the terminals of a three metre long wire of uniform thickness and resistance of the order of $100\,\Omega$. The difference of potential between two points separated by $50\,cm$ on the wire will be

[CPMT 1984; CBSE PMT 2004]

(a) $1\,V$ (b) $1.5\,V$

(c) $2\,V$ (d) $3\,V$

24. A galvanometer of resistance 50Ω is connected to a battery of 3V along with a resistance of 2950Ω in series. A full scale deflection of 30 divisions is obtained in the galvanometer. In order to reduce this deflection to 20 divisions, the resistance in series should be **[CBSE PMT 2008]**

(a) 6050Ω (b) 4450Ω

(c) 5050Ω (d) 5550Ω

25. A cell can be balanced against 110 cm and 100 cm of potentiometer wire, respectively with and without being short circuited through a resistance of 10Ω. Its internal resistance is

[CBSE PMT 2008; Similar SCRA 1998; MP PET 2007]

(a) 2.0 ohm (b) Zero

(c) 1.0 ohm (d) 0.5 ohm

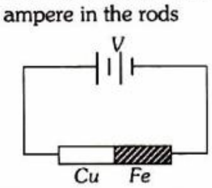
26. The percentage error in measuring resistance with a metre bridge can be minimized by adjusting the balancing point close to **[Kerala PMT 2012]**

(a) $0\,cm$ (b) $20\,cm$

(c) $50\,cm$ (d) $80\,cm$

(e) $100\,cm$

27. Two rods are joined end to end, as shown. Both have a cross-sectional area of $0.01\,cm^2$. Each is 1 meter long. One rod is of copper with a resistivity of 1.7×10^{-6} ohm-centimeter, the other is of iron with a resistivity of 10^{-5} ohm-centimeter. How much voltage is required to produce a current of 1 ampere in the rods **[NEET (Karnataka) 2013]**



(a) $0.00145\,V$ (b) $0.0145\,V$

(c) $1.7 \times 10^{-6}\,V$ (d) $0.117\,V$

28. In order to increase the sensitivity of galvanometer

[MP PET 2008]

(a) The suspension wire should be made stiff

(b) Area of the coil should be reduced

(c) The magnetic field should be increased

(d) The number of turns in the coil should be reduced

29. In potentiometer a balance point is obtained, when

(a) The e.m.f. of the battery becomes equal to the e.m.f. of the experimental cell

(b) The p.d. of the wire between the $+ve$ end to jockey becomes equal to the e.m.f. of the experimental cell

(c) The p.d. of the wire between $+ve$ point and jockey becomes equal to the e.m.f. of the battery

(d) The p.d. across the potentiometer wire becomes equal to the e.m.f. of the battery

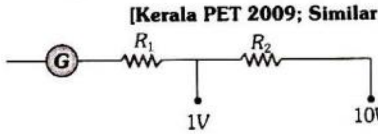
30. A cell in secondary circuit gives null deflection for $2.5m$ length of potentiometer having $10m$ length of wire. If the length of the potentiometer wire is increased by $1m$ without changing the cell in the primary, the position of the null point now is **[EAMCET 2009]**

(a) $3.5\ m$ (b) $3\ m$

(c) $2.75\ m$ (d) $2.0\ m$

31. The resistance of a galvanometer is $50\ \Omega$ and it shows full scale deflection for a current of $1mA$. To convert it into a voltmeter to measure $1V$ and as well as $10V$ (refer circuit diagram) the resistances R_1 and R_2 respectively are

[Kerala PET 2009; Similar MP PET 2013]



(a) $950\ \Omega$ and $9150\ \Omega$ (b) $900\ \Omega$ and $9950\ \Omega$

(c) $900\ \Omega$ and $9900\ \Omega$ (d) $950\ \Omega$ and $9000\ \Omega$

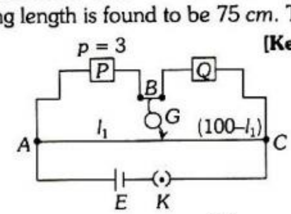
(e) $950\ \Omega$ and $9950\ \Omega$

32. The resistance of a galvanometer is 90 *ohm*. If only 10 percent of the main current may flow through the galvanometer, in which way and of what value, a resistor is to be used **[MP PET 1996]**

(a) 10 *ohm* in series (b) 10 *ohm* in parallel

(c) 810 *ohm* in series (d) 810 *ohm* in parallel

33. In a metre bridge experiment, resistances are connected as shown in figure. The balancing length l_1 is 55 *cm*. Now an unknown resistance x is connected in series with P and the new balancing length is found to be 75 *cm*. The value of x is **[Kerala PMT 2009]**



(a) $\frac{54}{12}\Omega$ (b) $\frac{20}{11}\Omega$

(c) $\frac{48}{11}\Omega$ (d) $\frac{11}{48}\Omega$

(e) 5Ω

34. A voltmeter has a resistance of G *ohm* and range V *volt*. The value of resistance used in series to convert it into a voltmeter of range nV volt is

[MP PMT 1999; MP PET 2002; DPMT 2004; MH CET 2004]

(a) nG (b) $(n-1)G$

(c) $\frac{G}{n}$ (d) $\frac{G}{(n-1)}$

35. Which of the following statements is wrong

[MP PET 1994; Similar BHU 1995]

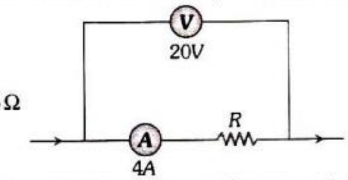
(a) Voltmeter should have high resistance

(b) Ammeter should have low resistance

(c) Ammeter is placed in parallel across the conductor in a circuit

(d) Voltmeter is placed in parallel across the conductor in a circuit

36. In the diagram shown, the reading of voltmeter is 20 V and that of ammeter is 4 A. The value of R should be (Consider given ammeter and voltmeter are not ideal) **[RPMT 1997]**



(a) Equal to 5Ω

(b) Greater than 5Ω

(c) Less than 5Ω

(d) Greater or less than 5Ω depending on the material of R

37. A moving coil galvanometer has a resistance of 50Ω and gives full scale deflection for 10 mA. How could it be converted into an ammeter with a full scale deflection for $1A$

[MP PMT 1996; Similar MP PET 1984; MP PMT 1997, 2007; AIIMS 1999; RPMT 2005; DUMET 2009]

(a) $50/99\Omega$ in series (b) $50/99\Omega$ in parallel

(c) 0.01Ω in series (d) 0.01Ω in parallel

38. A galvanometer of resistance $20\ \Omega$ shows a deflection of 10 divisions when a current of $1\ mA$ is passed through it. if a shunt of $4\ \Omega$ is connected and there are 50 divisions on the scale, the range of the galvanometer is **[Kerala PET 2007]**

(a) $1A$ (b) $3A$

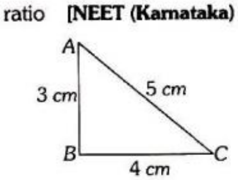
(c) $30mA$ (d) $30A$

39. A galvanometer of resistance 25Ω giving full scale deflection for a current of 10 *milliampere*, is to be changed into a voltmeter of range 100 V by connecting a resistance of 'R' in series with galvanometer. The value of resistance R in Ω is **[MP PET 1994; Similar Pb. PMT 2000]**

(a) 10000 (b) 10025

(c) 975 (d) 9975

40. A 12 *cm* wire is given a shape of a right angled triangle ABC having sides 3 *cm*, 4 *cm* and 5 *cm*, as shown in the figure. The resistance between two ends (AB, BC, CA) of the respective sides are measured one by one by a multi-meter. The resistances will be in the ratio **[NEET (Karnataka) 2013]**



(a) 9 : 16 : 25

(b) 27 : 32 : 35

(c) 21 : 24 : 25

(d) 3 : 4 : 5

41. The resistance of a galvanometer is 25 *ohm* and it requires $50\,\mu A$ for full deflection. The value of the shunt resistance required to convert it into an ammeter of 5 *amp* is

[MP PMT 1994, 2006; BHU 1997; Similar MP PMT 1985; KCET 2006; CBSE PMT 2007; Odisha JEE 2009]

(a) $2.5\times10^{-4}\,ohm$ (b) $1.25\times10^{-3}\,ohm$

(c) $0.05\,ohm$ (d) $2.5\,ohm$

42. A potentiometer wire, $10\,m$ long, has a resistance of $40\,\Omega$. It is connected in series with a resistance box and a $2V$ storage cell. If the potential gradient along the wire is $(0.1mV/cm)$, the resistance unplugged in the box is

[Kerala PET 2007; Similar MP PMT 2013]

(a) $260\,\Omega$ (b) $760\,\Omega$

(c) $960\,\Omega$ (d) $1060\,\Omega$

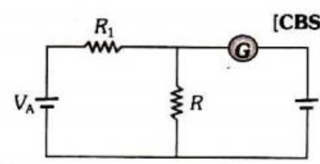
43. The resistances of the four arms P, Q, R and S in a wheatstone's bridge are 10 *ohm*, 30 *ohm*, 30 *ohm* are 90 *ohm*, respectively. The e.m.f. and internal resistance of the cell are 7 *volt* and 5 *ohm* respectively. If the galvanometer resistance is 50 *ohm*, the current drawn from the cell will be **[NEET 2013]**

(a) $2.0\,A$ (b) $1.0\,A$

(c) $0.2\,A$ (d) $0.1\,A$

44. In the circuit shown the cells *A* and *B* have negligible resistances. For $V_A = 12V, R_1 = 500\Omega$ and $R = 100\Omega$ the galvanometer (G) shows no deflection. The value of V_B is

[CBSE PMT (Pre.) 2012]



(a) $4V$ (b) $2V$

(c) $12V$ (d) $6V$

45. A potentiometer wire of length *L* and resistance $10\,\Omega$ is connected in series with a battery of e.m.f. $2.5\,V$ and a resistance in its primary circuit. The null point corresponding to a cell of e.m.f. $1\,V$ is obtained at a distance $\frac{L}{2}$. If the resistance in the primary circuit is doubled then the position of new null point will be **[DCE 2006]**

(a) $0.4\,L$ (b) $0.5\,L$

(c) $0.6\,L$ (d) $0.8\,L$

46. An ammeter with internal resistance 90Ω reads $1.85\,A$ when connected in a circuit containing a battery and two resistors 700Ω and 410Ω in series. Actual current will be

[Roorkee 1995]

(a) $1.85\,A$ (b) Greater than $1.85\,A$

(c) Less than $1.85\,A$ (d) None of these

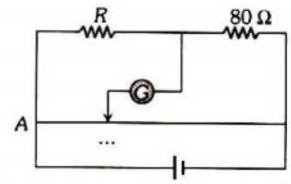
47. *AB* is a wire of uniform resistance. The galvanometer *G* shows no current when the length AC = 20*cm* and *CB* = 80 *cm*. The resistance *R* is equal to **[MP PMT 1995; RPET 2001]**

(a) $2\,\Omega$

(b) $8\,\Omega$

(c) $20\,\Omega$

(d) $40\,\Omega$



48. A milli voltmeter of 25 milli volt range is to be converted into an ammeter of 25 ampere range. The value (in ohm) of necessary shunt will be **[CBSE PMT (Pre.) 2012]**

(a) 0.001 (b) 0.01

(c) 1 (d) 0.05

49. In an experiment to measure the internal resistance of a cell by potentiometer, it is found that the balance point is at a length of $2m$ when the cell is shunted by a 5Ω resistance; and is at a length of $3m$ when the cell is shunted by a 10Ω resistance. The internal resistance of the cell is, then

[Haryana CEE 1996]

(a) 1.5Ω (b) 10Ω

(c) 15Ω (d) 1Ω

50. A galvanometer of resistance *G* can measure 1 A current. If a shunt *S* is used to convert it into an ammeter to measure 10*A* current. The ratio of $\frac{G}{S}$ is **[Odisha JEE 2011]**

(a) 1/9 (b) 9/1

(c) 10 (d) 1/10

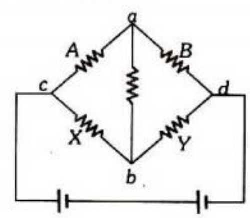
51. In the Wheatstone's bridge (shown in figure) *X*=*Y* and *A*>*B*. The direction of the current between *ab* will be

(a) From *a* to *b*

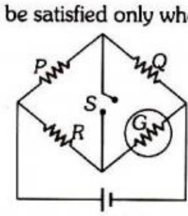
(b) From *b* to *a*

(c) From *b* to *a* through *c*

(d) From *a* to *b* through *c*



52. The figure shows a circuit diagram of a 'Wheatstone Bridge' to measure the resistance *G* of the galvanometer. The relation $\frac{P}{Q} = \frac{R}{G}$ will be satisfied only when



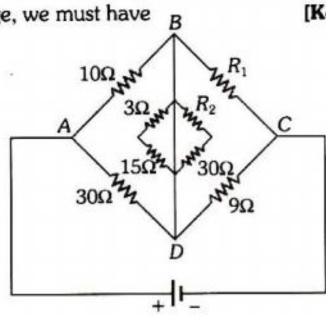
(a) The galvanometer shows a deflection when switch *S* is closed

(b) The galvanometer shows a deflection when switch *S* is open

(c) The galvanometer shows no change in deflection whether *S* is open or closed

(d) The galvanometer shows no deflection

53. In the Wheatstone bridge shown below, in order to balance the bridge, we must have **[Kerala PET 2003]**



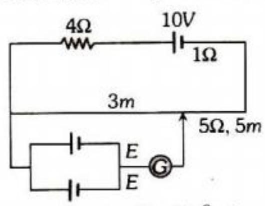
(a) $R_1 = 3\,\Omega\,; R_2 = 3\,\Omega$

(b) $R_1 = 6\,\Omega\,; R_2 = 15\,\Omega$

(c) $R_1 = 1.5\,\Omega\,; R_2 =$ any finite value

(d) $R_1 = 3\,\Omega\,; R_2 =$ any finite value

54. A resistance of 4Ω and a wire of length 5 *metres* and resistance 5Ω are joined in series and connected to a cell of e.m.f. 10 *V* and internal resistance 1Ω. A parallel combination of two identical cells is balanced across 300 *cm* of the wire. The e.m.f. *E* of each cell is **[MP PMT 1997]**



(a) 1.5 *V*

(b) 3.0 *V*

(c) 0.67 *V*

(d) 1.33 *V*

55. The resistivity of a potentiometer wire is $40 \times 10^{-8}\ ohm - m$ and its area of cross-section is $8 \times 10^{-6}\ m^2$. If 0.2 *amp* current is flowing through the wire, the potential gradient will be **[MP PMT/PET 1998]**

(a) $10^{-2}\ volt/m$ (b) $10^{-1}\ volt/m$

(c) $3.2 \times 10^{-2}\ volt/m$ (d) $1\ volt/m$

56. Potentiometer wire of length $1\ m$ is connected in series with $490\ \Omega$ resistance and $2\,V$ battery. If $0.2\ mV/cm$ is the potential gradient, then resistance of the potentiometer wire is **[DCE 2005]**

(a) $4.9\ \Omega$ (b) $7.9\ \Omega$

(c) $5.9\ \Omega$ (d) $6.9\ \Omega$

57. The resistance of an ideal voltmeter is **[EAMCET (Med.) 1995; MP PMT/PET 1998; Pb. PMT 1999; CPMT 2000]**

(a) Zero (b) Very low

(c) Very large (d) Infinite

58. A 100 *V* voltmeter of internal resistance $20\ k\Omega$ in series with a high resistance *R* is connected to a 110 *V* line. The voltmeter reads 5 *V*, the value of *R* is **[MP PET 1999]**

(a) $210\ k\Omega$ (b) $315\ k\Omega$

(c) $420\ k\Omega$ (d) $440\ k\Omega$

59. Constantan wire is used in making standard resistances because its **[MP PET 1999]**

(a) Specific resistance is low

(b) Density is high

(c) Temperature coefficient of resistance is negligible

(d) Melting point is high

60. The net resistance of a voltmeter should be large to ensure that **[MP PMT 1999]**

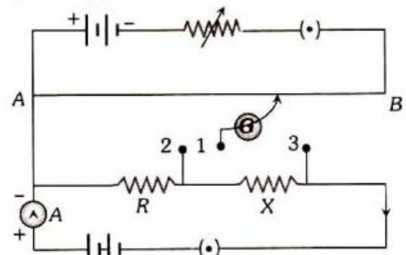
(a) It does not get overheated

(b) It does not draw excessive current

(c) It can measure large potential difference

(d) It does not appreciably change the potential difference to be measured

61. A potentiometer circuit is set up as shown. The potential gradient, across the potentiometer wire, is *k* volt/*cm* and the ammeter, present in the circuit, reads 1.0 *A* when two way key is switched off. The balance points, when the key between the terminals (i) 1 and 2 (ii) 1 and 3, is plugged in, are found to be at lengths l_1 *cm* and l_2*cm* respectively. The magnitudes, of the resistors *R* and *X*, in ohms, are then, equal, respectively, to **[CBSE PMT 2010]**



(a) kl_1 and kl_2 (b) $k(l_2 - l_1)$ and kl_2

(c) kl_1 and $k(l_2 - l_1)$ (d) $k(l_2 - l_1)$ and kl_1

62. A potentiometer consists of a wire of length 4 *m* and resistance $10\,\Omega$. It is connected to a cell of e.m.f. 2 *V*. The potential difference per unit length of the wire will be **[CBSE PMT 1999; AFMC 2001]**

(a) $0.5\ V/m$ (b) $2\,V/m$

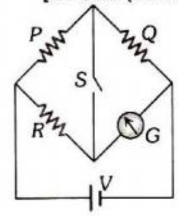
(c) $5\,V/m$ (d) $10\,V/m$

63. In a meter bridge, the balancing length from the left end (standard resistance of one *ohm* is in the right gap) is found to be 20 *cm*. The value of the unknown resistance is **[CBSE PMT 1999; Pb PMT 2004]**

(a) $0.8\,\Omega$ (b) $0.5\,\Omega$

(c) $0.4\,\Omega$ (d) $0.25\,\Omega$

64. In the circuit shown $P \neq R$, the reading of the galvanometer is same with switch *S* open or closed. Then **[IIT-JEE (Screening) 1999]**



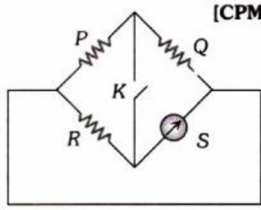
(a) $I_R = I_G$

(b) $I_P = I_G$

(c) $I_Q = I_G$

(d) $I_Q = I_R$

65. In the following Wheatstone bridge $P/Q = R/S$. If key K is closed, then the galvanometer will show deflection **[CPMT 1999]**



(a) In left side
(b) In right side
(c) No deflection
(d) In either side

66. A galvanometer having a resistance of 8 *ohm* is shunted by a wire of resistance 2 *ohm*. If the total current is 1 *amp*, the part of it passing through the shunt will be **[CBSE PMT 1998; AFMC 2006]**

(a) 0.25 *amp* (b) 0.8 *amp*
(c) 0.2 *amp* (d) 0.5 *amp*

67. If resistance of voltmeter is 10000Ω and resistance of ammeter is 2Ω, then find R when voltmeter reads 12V and ammeter reads 0.1 A **[BCECE 2005]**

(a) 118 Ω (b) 120 Ω
(c) 124 Ω (d) 114 Ω

68. Two resistances are connected in two gaps of a metre bridge. The balance point is 20 *cm* from the zero end. A resistance of 15 *ohms* is connected in series with the smaller of the two. The null point shifts to 40 *cm*. The value of the smaller resistance in ohms is **[KCET 2005]**

(a) 3 (b) 6
(c) 9 (d) 12

69. A galvanometer whose resistance is 120Ω gives full scale deflection with a current of 0.05 A so that it can read a maximum current of 10 A. A shunt resistance is added in parallel with it. The resistance of the ammeter so formed is **[Bihar MEE 1995; DUMET 2010]**

(a) 0.06Ω (b) 0.006Ω
(c) 0.6Ω (d) 6Ω

70. In a potentiometer experiment, when three cells A, B and C are connected in series, the balancing length is found to be 740 *cm*. If A and B are connected in series balancing length is 440 *cm* and for B and C connected in series that is 540 *cm*. Then the emf of E_A, E_B and E_C are respectively (in volts) **[Kerala PET 2011]**

(a) 1, 1.2 and 1.5 (b) 1, 2, and 3
(c) 1.5, 2 and 3 (d) 1.5, 2.5 and 3.5
(e) 1.2, 1.5 and 3.5

71. A galvanometer of resistance, G, is shunted by a resistance S *ohm*. To keep the main current in the circuit unchanged, the resistance to be put in series with the galvanometer is **[CBSE PMT (Mains) 2011]**

(a) $\frac{G^2}{(S+G)}$ (b) $\frac{G}{(S+G)}$
(c) $\frac{S^2}{(S+G)}$ (d) $\frac{SG}{(S+G)}$

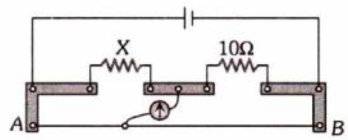
72. A moving coil galvanometer of resistance 100Ω is used as an ammeter using a resistance 0.1Ω. The maximum deflection current in the galvanometer is 100μA. Find the minimum current in the circuit so that the ammeter shows maximum deflection **[IIT-JEE (Screening) 2005]**

(a) 100.1 *mA* (b) 1000.1 *mA*
(c) 10.01 *mA* (d) 1.01 *mA*

73. We have a galvanometer of resistance 25Ω. It is shunted by a 2.5Ω wire. The part of total current that flows through the galvanometer is given as **[AFMC 1998; MH CET 1999; Pb. PMT 2002; J & K CET 2006; Similar VITEEE 2006]**

(a) $\frac{I}{I_0}=\frac{1}{11}$ (b) $\frac{I}{I_0}=\frac{1}{10}$
(c) $\frac{I}{I_0}=\frac{3}{11}$ (d) $\frac{I}{I_0}=\frac{4}{11}$

74. A meter bridge is set-up as shown, to determine an unknown resistance 'X' using a standard 10 *ohm* resistor. The galvanometer shows null point when tapping-key is at 52*cm* mark. The end-corrections are 1*cm* and 2*cm* respectively for the ends A and B. The determined value of 'X' is **[IIT-JEE 2011]**



(a) 10.2 *ohm* (b) 10.6 *ohm*
(c) 10.8 *ohm* (d) 11.1 *ohm*

75. If the resistivity of a potentiometer wire be ρ and area of cross-section be A, then what will be potential gradient along the wire **[RPET 1996]**

(a) $\frac{I\rho}{A}$ (b) $\frac{I}{A\rho}$
(c) $\frac{IA}{\rho}$ (d) $IA\rho$

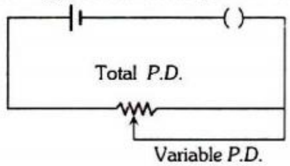
76. A voltmeter has resistance of 2000 *ohm* and it can measure upto 2V. If we want to increase its range to 10 V, then the required resistance in series will be **[CPMT 1997, SCRA 1994]**

(a) 2000Ω (b) 4000Ω
(c) 6000Ω (d) 8000Ω

77. With a potentiometer null point were obtained at 140 *cm* and 180 *cm* with cells of emf 1.1 V and one unknown X volt. Unknown emf is **[DCE 2002]**

(a) 1.1 V (b) 1.8 V
(c) 2.4 V (d) 1.41 V

78. The arrangement as shown in figure is called as **[CPMT 1999]**



(a) Potential divider
(b) Potential adder
(c) Potential substracter
(d) Potential multiplier

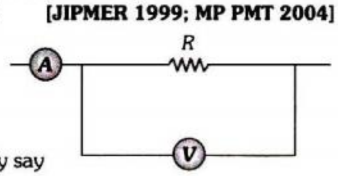
79. A potentiometer wire of length $1m$ and resistance $10\ \Omega$ is connected in series with a cell of *emf* $2V$ with internal resistance $1\ \Omega$ and a resistance box including a resistance R. If potential difference between the ends of the wire is $1\ mV$, the value of R is **[KCET 1999; Similar RPET 1997]**

(a) $20000\ \Omega$ (b) $19989\ \Omega$
(c) $10000\ \Omega$ (d) $9989\ \Omega$

80. In a balanced Wheatstone's network, the resistances in the arms Q and S are interchanged. As a result of this **[KCET 1999]**

(a) Network is not balanced
(b) Network is still balanced
(c) Galvanometer shows zero deflection
(d) Galvanometer and the cell must be interchanged to balance

81. The ammeter A reads $2\ A$ and the voltmeter V reads $20\ V$. The value of resistance R is (Assuming finite resistance's of ammeter and voltmeter) **[JIPMER 1999; MP PMT 2004]**



(a) Exactly 10 *ohm*
(b) Less than 10 *ohm*
(c) More than 10 *ohm*
(d) We cannot definitely say

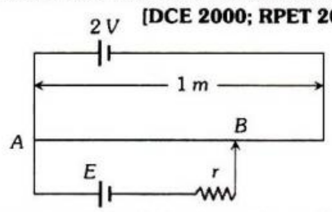
82. The resistance of a galvanometer coil is R. What is the shunt resistance required to convert it into an ammeter of range 4 times **[BHU 2000]**

(a) $R/5$ (b) $R/4$
(c) $R/3$ (d) $4R$

83. If an ammeter is connected in parallel to a circuit, it is likely to be damaged due to excess **[BHU 2000; BCECE 2004]**

(a) Current (b) Voltage
(c) Resistance (d) All of these

84. In the given figure, battery E is balanced on 55 *cm* length of potentiometer wire but when a resistance of $10\ \Omega$ is connected in parallel with the battery then it balances on 50 *cm* length of the potentiometer wire then internal resistance r of the battery is **[DCE 2000; RPET 2000]**



(a) $1\ \Omega$
(b) $3\ \Omega$
(c) $10\ \Omega$
(d) $5\ \Omega$

85. In a potentiometer experiment the balancing with a cell is at length 240 *cm*. On shunting the cell with a resistance of $2\ \Omega$, the balancing length becomes 120 *cm*. The internal resistance of the cell is

[DCE 2002; AIEEE 2005; Similar MP PET 1993]

(a) $4\ \Omega$ (b) $2\ \Omega$
(c) $1\ \Omega$ (d) $0.5\ \Omega$

86. The resistance of an ideal ammeter is **[KCET 2000]**

(a) Infinite (b) Very high
(c) Small (d) Zero

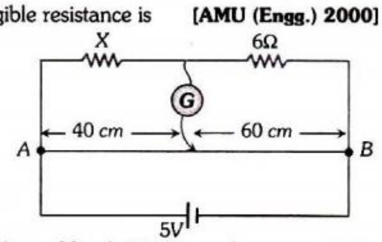
87. A galvanometer of $25\ \Omega$ resistance can read a maximum current of $6mA$. It can be used as a voltmeter to measure a maximum of $6\ V$ by connecting a resistance to the galvanometer. Identify the correct choice in the given answers **[MP PMT 1999; EAMCET (Med.) 2000; MP PET 2006; CBSE PMT 2010; Similar MNR 1994; UPSEAT 2000]**

(a) $1025\ \Omega$ in series (b) $1025\ \Omega$ in parallel
(c) $975\ \Omega$ in series (d) $975\ \Omega$ in parallel

88. A galvanometer has a resistance of 25 *ohm* and a maximum of $0.01\ A$ current can be passed through it. In order to change it into an ammeter of range $10\ A$, the shunt resistance required is **[MP PET 2000]**

(a) 5/999 *ohm* (b) 10/999 *ohm*
(c) 20/999 *ohm* (d) 25/999 *ohm*

89. In the circuit shown, a *meter* bridge is in its balanced state. The *meter* bridge wire has a resistance 0.1 *ohm/cm*. The value of unknown resistance X and the current drawn from the battery of negligible resistance is **[AMU (Engg.) 2000]**



(a) $6\ \Omega$, 5 *amp*
(b) $10\ \Omega$, 0.1 *amp*
(c) $4\ \Omega$, 1.0 *amp*
(d) $12\ \Omega$, 0.5 *amp*

90. A galvanometer has 30 divisions and a sensitivity $16\ \mu A/\text{div}$. It can be converted into a voltmeter to read 3 V by connecting **[Kerala PMT 2005]**

(a) Resistance nearly $6\ k\Omega$ in series
(b) $6k\Omega$ in parallel
(c) 500Ω in series
(d) It cannot be converted

91. Voltmeters V_1 and V_2 are connected in series across a $D.C.$ line. V_1 reads 80 *volt* and has a per *volt* resistance of 200 *ohm*. V_2 has a total resistance of 32 *kilo ohm*. The line voltage is **[UPSEAT 2000]**

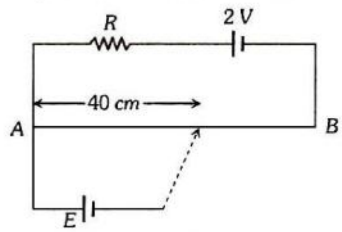
(a) 120 *volt* (b) 160 *volt*
(c) 220 *volt* (d) 240 *volt*

92. A potentiometer having the potential gradient of 2 *mV/cm* is used to measure the difference of potential across a resistance of 10 *ohm*. If a length of 50 *cm* of the potentiometer wire is required to get the null point, the current passing through the 10 *ohm* resistor is (in *mA*)

[AMU (Med.) 2000]

(a) 1 (b) 2
(c) 5 (d) 10

93. *AB* is a potentiometer wire of length 100 *cm* and its resistance is 10 *ohm*. It is connected in series with a resistance R = 40 *ohm* and a battery of e.m.f. 2 *V* and negligible internal resistance. If a source of unknown e.m.f. *E* is balanced by 40 *cm* length of the potentiometer wire, the value of *E* is **[MP PET 2001; Similar Kerala PET 2008]**



(a) 0.8 *V*
(b) 1.6 *V*
(c) 0.08 *V*
(d) 0.16 *V*

94. An ammeter gives full deflection when a current of 2 *amp.* flows through it. The resistance of ammeter is 12 *ohm*. If the same ammeter is to be used for measuring a maximum current of 5 *amp.*, then the ammeter must be connected with a resistance of **[MP PET 2001]**

(a) 8 *ohm* in series (b) 18 *ohm* in series
(c) 8 *ohm* in parallel (d) 18 *ohm* in parallel

95. In a circuit 5 percent of total current passes through a galvanometer. If resistance of the galvanometer is *G* then value of the shunt is **[MP PET 2001; Similar MP PMT/PET 1998; Kerala PMT 2008; CBSE PMT 2014]**

(a) 19 *G* (b) 20 *G*
(c) $\frac{G}{20}$ (d) $\frac{G}{19}$

96. A voltmeter having resistance of 50×10^3 *ohm* is used to measure the voltage in a circuit. To increase the range of measurement 3 times the additional series resistance required is **[MP PET 2001]**

(a) 10^5 *ohm* (b) 150 *k.ohm*
(c) 900 *k.ohm* (d) 9×10^6 *ohm*

97. In a potentiometer experiment two cells of e.m.f.'s E_1 and E_2 are used in series and in conjunction and the balancing length is found to be 58 *cm* of the wire. If the polarity of E_2 is reversed, then the balancing length becomes 29 *cm*. The ratio $\frac{E_1}{E_2}$ of the e.m.f. of the two cells is

[Kerala (Engg.) 2001]

(a) 1 : 1 (b) 2 : 1
(c) 3 : 1 (d) 4 : 1

98. A milliammeter of range 10 *mA* has a coil of resistance 1 Ω. To use it as voltmeter of range 10 *volt*, the resistance that must be connected in series with it, will be

[KCET 2001; Similar RPET 2003]

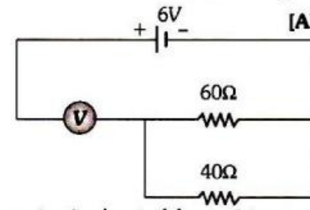
(a) 999 Ω (b) 99 Ω
(c) 1000 Ω (d) None of these

99. A voltmeter has a range 0-*V* with a series resistance *R*. With a series resistance 2*R*, the range is 0-*V*′. The correct relation between *V* and *V*′ is **[CPMT 2001]**

(a) $V' = 2V$ (b) $V' > 2V$
(c) $V' >> 2V$ (d) $V' < 2V$

100. The measurement of voltmeter in the following circuit is

[AFMC 2001]



(a) 2.4 *V*
(b) 3.4 *V*
(c) 4.0 *V*
(d) 6.0 *V*

101. A 36 Ω galvanometer is shunted by resistance of 4Ω. The percentage of the total current, which passes through the galvanometer is **[UPSEAT 2002]**

(a) 8 % (b) 9 %
(c) 10 % (d) 91 %

102. An ammeter and a voltmeter of resistance *R* are connected in series to an electric cell of negligible internal resistance. Their readings are *A* and *V* respectively. If another resistance *R* is connected in parallel with the voltmeter

[EAMCET 2000; KCET 2002; MP PET 2009]

(a) Both *A* and *V* will increase
(b) Both *A* and *V* will decrease
(c) *A* will decrease and *V* will increase
(d) *A* will increase and *V* will decrease

103. A wire of length 100 *cm* is connected to a cell of *emf* 2 *V* and negligible internal resistance. The resistance of the wire is 3 Ω. The additional resistance required to produce a potential drop of 1 *milli volt* per *cm* is **[Kerala PET 2002]**

(a) 60 Ω (b) 47 Ω
(c) 57 Ω (d) 35 Ω

104. A galvanometer of resistance 20 Ω is to be converted into an ammeter of range 1 *A*. If a current of 1 *mA* produces full scale deflection, the shunt required for the purpose is

[Kerala PET 2002]

(a) 0.01 Ω (b) 0.05 Ω
(c) 0.02 Ω (d) 0.04 Ω

105. There are three voltmeters of the same range but of resistances 10000 Ω, 8000 Ω and 4000 Ω respectively. The best voltmeter among these is the one whose resistance is **[Kerala PET 2002]**

(a) 10000 Ω (b) 8000 Ω
(c) 4000 Ω (d) All are equally good

106. If an ammeter is to be used in place of a voltmeter then we must connect with the ammeter a

[AIEEE 2002; AFMC 2002; Similar GUJCET 2014]

(a) Low resistance in parallel
(b) High resistance in parallel
(c) High resistance in series
(d) Low resistance in series

107. A 10 *m* long wire of 20Ω resistance is connected with a battery of 3 *volt* e.m.f. (negligible internal resistance) and a 10 Ω resistance is joined to it is series. Potential gradient along wire in volt per meter is

[MP PMT 2003; Similar KCET 1994]

(a) 0.02 (b) 0.3
(c) 0.2 (d) 1.3

108. A potentiometer has uniform potential gradient across it. Two cells connected in series (i) to support each other and (ii) to oppose each other are balanced over 6*m* and 2*m* respectively on the potentiometer wire. The e.m.f.'s of the cells are in the ratio of **[MP PMT 2002]**

(a) 1 : 2 (b) 1 : 1

(c) 3 : 1 (d) 2 : 1

109. The material of wire of potentiometer is **[MP PMT 2002]**

(a) Copper (b) Steel

(c) Manganin (d) Aluminium

110. A voltmeter essentially consists of **[UPSEAT 2004]**

(a) A high resistance, in series with a galvanometer

(b) A low resistance, in series with a galvanometer

(c) A high resistance in parallel with a galvanometer

(d) A low resistance in parallel with a galvanometer

111. To convert a 800 *mV* range *milli voltmeter* of resistance 40 Ω into a galvanometer of 100 *mA* range, the resistance to be connected as shunt is **[CBSE PMT 2002]**

(a) 10 Ω (b) 20 Ω

(c) 30 Ω (d) 40 Ω

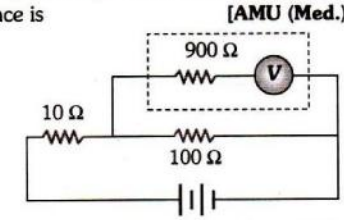
112. A 100 *ohm* galvanometer gives full scale deflection at 10 *mA*. How much shunt is required to read 100 *mA*

[MP PET 2002; Similar Pb. PET 2000]

(a) 11.11 *ohm* (b) 9.9 *ohm*

(c) 1.1 *ohm* (d) 4.4 *ohm*

113. The potential difference across the 100Ω resistance in the following circuit is measured by a voltmeter of 900 Ω resistance. The percentage error made in reading the potential difference is **[AMU (Med.) 2002]**



(a) $\frac{10}{9}$

(b) 0.1

(c) 1.0

(d) 10.0

114. A cell of internal resistance 3 *ohm* and *emf* 10 *volt* is connected to a uniform wire of length 500 *cm* and resistance 3 *ohm*. The potential gradient in the wire is **[MP PET 2003]**

(a) 30 *mV/cm* (b) 10 *mV/cm*

(c) 20 *mV/cm* (d) 4 *mV/cm*

115. A potentiometer consists of a wire of length 4 *m* and resistance 10 Ω. It is connected to cell of emf 2 *V*. The potential difference per unit length of the wire will be

[Pb. PET 2002]

(a) 0.5 *V/m* (b) 10 *V/m*

(c) 2 *V/m* (d) 5 *V/m*

116. A galvanometer of resistance 36 Ω is changed into an ammeter by using a shunt of 4 Ω. The fraction f_0 of total current passing through the galvanometer is **[BCECE 2003]**

(a) $\frac{1}{40}$ (b) $\frac{1}{4}$

(c) $\frac{1}{140}$ (d) $\frac{1}{10}$

117. A resistance of 2Ω is connected across one gap of a meter–bridge (the length of the wire is 100*cm*) and an unknown resistance, greater than 2Ω, is connected across the other gap. When these resistances are interchanged, the balance point shifts by 20*cm*. Neglecting any corrections, the unknown resistance is

[IIT-JEE 2007; Similar CBSE PMT 2014]

(a) 3 Ω (b) 4 Ω

(c) 5 Ω (d) 6 Ω

118. A 50 *ohm* galvanometer gets full scale deflection when a current of 0.01 *A* passes through the coil. When it is converted to a 10 *A* ammeter, the shunt resistance is

[Odisha JEE 2003]

(a) 0.01 Ω (b) 0.05 Ω

(c) 2000 Ω (d) 5000 Ω

119. Resistance in the two gaps of a *meter* bridge are 10 *ohm* and 30 *ohm* respectively. If the resistances are interchanged the balance point shifts by **[Odisha JEE 2003]**

(a) 33.3 *cm* (b) 66.67*cm*

(c) 25 *cm* (d) 50 *cm*

120. A potentiometer has uniform potential gradient. The specific resistance of the material of the potentiometer wire is 10^{-7} *ohm–meter* and the current passing through it is 0.1 *ampere*; cross-section of the wire is 10^{-6} m^2. The potential gradient along the potentiometer wire is **[KCET 2003]**

(a) 10^{-4} *V/m* (b) 10^{-6} *V/m*

(c) 10^{-2} *V/m* (d) 10^{-8} *V/m*

121. Two resistances of 400 Ω and 800 Ω are connected in series with 6 *volt* battery of negligible internal resistance. A voltmeter of resistance 10,000 Ω is used to measure the potential difference across 400 Ω. The error in the measurement of potential difference in *volt* approximately is

[EAMCET 2003; Similar DCE 2006]

(a) 0.01 (b) 0.02

(c) 0.03 (d) 0.05

122. A galvanometer, having a resistance of 50 Ω gives a full scale deflection for a current of 0.05 *A*. The length in *meter* of a resistance wire of area of cross-section 2.97× 10^{-2} cm^2 that can be used to convert the galvanometer into an ammeter which can read a maximum of 5 *A* current is (Specific resistance of the wire = 5 × 10^{-7} Ω*m*) **[EAMCET 2003]**

(a) 9 (b) 6

(c) 3 (d) 1.5

123. An ammeter reads upto 1 *ampere*. Its internal resistance is 0.81 *ohm*. To increase the range to 10 *A* the value of the required shunt is **[AIEEE 2003]**

(a) 0.09 Ω (b) 0.03 Ω

(c) 0.3 Ω (d) 0.9 Ω

124. The length of a wire of a potentiometer is 100 *cm*, and the *emf* of its standard cell is *E volt*. It is employed to measure the *e.m.f* of a battery whose internal resistance is 0.5 Ω. If the balance point is obtained at l = 30 *cm* from the positive end, the e.m.f. of the battery is **[AIEEE 2003]**

(a) $\frac{30E}{100}$ (b) $\frac{30E}{100.5}$

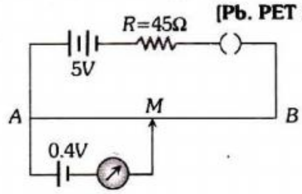
(c) $\frac{30E}{(100-0.5)}$ (d) $\frac{30(E-0.5i)}{100}$

Where *i* is the current in the potentiometer

125. Resistance of 100 *cm* long potentiometer wire is 10Ω, it is connected to a battery (2 *volt*) and a resistance *R* in series. A source of 10 *mV* gives null point at 40 *cm* length, then external resistance *R* is **[MP PMT 2003]**

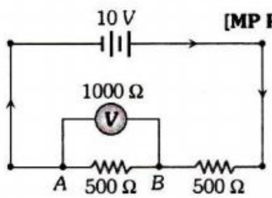
(a) 490 Ω (b) 790 Ω
(c) 590 Ω (d) 990 Ω

126. In given figure, the potentiometer wire *AB* has a resistance of 5 Ω and length 10 *m*. The balancing length *AM* for the emf of 0.4 *V* is **[Pb. PET 2001]**



(a) 0.4 *m*
(b) 4 *m*
(c) 0.8 *m*
(d) 8 *m*

127. What is the reading of voltmeter in the following figure **[MP PMT 2004]**



(a) 3 *V*
(b) 2 *V*
(c) 5 *V*
(d) 4 *V*

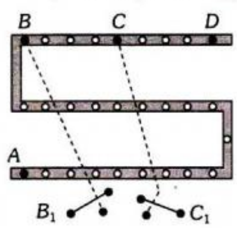
128. The current flowing in a coil of resistance 90 Ω is to be reduced by 90%. What value of resistance should be connected in parallel with it **[MP PMT 2004; Similar Roorkee 1992]**

(a) 9 Ω (b) 90 Ω
(c) 1000 Ω (d) 10 Ω

129. The maximum current that can be measured by a galvanometer of resistance 40 Ω is 10 *mA*. It is converted into a voltmeter that can read upto 50 *V*. The resistance to be connected in series with the galvanometer is ... (in *ohm*) **[KCET 2004]**

(a) 5040 (b) 4960
(c) 2010 (d) 4050

130. For the post office box arrangement to determine the value of unknown resistance the unknown resistance should be connected between **[IIT-JEE (Screening) 2004]**



(a) *B* and *C*
(b) *C* and *D*
(c) *A* and *D*
(d) B_1 and C_1

131. A galvanometer of 50 *ohm* resistance has 25 divisions. A current of 4×10^{-4} *ampere* gives a deflection of one division. To convert this galvanometer into a voltmeter having a range of 25 *volts*, it should be connected with a resistance of **[CBSE PMT 2004]**

(a) 2500 Ω as a shunt (b) 2450 Ω as a shunt
(c) 2550 Ω in series (d) 2450 Ω in series

132. In a metre bridge experiment null point is obtained at 20 *cm* from one end of the wire when resistance *X* is balanced against another resistance *Y*. If $X < Y$, then where will be the new position of the null point from the same end, if one decides to balance a resistance of 4*X* against *Y* **[AIEEE 2004]**

(a) 50 *cm* (b) 80 *cm*
(c) 40 *cm* (d) 70 *cm*

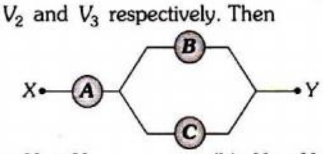
133. The potentiometer is superior to a voltmeter for measuring a potential difference because **[MP PET 2010]**

(a) The resistance of the voltmeter
(b) The potentiometer does not draw any current from the source of the potential
(c) The sensitivity of potentiometer is better than that of the voltmeter
(d) The voltmeter has a dial and of small size

134. The range of a voltmeter of resistance 500Ω is 10V. The resistance to be connected to convert it into an ammeter of range 10 *A* is **[MP PET 2010]**

(a) 1Ω in parallel (b) 1Ω in series
(c) 0.1Ω in parallel (d) 0.1Ω in series

135. Three voltmeters *A*, *B* and *C* having resistances *R*, 1.5*R* and 3*R* respectively are used in a circuit as shown. When a P.D. is applied between *X* and *Y*, the reading of the voltmeters are V_1, V_2 and V_3 respectively. Then **[KCET 2010]**



(a) $V_1 = V_2 = V_3$ (b) $V_1 < V_2 = V_3$
(c) $V_1 > V_2 > V_3$ (d) $V_1 > V_2 = V_3$

136. When the number of turns of the coil is doubled, the current sensitivity of a moving coil galvanometer is doubled whereas the voltage sensitivity of the galvanometer **[J & K CET 2010]**

(a) Remains the same (b) Is halved
(c) Is doubled (d) Is quadrupled

137. A galvanometer of resistance 100Ω is converted to a voltmeter of range 10 V by connecting a resistance of 10 kΩ. The resistance required to convert the same galvanometer to an ammeter of range 1 A is **[Kerala PET 2010]**

(a) 0.4Ω (b) 0.3Ω
(c) 1.2Ω (d) 0.2Ω
(e) 0.1Ω

138. A potentiometer circuit has been set up for finding the internal resistance of a given cell. The main battery, used across the potentiometer wire, has an emf of 2.0 *V* and a negligible internal resistance. The potentiometer wire itself is 4 *m* long. When the resistance, *R*, connected across the given cell, has values of **[CBSE PMT 2014]**

(i) Infinity
(ii) 9.5 Ω

the 'balancing lengths', on the potentiometer wire are found to be 3 m and 2.85 m, respectively. The value of internal resistance of the cell is

(a) 0.5 Ω (b) 0.75 Ω
(c) 0.25 Ω (d) 0.95 Ω

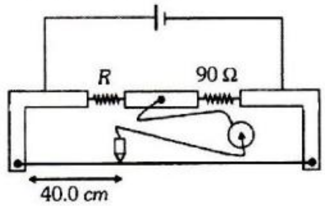
139. During experiment with a metre bridge, the galvanometer shows a null point when the jockey is pressed at 40.0 cm using a standard resistance of 90 Ω, as shown in the figure. The least count of the scale used in the meter bridge is 1mm. The unknown resistance is **[JEE (Advanced) 2014]**

(a) $60 \pm 0.15\Omega$

(b) $135 \pm 0.56\Omega$

(c) $60 \pm 0.25\Omega$

(d) $135 \pm 0.23\Omega$



Critical Thinking

1. In an electrical cable there is a single wire of radius 9 mm of copper. Its resistance is 5Ω. The cable is replaced by 6 different insulated copper wires, the radius of each wire is 3mm. Now the total resistance of the cable will be

[CPMT 1988; MP PMT 2006]

(a) 7.5 Ω (b) 45 Ω

(c) 90 Ω (d) 270 Ω

2. Three identical bulbs connected in series across an accumulator consumes 20 W power. If the bulbs are connected in parallel to the same source, the power consumed is **[Kerala PET 2012]**

(a) 20 W (b) 60 W

(c) 90 W (d) 120 W

(e) 180 W

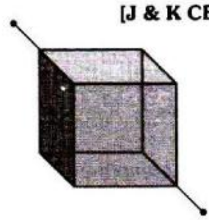
3. Twelve wires of equal length and same cross-section are connected in the form of a cube. If the resistance of each of the wires is R, then the effective resistance between the two diagonal ends would be **[J & K CET 2004]**

(a) $2R$

(b) $12R$

(c) $\frac{5}{6}R$

(d) $8R$



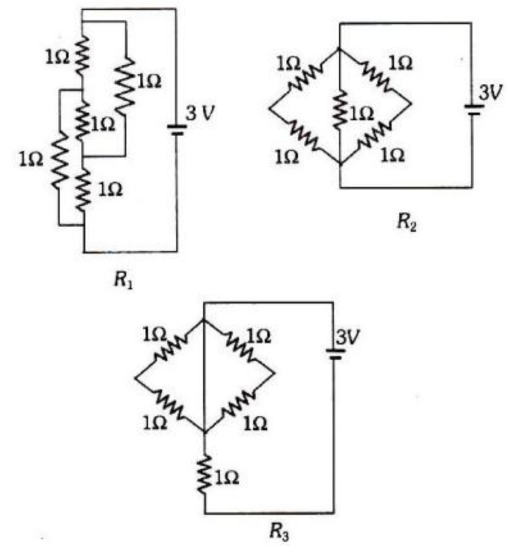
4. You are given several identical resistances each of value $R = 10\Omega$ and each capable of carrying maximum current of 1 ampere. It is required to make a suitable combination of these resistances to produce a resistance of 5Ω which can carry a current of 4 ampere. The minimum number of resistances of the type R that will be required for this job

[CBSE PMT 1990]

(a) 4 (b) 10

(c) 8 (d) 20

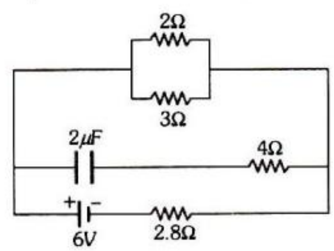
5. Figure shows three resistor configurations R_1, R_2 and R_3 connected to 3V battery. If the power dissipated by the configuration R_1, R_2 and R_3 is P_1, P_2 and P_3 respectively, then **[IIT-JEE 2008]**



(a) $P_1 > P_2 > P_3$ (b) $P_1 > P_3 > P_2$

(c) $P_2 > P_1 > P_3$ (d) $P_3 > P_2 > P_1$

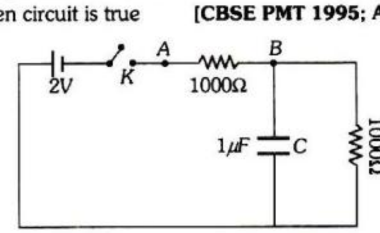
6. In the figure shown, the capacity of the condenser C is $2\mu F$. The current in 2Ω resistor is **[IIT 1982; AIIMS 2008]**



(a) 9 A (b) 0.9 A

(c) $\frac{1}{9}A$ (d) $\frac{1}{0.9}A$

7. When the key K is pressed at time $t = 0$, which of the following statements about the current I in the resistor AB of the given circuit is true **[CBSE PMT 1995; AIIMS 2008]**



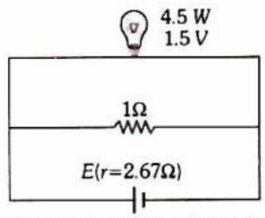
(a) $I = 2\ mA$ at all t

(b) I oscillates between 1 mA and 2mA

(c) $I = 1\ mA$ at all t

(d) At $t = 0$, $I = 2\ mA$ and with time it goes to 1 mA

8. A torch bulb rated as 4.5 *W*, 1.5 *V* is connected as shown in the figure. The *e.m.f.* of the cell needed to make the bulb glow at full intensity is **[MP PMT 1999]**



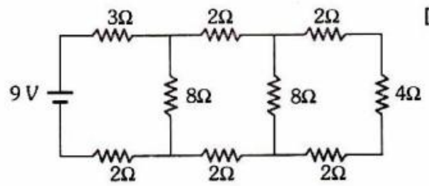
(a) 4.5 *V*

(b) 1.5 *V*

(c) 2.67 *V*

(d) 13.5 *V*

9. In the circuit shown in the figure, the current through **[IIT 1998]**



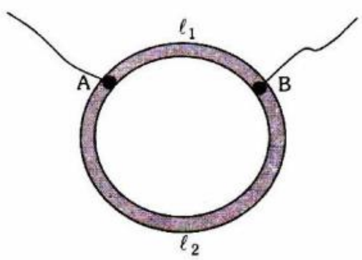
(a) The 3Ω resistor is 0.50 *A*

(b) The 3Ω resistor is 0.25 *A*

(c) The 4Ω resistor is 0.50 *A*

(d) The 4Ω resistor is 0.25 *A*

10. A ring is made of a wire having a resistance $R_0 = 12\Omega$. Find the points *A* and *B* as shown in the figure, at which a current carrying conductor should be connected so that the resistance *R* of the sub circuit between these points is equal to $\frac{8}{3}\Omega$. **[CBSE PMT (Pre.) 2012]**



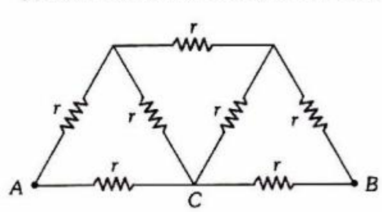
(a) $\frac{\ell_1}{\ell_2} = \frac{5}{8}$

(b) $\frac{\ell_1}{\ell_2} = \frac{1}{3}$

(c) $\frac{\ell_1}{\ell_2} = \frac{3}{8}$

(d) $\frac{\ell_1}{\ell_2} = \frac{1}{2}$

11. In the circuit shown, the value of each resistance is *r*, then equivalent resistance of circuit between points *A* and *B* will be **[Similar CBSE PMT 1999; RPET 1999]**



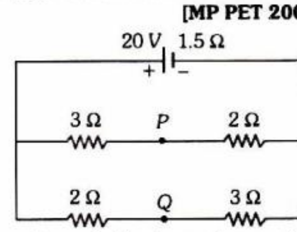
(a) (4/3) *r*

(b) $3r/2$

(c) $r/3$

(d) $8r/7$

12. If in the circuit shown below, the internal resistance of the battery is 1.5 Ω and V_P and V_Q are the potentials at *P* and *Q* respectively, what is the potential difference between the points *P* and *Q* **[MP PET 2000]**



(a) Zero

(b) 4 *volts* ($V_P > V_Q$)

(c) 4 *volts* ($V_Q > V_P$)

(d) 2.5 *volts* ($V_Q > V_P$)

13. Two wires of resistances R_1 and R_2 have temperature coefficient of resistances α_1 and α_2 respectively. These are joined in series. The effective temperature coefficient of resistance is **[MP PET 2003]**

(a) $\frac{\alpha_1 + \alpha_2}{2}$

(b) $\sqrt{\alpha_1 \alpha_2}$

(c) $\frac{\alpha_1 R_1 + \alpha_2 R_2}{R_1 + R_2}$

(d) $\frac{\sqrt{R_1 R_2 \alpha_1 \alpha_2}}{\sqrt{R_1^2 + R_2^2}}$

14. Two cells of equal *e.m.f.* and of internal resistances r_1 and $r_2 (r_1 > r_2)$ are connected in series. On connecting this combination to an external resistance *R*, it is observed that the potential difference across the first cell becomes zero. The value of *R* will be **[MP PET 1985; KCET 2005; Kerala PMT 2005; CBSE PMT 2006]**

(a) $r_1 + r_2$

(b) $r_1 - r_2$

(c) $\frac{r_1 + r_2}{2}$

(d) $\frac{r_1 - r_2}{2}$

15. When connected across the terminals of a cell, a voltmeter measures 5*V* and a connected ammeter measures 10 *A* of current. A resistance of 2 *ohm* is connected across the terminals of the cell. The current flowing through this resistance will be **[MP PMT 1997]**

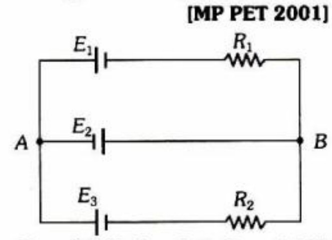
(a) 2.5 *A*

(b) 2.0 *A*

(c) 5.0 *A*

(d) 7.5 *A*

16. In the circuit shown here, $E_1 = E_2 = E_3 = 2$ *V* and $R_1 = R_2 = 4$ *ohm*. The current flowing between points *A* and *B* through battery E_2 is **[MP PET 2001]**



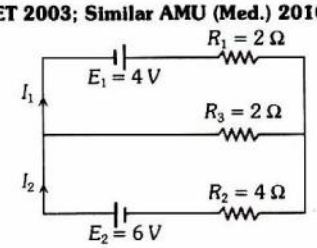
(a) Zero

(b) 2 *amp* from *A* to *B*

(c) 2 *amp* from *B* to *A*

(d) None of the above

17. In the circuit shown below $E_1 = 4.0$ *V*, $R_1 = 2\ \Omega$, $E_2 = 6.0$ *V*, $R_2 = 4\ \Omega$ and $R_3 = 2\ \Omega$. The current I_1 is **[MP PET 2003; Similar AMU (Med.) 2010]**



(a) 1.6 *A*

(b) 1.8 *A*

(c) 1.25 *A*

(d) 1.0 *A*

18. Two resistors of resistances 200 $k\Omega$ and $1M\Omega$ respectively form a potential divider with outer junctions maintained at potentials of $+3V$ and $-15V$. Then, the potential at the junction between the resistors is **[Kerala PET 2010]**

(a) +1 V (b) –0.6 V

(c) 0 V (d) –12 V

(e) +12 V

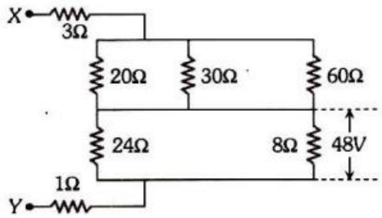
19. The potential difference across 8 *ohm* resistance is 48 *volt* as shown in the figure. The value of potential difference across X and Y points will be **[MP PET 1996]**

(a) 160 *volt*

(b) 128 *volt*

(c) 80 *volt*

(d) 62 *volt*



20. Two resistances R_1 and R_2 are made of different materials. The temperature coefficient of the material of R_1 is α and of the material of R_2 is $-\beta$. The resistance of the series combination of R_1 and R_2 will not change with temperature, if R_1 / R_2 equals **[MP PMT 1997]**

(a) $\frac{\alpha}{\beta}$ (b) $\frac{\alpha+\beta}{\alpha-\beta}$

(c) $\frac{\alpha^2+\beta^2}{\alpha\beta}$ (d) $\frac{\beta}{\alpha}$

21. An ionization chamber with parallel conducting plates as anode and cathode has 5×10^7 electrons and the same number of singly-charged positive ions per cm^3. The electrons are moving at 0.4 *m/s*. The current density from anode to cathode is 4 $\mu A/m^2$. The velocity of positive ions moving towards cathode is **[CBSE PMT 1992]**

(a) 0.4 *m/s* (b) 16 *m/s*

(c) Zero (d) 0.1 *m/s*

22. A wire of resistance 10 Ω is bent to form a circle. *P* and *Q* are points on the circumference of the circle dividing it into a quadrant and are connected to a battery of 3 *V* and internal resistance 1 Ω as shown in the figure. The currents in the two parts of the circle are

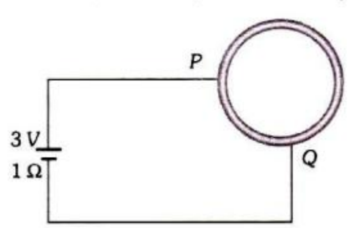
[Roorkee 1999; Similar KCET 2008]

(a) $\frac{6}{23}A$ and $\frac{18}{23}A$

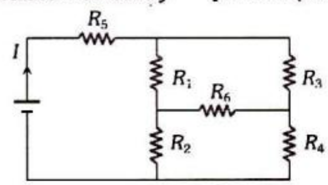
(b) $\frac{5}{26}A$ and $\frac{15}{26}A$

(c) $\frac{4}{25}A$ and $\frac{12}{25}A$

(d) $\frac{3}{25}A$ and $\frac{9}{25}A$



23. In the given circuit, it is observed that the current *I* is independent of the value of the resistance R_6. Then the resistance values must satisfy **[IIT-JEE (Screening) 2001]**



(a) $R_1R_2R_5 = R_3R_4R_6$

(b) $\frac{1}{R_5}+\frac{1}{R_6} = \frac{1}{R_1+R_2}+\frac{1}{R_3+R_4}$

(c) $R_1R_4 = R_2R_3$

(d) $R_1R_3 = R_2R_4 = R_5R_6$

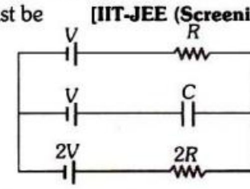
24. In the given circuit, with steady current, the potential drop across the capacitor must be **[IIT-JEE (Screening) 2001]**

(a) V

(b) $V/2$

(c) $V/3$

(d) $2V/3$



25. A wire of length *L* and 3 identical cells of negligible internal resistances are connected in series. Due to current, the temperature of the wire is raised by ΔT in time *t*. A number *N* of similar cells is now connected in series with a wire of the same material and cross–section but of length 2 *L*. The temperature of the wire is raised by the same amount ΔT in the same time *t*. The value of *N* is

[IIT-JEE (Screening) 2001]

(a) 4 (b) 6

(c) 8 (d) 9

26. What is the equivalent resistance between the points *A* and *B* of the network

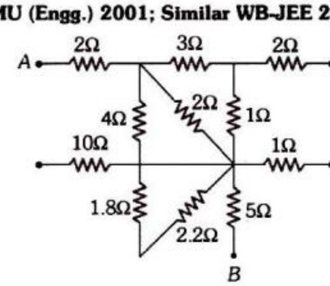
[AMU (Engg.) 2001; Similar WB-JEE 2013]

(a) $\frac{57}{7}\Omega$

(b) 8 Ω

(c) 6 Ω

(d) $\frac{57}{5}\Omega$



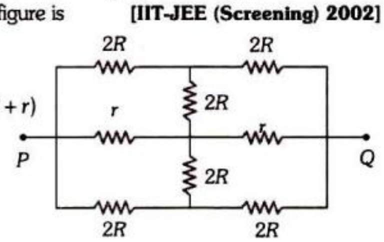
27. The effective resistance between points *P* and *Q* of the electrical circuit shown in the figure is **[IIT-JEE (Screening) 2002]**

(a) $2Rr/(R+r)$

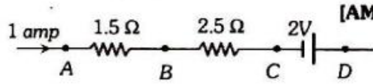
(b) $8R(R+r)/(3R+r)$

(c) $2r+4R$

(d) $5R/2+2r$



28. In the circuit element given here, if the potential at point B, $V_B = 0$, then the potentials of A and D are given as **[AMU (Med.) 2002]**



(a) $V_A = -1.5V, V_D = +2V$ (b) $V_A = +1.5V, V_D = +2V$

(c) $V_A = +1.5V, V_D = +0.5V$ (d) $V_A = +1.5V, V_D = -0.5V$

29. The equivalent resistance between the points P and Q in the network given here is equal to (given $r = \frac{3}{2}\Omega$)

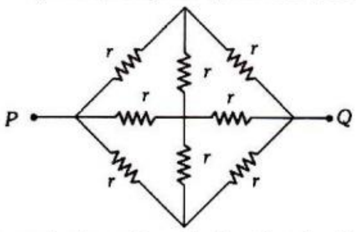
[AMU (Med.) 2002; Similar KCET 2008]

(a) $\frac{1}{2}\Omega$

(b) 1Ω

(c) $\frac{3}{2}\Omega$

(d) 2Ω



30. The current in a conductor varies with time t as $I = 2t + 3t^2$ where I is in *ampere* and t in *seconds*. Electric charge flowing through a section of the conductor during $t = 2$ *sec* to $t = 3$ *sec* is **[Odisha JEE 2003]**

(a) 10 *C* (b) 24 *C*

(c) 33 *C* (d) 44 *C*

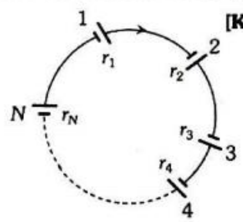
31. A group of N cells whose *emf* varies directly with the internal resistance as per the equation $E_N = 1.5\, r_N$ are connected as shown in the figure below. The current I in the circuit is **[KCET 2003]**

(a) 0.51 *amp*

(b) 5.1 *amp*

(c) 0.15 *amp*

(d) 1.5 *amp*



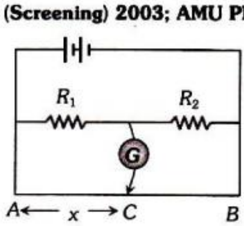
32. In the shown arrangement of the experiment of the meter bridge if AC corresponding to null deflection of galvanometer is x, what would be its value if the radius of the wire AB is doubled **[IIT-JEE (Screening) 2003; AMU PMT 2009]**

(a) x

(b) x/4

(c) 4x

(d) 2x



33. If voltage across a bulb rated 220 Volt – 100 Watt drops by 2.5% of its rated value, the percentage of the rated value by which the power would decrease is **[CBSE PMT (Pre.) 2012]**

(a) 20 % (b) 2.5 %

(c) 5 % (d) 10 %

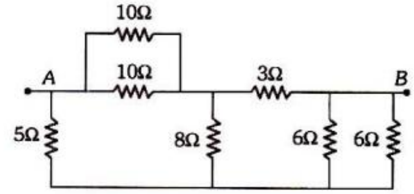
34. Seven resistances are connected as shown in the figure. The equivalent resistance between A and B is **[MP PET 2000]**

(a) 3Ω

(b) 4Ω

(c) 4.5Ω

(d) 5Ω



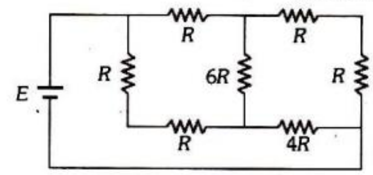
35. A battery of internal resistance 4Ω is connected to the network of resistances as shown. In order to give the maximum power to the network, the value of R (in Ω) should be **[IIT 1995]**

(a) 4/9

(b) 8/9

(c) 2

(d) 18



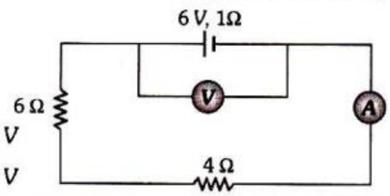
36. In the circuit shown here, the readings of the ammeter and voltmeter are **[Kerala PMT 2002]**

(a) 6 *A*, 60 *V*

(b) 0.6 *A*, 6 *V*

(c) 6/11 *A*, 60/11 *V*

(d) 11/6 *A*, 11/60 *V*



37. Length of a hollow tube is 5*m*, it's outer diameter is 10 *cm* and thickness of it's wall is 5 *mm*. If resistivity of the material of the tube is $1.7 \times 10^{-8}\ \Omega \times m$ then resistance of tube will be

[Similar AMU PMT 2009]

(a) $5.6 \times 10^{-5}\ \Omega$ (b) $2 \times 10^{-5}\ \Omega$

(c) $4 \times 10^{-5}\ \Omega$ (d) None of these

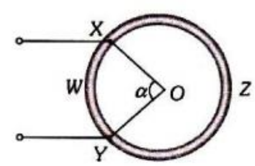
38. A wire of resistor R is bent into a circular ring of radius r. Equivalent resistance between two points X and Y on its circumference, when angle XOY is α, can be given by

(a) $\frac{R\alpha}{4\pi^2}(2\pi - \alpha)$

(b) $\frac{R}{2\pi}(2\pi - \alpha)$

(c) $R\,(2\pi - \alpha)$

(d) $\frac{4\pi}{R\alpha}(2\pi - \alpha)$



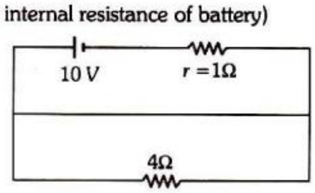
39. Potential difference across the terminals of the battery shown in figure is (r = internal resistance of battery)

(a) 8 *V*

(b) 10 *V*

(c) 6 *V*

(d) Zero

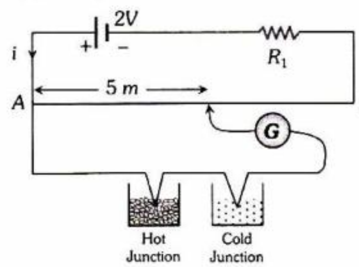


40. Two conductors have the same resistance at 0°C but their temperature coefficients of resistance are α_1 and α_2. The respective temperature coefficients of their series and parallel combinations are nearly **[AIEEE 2010]**

(a) $\frac{\alpha_1+\alpha_2}{2}, \frac{\alpha_1+\alpha_2}{2}$ (b) $\frac{\alpha_1+\alpha_2}{2}, \alpha_1+\alpha_2$

(c) $\alpha_1+\alpha_2, \frac{\alpha_1+\alpha_2}{2}$ (d) $\alpha_1+\alpha_2, \frac{\alpha_1\alpha_2}{\alpha_1+\alpha_2}$

41. In the following circuit a 10 m long potentiometer wire with resistance 1.2 ohm/m, a resistance R_1 and an accumulator of emf 2 V are connected in series. When the emf of thermocouple is 2.4 mV then the deflection in galvanometer is zero. The current supplied by the accumulator will be



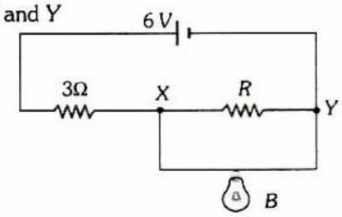
(a) $4\times10^{-4}\,A$

(b) $8\times10^{-4}\,A$

(c) $4\times10^{-3}\,A$

(d) $8\times10^{-3}\,A$

42. In the following circuit, bulb rated as 1.5 V, 0.45 W. If bulbs glows with full intensity then what will be the equivalent resistance between X and Y



(a) 0.45 Ω

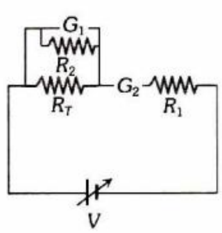
(b) 1 Ω

(c) 3 Ω

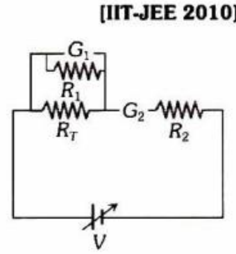
(d) 5 Ω

43. To verify ohm's law, a student is provided with a test resistor R_T, a high resistance R_1, a small resistance R_2, two identical galvanometers G_1 and G_2, and a variable voltage source V. The correct circuit to carry out the experiment is **[IIT-JEE 2010]**

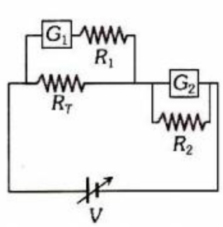
(a)



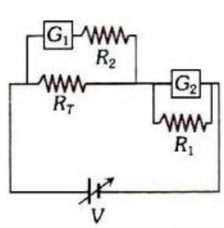
(b)



(c)



(d)



44. In order to quadruple the resistance of a uniform wire, a part of its length was uniformly stretched till the final length of the entire wire was 1.5 times the original length, the part of the wire was fraction equal to

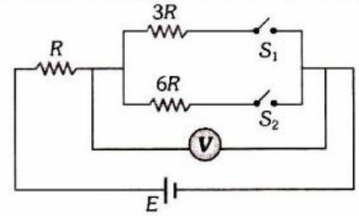
(a) 1 / 8

(b) 1 / 6

(c) 1 / 10

(d) 1 / 4

45. In the circuit shown in figure reading of voltmeter is V_1 when only S_1 is closed, reading of voltmeter is V_2 when only S_2 is closed and reading of voltmeter is V_3 when both S_1 and S_2 are closed. Then



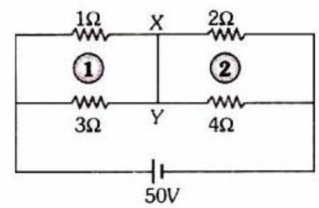
(a) $V_3 > V_2 > V_1$

(b) $V_2 > V_1 > V_3$

(c) $V_3 > V_1 > V_2$

(d) $V_1 > V_2 > V_3$

46. Current through wire XY of circuit shown is



(a) 1 A

(b) 4 A

(c) 2 A

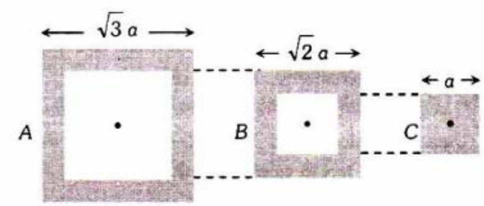
(d) 3 A

47. 12 cells each having same emf are connected in series with some cells wrongly connected. The arrangement is connected in series with an ammeter and two cells which are in series. Current is 3 A when cells and battery aid each other and is 2 A when cells and battery oppose each other. The number of cells wrongly connected is

(a) 4 (b) 1

(c) 3 (d) 2

48. Following figure shows cross-sections through three long conductors of the same length and material, with square cross-section of edge lengths as shown. Conductor B will fit snugly within conductor A, and conductor C will fit snugly within conductor B. Relationship between their end to end resistance is



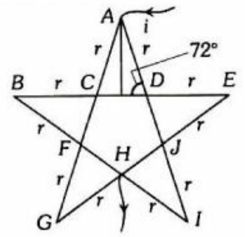
(a) $R_A = R_B = R_C$

(b) $R_A > R_B > R_C$

(c) $R_A < R_B < R_C$

(d) Information is not sufficient

49. In the following star circuit diagram (figure), the equivalent resistance between the points A and H will be



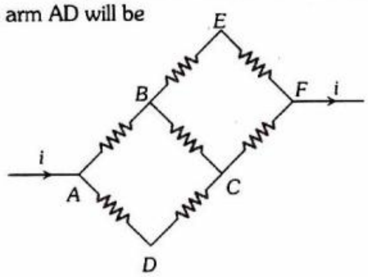
(a) $1.944\ r$

(b) $0.973\ r$

(c) $0.486\ r$

(d) $0.243\ r$

50. In the adjoining circuit diagram each resistance is of 10 Ω. The current in the arm AD will be



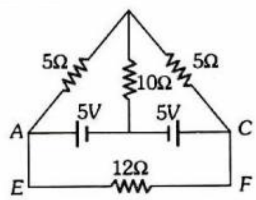
(a) $\frac{2i}{5}$

(b) $\frac{3i}{5}$

(c) $\frac{4i}{5}$

(d) $\frac{i}{5}$

51. In the circuit of adjoining figure the current through 12 Ω resister will be



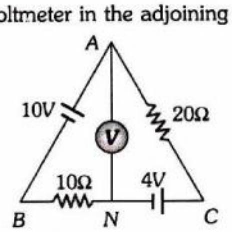
(a) $1\ A$

(b) $\frac{1}{5}A$

(c) $\frac{2}{5}A$

(d) $0\ A$

52. The reading of the ideal voltmeter in the adjoining diagram will be



(a) 4 V

(b) 8 V

(c) 12 V

(d) 14 V

53. The resistance of the series combination of two resistances is S. When they are joined in parallel the total resistance is P. If $S = nP$, then the minimum possible value of n is **[AIEEE 2004]**

(a) 4 (b) 3

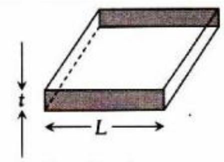
(c) 2 (d) 1

54. A moving coil galvanometer has 150 equal divisions. Its current sensitivity is 10 *divisions per milliampere* and voltage sensitivity is 2 *divisions per millivolt*. In order that each division reads 1 *volt*, the resistance in ohms needed to be connected in series with the coil will be **[AIEEE 2005]**

(a) 99995 (b) 9995

(c) 10^3 (d) 10^5

55. Consider a thin square sheet of side L and thickness t, made of a material of resistivity ρ. The resistance between two opposite faces, shown by the shaded areas in the figure is **[IIT-JEE 2010]**



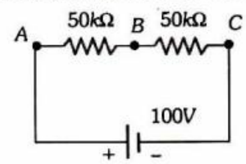
(a) Directly proportional to L

(b) Directly proportional to t

(c) Independent of L

(d) Independent of t

56. In the adjacent shown circuit, a voltmeter of internal resistance R, when connected across B and C reads $\frac{100}{3}V$. Neglecting the internal resistance of the battery, the value of R is **[EAMCET 2009; Similar KCET 2005]**



(a) 100 kΩ

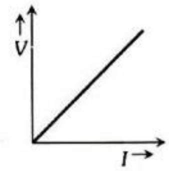
(b) 75 kΩ

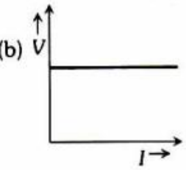
(c) 50 kΩ

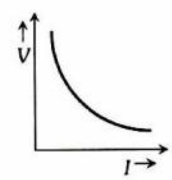
(d) 25 kΩ

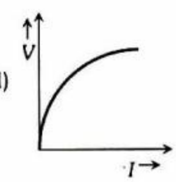
Graphical Questions

1. Which of the adjoining graphs represents *ohmic* resistance **[CPMT 1981; DPMT 2002]**

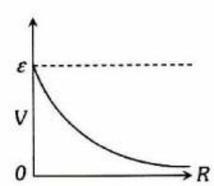
(a) 

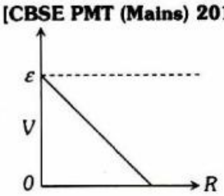
(b) 

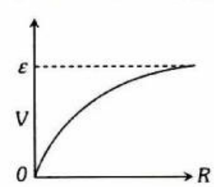
(c) 

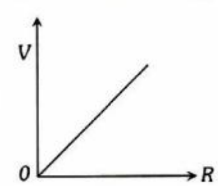
(d) 

2. Cell having an *emf* ε and internal resistance r is connected across a variable external resistance R. As the resistance R is increased, the plot of potential difference V across R is given by **[CBSE PMT (Mains) 2012]**

(a) 

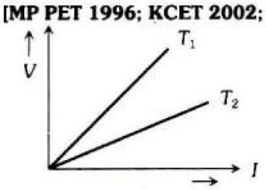
(b) 

(c) 

(d) 

3. The voltage V and current I graph for a conductor at two different temperatures T_1 and T_2 are shown in the figure. The relation between T_1 and T_2 is

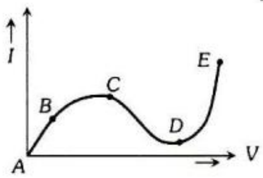
[MP PET 1996; KCET 2002; Similar WB-JEE 2012]



(a) $T_1 > T_2$ (b) $T_1 \approx T_2$

(c) $T_1 = T_2$ (d) $T_1 < T_2$

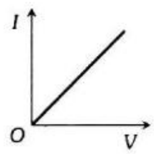
4. From the graph between current I and voltage V shown below, identify the portion corresponding to negative resistance **[CBSE PMT 1997]**



(a) AB (b) BC

(c) CD (d) DE

5. I-V characteristic of a copper wire of length L and area of cross-section A is shown in figure. The slope of the curve becomes **[Odisha JEE 2003]**



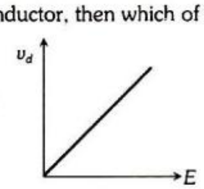
(a) More if the experiment is performed at higher temperature

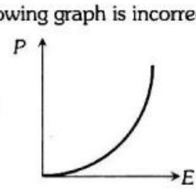
(b) More if a wire of steel of same dimension is used

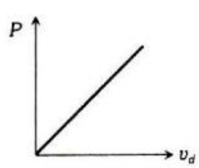
(c) More if the length of the wire is increased

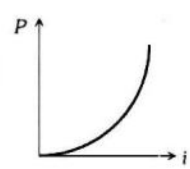
(d) Less if the length of the wire is increased

6. E denotes electric field in a uniform conductor, I corresponding current through it, v_d drift velocity of electrons and P denotes thermal power produced in the conductor, then which of the following graph is incorrect

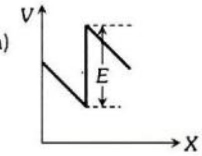
(a)


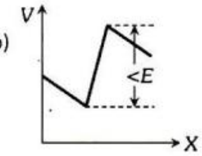
(b)


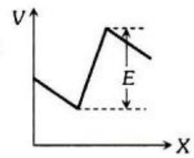
(c)


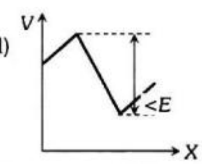
(d)


7. The two ends of a uniform conductor are joined to a cell of e.m.f. E and some internal resistance. Starting from the midpoint P of the conductor, we move in the direction of current and return to P. The potential V at every point on the path is plotted against the distance covered (x). Which of the following graphs best represents the resulting curve

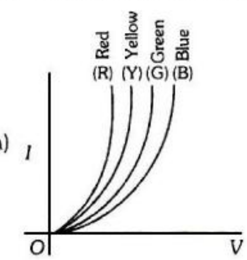
(a)


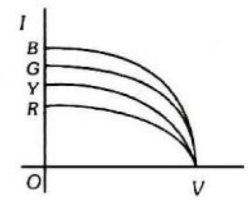
(b)


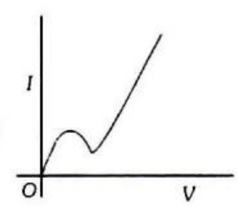
(c)


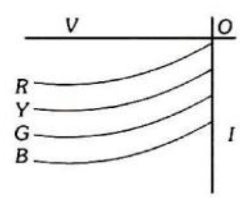
(d)


8. The $I-V$ characteristic of an LED is **[JEE (Mains) 2013]**

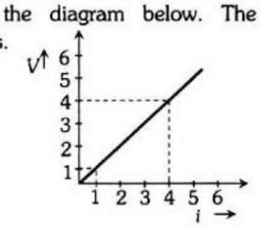
(a)


(b)


(c)


(d)


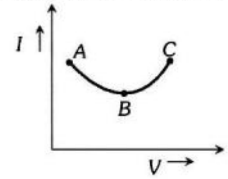
9. Variation of current and voltage in a conductor has been shown in the diagram below. The resistance of the conductor is.



(a) 4 *ohm* (b) 2 *ohm*

(c) 3 *ohm* (d) 1 *ohm*

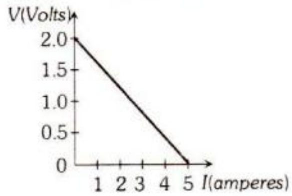
10. Resistance as shown in figure is negative at **[CPMT 1997]**



(a) A (b) B

(c) C (d) None of these

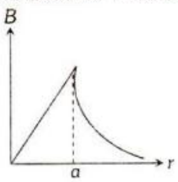
11. For a cell, the graph between the potential difference (V) across the terminals of the cell and the current (I) drawn from the cell is shown in the figure. The e.m.f. and the internal resistance of the cell are

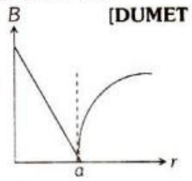


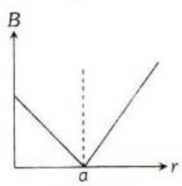
(a) $2V, 0.5\Omega$ (b) $2V, 0.4\Omega$

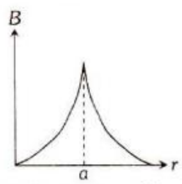
(c) $> 2V, 0.5\Omega$ (d) $> 2V, 0.4\Omega$

12. A long straight wire of a circular cross section (radius a) carries a steady current I and the current I is uniformly distributed across this cross-section. Which of the following plots represents the variation of magnitude of magnetic field B with distance r from the centre of the wire **[DUMET 2009]**

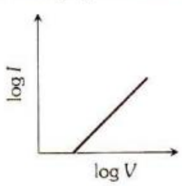
(a) 

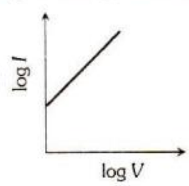
(b) 

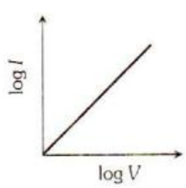
(c) 

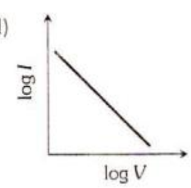
(d) 

13. When a current I is passed through a wire of constant resistance, it produces a potential difference V across its ends. The graph drawn between log I and log V will be

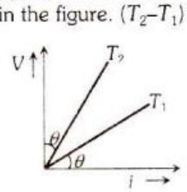
(a) 

(b) 

(c) 

(d) 

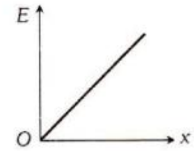
14. The V-i graph for a conductor at temperatures T_1 and T_2 are as shown in the figure. $(T_2 - T_1)$ is proportional to

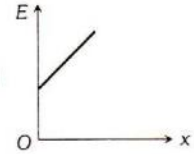


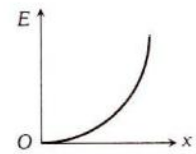
(a) $\cos 2\theta$ (b) $\sin\theta$

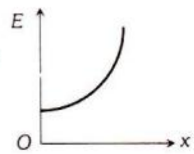
(c) $\cot 2\theta$ (d) $\tan\theta$

15. A cylindrical conductor has uniform cross-section. Resistivity of its material increases linearly from left end to right end. If a constant current is flowing through it and at a section distance x from left end, magnitude of electric field intensity is E, which of the following graphs is correct

(a) 

(b) 

(c) 

(d) 

16. The V-i graph for a conductor makes an angle θ with V-axis. Here V denotes the voltage and i denotes current. The resistance of conductor is given by

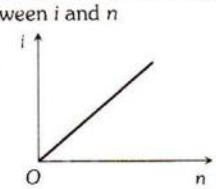
(a) $\sin\theta$

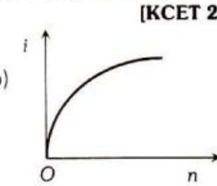
(b) $\cos\theta$

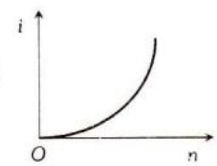
(c) $\tan\theta$

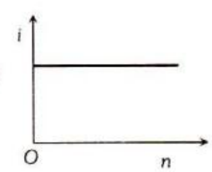
(d) $\cot\theta$

17. A battery consists of a variable number 'n' of identical cells having internal resistances connected in series. The terminals of battery are short circuited and the current i is measured. Which of the graph below shows the relationship between i and n **[KCET 2006]**

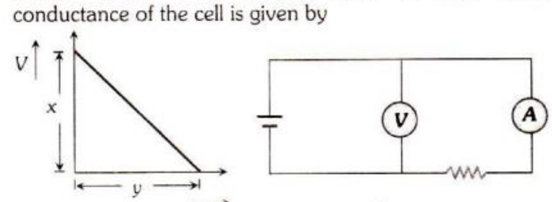
(a) 

(b) 

(c) 

(d) 

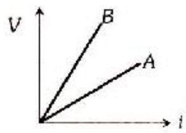
18. In an experiment, a graph was plotted of the potential difference V between the terminals of a cell against the circuit current i by varying load rheostat. Internal conductance of the cell is given by



(a) xy (b) $\frac{y}{x}$

(c) $\frac{x}{y}$ (d) $(x - y)$

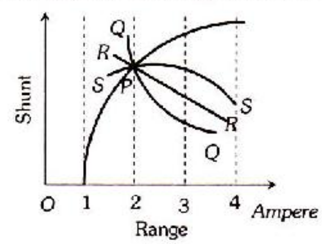
19. *V-i* graphs for parallel and series combination of two identical resistors are as shown in figure. Which graph represents parallel combination



(a) *A* (b) *B*

(c) *A* and *B* both (d) Neither *A* nor *B*

20. The ammeter has range 1 *ampere* without shunt. The range can be varied by using different shunt resistances. The graph between shunt resistance and range will have the nature



(a) *P* (b) *Q*

(c) *R* (d) *S*

A Answers

Electric Conduction, Ohm's Law and Resistance

1	b	2	c	3	c	4	e	5	a
6	d	7	a	8	a	9	d	10	c
11	d	12	d	13	a	14	d	15	a
16	c	17	c	18	a	19	c	20	b
21	d	22	b	23	b	24	b	25	d
26	c	27	c	28	b	29	b	30	d
31	a	32	b	33	b	34	d	35	b
36	b	37	b	38	c	39	a	40	d
41	b	42	a	43	a	44	e	45	a
46	a	47	b	48	b	49	c	50	a
51	c	52	a	53	c	54	b	55	b
56	b	57	a	58	c	59	c	60	d
61	a	62	b	63	b	64	c	65	c
66	d	67	a	68	b	69	d	70	a
71	a	72	a	73	d	74	b	75	a
76	c	77	c	78	a	79	d	80	b
81	a	82	d	83	a	84	b	85	c
86	b	87	c	88	a	89	d	90	d
91	a	92	c	93	b	94	d	95	b
96	b	97	c	98	a	99	c	100	d
101	c	102	a	103	c	104	b	105	b
106	d	107	d	108	c	109	d	110	d
111	d	112	d	113	a	114	a	115	c
116	b	117	a	118	b	119	c	120	d
121	c	122	a	123	a	124	b	125	b

Grouping of Resistances

1	a	2	d	3	a	4	a	5	c
6	b	7	c	8	b	9	a	10	b
11	b	12	c	13	b	14	d	15	b
16	c	17	d	18	e	19	d	20	d
21	d	22	a	23	b	24	b	25	d
26	b	27	d	28	d	29	c	30	c
31	b	32	d	33	a	34	b	35	c
36	b	37	a	38	b	39	c	40	a
41	a	42	c	43	a	44	d	45	a
46	d	47	c	48	b	49	b	50	d
51	d	52	c	53	d	54	a	55	c
56	c	57	c	58	c	59	d	60	c
61	d	62	c	63	c	64	c	65	c
66	c	67	b	68	c	69	d	70	b
71	a	72	c	73	a	74	b	75	a
76	c	77	c	78	b	79	c	80	a
81	b	82	b	83	b	84	d	85	d
86	a	87	a	88	a	89	a	90	b
91	b	92	c	93	b	94	d	95	a
96	d	97	b	98	b	99	d	100	b
101	c	102	a	103	b	104	d	105	a
106	c	107	b	108	d	109	bc	110	b
111	d	112	b	113	a	114	a	115	d
116	a	117	b	118	b	119	a	120	c
121	b	122	b	123	b	124	c	125	b
126	a								

Kirchhoff's Law, Cells

1	b	2	c	3	d	4	a	5	b
6	b	7	a	8	a	9	b	10	a
11	a	12	c	13	b	14	d	15	b
16	b	17	c	18	c	19	d	20	c
21	c	22	c	23	b	24	c	25	a
26	a	27	b	28	b	29	a	30	d
31	d	32	a	33	b	34	b	35	a
36	b	37	a	38	b	39	b	40	d
41	d	42	d	43	d	44	d	45	c
46	c	47	b	48	a	49	a	50	d
51	a	52	d	53	b	54	c	55	a
56	b	57	c	58	a	59	d	60	b
61	c	62	c	63	c	64	b	65	a
66	c	67	a	68	a	69	c	70	a
71	a	72	d	73	c	74	b	75	b
76	b	77	c	78	c	79	d	80	d
81	a	82	d	83	b	84	d	85	c
86	b	87	c	88	d				

Different Measuring Instruments

1	a	2	c	3	d	4	c	5	c
6	a	7	e	8	b	9	c	10	c
11	d	12	c	13	d	14	a	15	a
16	c	17	a	18	d	19	c	20	a
21	b	22	c	23	a	24	b	25	c
26	c	27	d	28	c	29	b	30	c
31	d	32	b	33	c	34	b	35	c
36	c	37	b	38	c	39	d	40	b
41	a	42	b	43	c	44	b	45	c
46	b	47	c	48	a	49	b	50	b
51	b	52	c	53	d	54	b	55	a
56	a	57	d	58	c	59	c	60	d
61	c	62	a	63	d	64	a	65	d
66	b	67	a	68	c	69	c	70	a
71	a	72	a	73	a	74	b	75	a
76	d	77	d	78	a	79	b	80	a
81	c	82	c	83	a	84	a	85	b
86	d	87	c	88	d	89	c	90	a
91	d	92	d	93	d	94	c	95	d
96	a	97	c	98	a	99	d	100	d
101	c	102	d	103	c	104	c	105	a
106	c	107	c	108	d	109	c	110	a
111	a	112	a	113	c	114	b	115	a
116	d	117	a	118	b	119	d	120	c
121	d	122	c	123	a	124	a	125	b
126	d	127	d	128	d	129	b	130	c
131	d	132	a	133	b	134	a	135	a
136	a	137	e	138	a	139	c		

Critical Thinking Questions

1	a	2	e	3	c	4	c	5	c
6	b	7	d	8	d	9	d	10	d
11	d	12	d	13	c	14	b	15	b
16	b	17	b	18	c	19	a	20	d
21	d	22	a	23	c	24	c	25	b
26	b	27	a	28	d	29	b	30	b
31	d	32	a	33	c	34	b	35	c
36	c	37	a	38	a	39	d	40	a
41	a	42	b	43	c	44	a	45	b
46	c	47	b	48	a	49	b	50	a
51	d	52	b	53	a	54	b	55	c
56	c								

Graphical Questions

1	a	2	c	3	a	4	c	5	d
6	c	7	b	8	a	9	d	10	a
11	b	12	a	13	a	14	c	15	b
16	d	17	d	18	b	19	a	20	b

4. (e) According to Ohm's law, $V \propto I$ or $V = RI$

where the constant of proportionality R is called the resistance of the conductor.

From the above relation it is clear that Ohm's law is valid if V depends on I linearly.

5. (a) $I = \frac{dq}{dt} = 3t^2 + 2t + 5$

$\therefore\ dq = (3t^2 + 2t + 5)dt$

$\therefore\ q = \int_{t=0}^{t=2} (3t^2 + 2t + 5)dt$

$= \frac{3t^3}{3} + \frac{2t^2}{2} + 5t\Big|_0^2 = t^3 + t^2 + 5t\Big|_0^2 = 22\,C.$

6. (d) Here, $R_{20} = 20\,\Omega, R_{500} = 60\,\Omega, R_t = 25\,\Omega$

$R_t = R_0(1 + \alpha t)$,

where α is the temperature coefficient of resistance

$\therefore\ R_{20} = R_0(1 + \alpha \times 20)$

$\Rightarrow 20 = R_0(1 + \alpha \times 20)$ ....(i)

$R_{500} = R_0(1 + \alpha \times 500)$

$\Rightarrow 60 = R_0(1 + \alpha \times 500)$ ....(ii)

Divide (ii) by (i), we get

$\frac{60}{20} = \frac{1 + \alpha \times 500}{1 + \alpha \times 20}$ or $3 + 60\alpha = 1 + 500\alpha$

$\Rightarrow\ \alpha = \frac{2}{440} = \frac{1}{220}\,°C^{-1}$

Again, $R_{20} = R_0(1 + \alpha \times 20)$

$\Rightarrow 20 = R_0\left(1 + \frac{1}{220} \times 20\right)$ ....(iii)

$R_t = R_0(1 + \alpha t)$

or $25 = R_0\left(1 + \frac{1}{220} \times t\right)$ ....(iv)

Divide (iv) by (iii), we get

$\frac{25}{20} = \frac{\left(1 + \frac{1}{220} \times t\right)}{\left(1 + \frac{1}{220} \times 20\right)} \Rightarrow 4 + \frac{4t}{220} = 5 + \frac{100}{220}$

$\Rightarrow \frac{4t}{220} = 1 + \frac{5}{11} = \frac{16}{11} \Rightarrow t = \frac{16}{11} \times \frac{220}{4} = 80°C.$

7. (a) $R = \frac{\rho l}{A} = 50 \times 10^{-8} \times \frac{50 \times 10^{-2}}{(50 \times 10^{-2})^2} = 10^{-6}\,\Omega$

8. (a) Resistivity of a material is its intrinsic property and is constant at particular temperature. Resistivity does not depend upon shape.

9. (d) $\frac{R_1}{R_2} = \frac{(1 + \alpha t_1)}{(1 + \alpha t_2)} \Rightarrow \frac{1}{2} = \frac{(1 + 0.00125 \times 27)}{(1 + 0.00125 \times t)}$

$\Rightarrow t = 854°C \Rightarrow T = 1127K$

11. (d) In case of stretching of wire $R \propto l^2$

$\Rightarrow$ If length becomes 3 times so Resistance becomes 9 times *i.e.* $R' = 9 \times 20 = 180\,\Omega$

12. (d) Resistivity is the property of the material. It does not depend upon size and shape.

13. (a) Because with rise in temperature resistance of conductor increases, so graph between V and i becomes non linear.

14. (d) In Stretching of wire $R \propto l^2 \Rightarrow \frac{R_1}{R_2} = \left(\frac{l_1}{l_2}\right)^2$

If $l_1 = 100$, then $l_2 = 110 \Rightarrow \frac{R_1}{R_2} = \left(\frac{100}{110}\right)^2$

$\Rightarrow R_2 = 1.21\,R_1$

Resistivity doesn't change with stretching.

15. (a) $v_d = \frac{e}{m} \times \frac{V}{l}\tau$ or $v_d = \frac{e}{m} \cdot \frac{El}{l}\tau$ $[\because V = El]$

$\therefore v_d \propto E$

17. (c) $v_d = \frac{i}{neA}$ and $v_d' = \frac{E}{\rho \times 2l \times n \times e}$

$= \frac{E}{R \times neA} \Rightarrow \frac{E \times A}{\rho \times l \times n \times e \times A} \Rightarrow \frac{E}{\rho \times l \times n \times e}$

$\Rightarrow \frac{v_d'}{v_d} = \frac{1}{2} \Rightarrow v_d' = \frac{v_d}{2}$

18. (a) Current, $I = \frac{q}{t} = \frac{3000C}{10 \times 60s} = 5A$

19. (c) $i = \frac{ne}{t} = \frac{62.5 \times 10^{18} \times 1.6 \times 10^{-19}}{1} = 10\,ampere$

20. (b) Let the number of electrons $= N$

$I = 4 - 0.08t \Rightarrow \frac{dQ}{dt} = 4 - 0.08t$

$\Rightarrow Q = \int_0^{50} (4 - 0.08t)dt$

$\Rightarrow Ne = \left[4t - \frac{0.08t^2}{2}\right]_0^{50} = 100C$

$\Rightarrow N = \frac{100}{e} = \frac{100}{1.6 \times 10^{-19}} = 6.25 \times 10^{20}$.

21. (d) In stretching of wire $R \propto \frac{1}{d^4}$, where d = Diameter of wire.

22. (b) $R = \frac{\rho L}{A} \Rightarrow 0.7 = \frac{\rho \times 1}{\frac{22}{7}(1 \times 10^{-3})^2}$

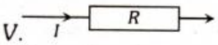
$\rho = 2.2 \times 10^{-6}\,ohm\text{-}m.$

23. (b) $R \propto \frac{1}{A} \Rightarrow R \propto \frac{1}{r^2} \propto \frac{1}{d^2}$ [d = diameter of wire]

24. (b) $i = q\nu = 1.6 \times 10^{-19} \times 6.6 \times 10^{15} = 10.56 \times 10^{-4}A = 1mA$

25. (d) $R \propto \frac{l}{r^2} \Rightarrow \frac{R_1}{R_2} = \frac{l_1}{l_2} \times \frac{r_2^2}{r_1^2} \Rightarrow \frac{1}{1} = \frac{5}{l_2} \times \left(\frac{2}{1}\right)^2 \Rightarrow l_2 = 20m$

27. (c) Resistance of the slab $= \rho \frac{L}{A}$ where



The potential across R is $I \times R = V$.

The length of the slab is doubled. Therefore the resistance is $2R$. Assuming that the same current is passed, the potential across the new resistance is $I \times 2R = 2V$.

28. (b) Resistance of the wire, $R = \rho \frac{L}{A}$

When the wire is enlongated to $n-$fold, its length becomes L' = nL

As the volume of the wire remains constant

$\therefore\ A'L' = AL \Rightarrow A' = \frac{AL}{L'} = \frac{A}{n}$

New resistance, $R' = \rho \frac{L'}{A'} = \rho \frac{(nL)}{(A/n)} = n^2 \rho \frac{L}{A} = n^2 R$

29. (b) In the absence of external electric field mean velocity of free electrons (V_{rms}) is given by

$V_{rms} = \sqrt{\frac{3KT}{m}} \Rightarrow V_{rms} \propto \sqrt{T}$

30. (d) Mobility $\mu = \frac{V_d}{E}$, $rE = \frac{V}{l}$

$\mu = \frac{0.5}{200} \times 2 = 5 \times 10^{-3}$

31. (a) The conduction electrons collides with each other more. The specific resistance of a conductor increases with temperature according to the reaction $\rho_T = \rho_0 e^{E_g/k_B T}$ where ρ_0 is the specific resistance at $0^\circ\ C$, E_g = energy of the gap between the valence and the conduction band, k_B is the Boltzmann constant and T, the temperature of the resistor.

32. (b) The drift velocity is small and random. It is of the order of $10^{-2}\ cm/s$. When the potential is applied, the electric field is setup with the speed of light. When no potential is applied, the random motion does not contribute to the motion of the charge in a specific direction.

33. (b) $R = \frac{\rho l}{A}$ $\qquad [\because V = Al \text{ const.}]$

$V = Al$

By differentiation $0 = ldA + Adl$ ... (i)

By differentiation $dR = \frac{\rho(Adl - ldA)}{A^2}$ ... (ii)

$dR = \rho \frac{2Adl}{A^2}$

$dR = \frac{2\rho dl}{A}$ or $\frac{dR}{R} = 2 \cdot \frac{dl}{l}$

So, $\frac{dR}{R}\% = 2 \cdot \frac{dl}{l}\% = 2 \times 0.1\%$

$\frac{dR}{R}\% = 0.2\%$.

34. (d) Resistance of a conductor, $R = \frac{m}{ne^2\tau} \frac{l}{A}$

Where the symbols have their usual meaning.

As the temperature increases, the relaxation time τ decreases

35. (b) It is the electric field that is set up which moves with the velocity of light in that medium.

36. (b) Specific resistance $k = \frac{E}{j}$

37. (b) $R \propto \frac{l}{A} \propto \frac{l}{d^2} \Rightarrow \frac{R_1}{R_2} = \frac{l_1}{l_2} \times \left(\frac{d_2}{d_1}\right)^2 = \frac{L}{4L}\left(\frac{2d}{d}\right)^2 = 1$

$\Rightarrow R_2 = R_1 = R$.

38. (c) $v_d = \frac{i}{nAe} = \frac{1.344}{10^{-2} \times 1.6 \times 10^{-19} \times 8.4 \times 10^{22}}$

$= \frac{1.344}{10 \times 1.6 \times 8.4} = 0.01 cm/s = 0.1 mm/s$

39. (a) Internal resistance $\propto \frac{1}{\text{Temperature}}$

40. (d) Charge = Current × Time = 5 × 60 = 300 C

41. (b) When the temperature increases, resistance increases. As the e.m.f. applied is the same, the current density decreases. The drift velocity decreases. But the rms velocity of the electron due to thermal motion is proportional to $\sqrt{T}$. The Thermal velocity increases.

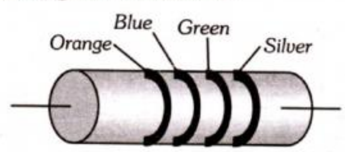
42. (a) Drift velocity, $v_d = \frac{e\tau V}{mL}\left[\because E = \frac{V}{L}\right]$

Where the symbols have their usual meaning.

If the temperatures are not same, τ cannot be same. Then none of the given options is correct.

If temperatures are same, then $\frac{v_{d_1}}{v_{d_2}} = \frac{V_1}{V_2} = \frac{1}{2}$.

45. (a) First colour gives first digit, second colour gives second digit and third colour gives the multiplier and fourth colour gives the tolerance.



$= 36 \times 10^5\ \Omega \pm 10\%$.

46. (a) Red, brown, orange, silver red and brown represents the first two significant figures.

Significant figures		Multiplier	Tolerance
Red	Brown	Orange	Silver
2	1	10^3	± 10%

$\therefore R = 21 \times 10^3 \pm 10\%$

47. (b) Because as temperature increases, the resistivity increases and hence the relaxation time decreases for conductors $\left(\tau \propto \frac{1}{\rho}\right)$.

48. (b) In VI graph, we will not get a straight line in case of liquids.

49. (c) $R = \rho \frac{l}{A}$

50. (a) Since $R \propto l^2 \Rightarrow$ If length is increased by 10%, resistance increases by almost 20%

Hence new resistance $R' = 10 + 20\%$ of 10

$= 10 + \frac{20}{100} \times 10 = 12\,\Omega.$

51. (c) $\frac{R_{150}}{R_{500}} = \frac{[1+\alpha(150)]}{[1+\alpha(500)]}$. Putting $R_{150} = 133\Omega$ and $\alpha = 0.0045/°C$, we get $R_{500} = 258\Omega$

52. (a) $R \propto \frac{l}{r^2}$. For highest resistance $\frac{l}{r^2}$ should be maximum, which is correct for option (a)

53. (c) By using $v_d = \frac{i}{neA} = \frac{100}{10^{28} \times 1.6 \times 10^{-19} \times \frac{\pi}{4} \times (0.02)^2}$

$= 2 \times 10^{-4}\ m/sec$

54. (b) As $\frac{V}{i} = R$ and $R \propto$ temperature

55. (b) $R \propto l^2 \Rightarrow$ If l doubled then R becomes 4 times.

56. (b) $R \propto \frac{l}{r^2} \Rightarrow \frac{R_2}{R_1} = \frac{l_2}{l_1} \times \frac{r_1^2}{r_2^2} = \left(\frac{2}{1}\right) \times \left(\frac{1}{2}\right)^2 = \frac{1}{2}$

$\Rightarrow R_2 = \frac{R_1}{2}$, specific resistance doesn't depend upon length, and radius.

57. (a) The reciprocal of resistance is called conductance

59. (c) Ohm's Law is not obeyed by semiconductors.

61. (a) Using $R_{T_2} = R_{T_1}[1 + \alpha(T_2 - T_1)]$

$\Rightarrow R_{100} = R_{50}[1 + \alpha(100 - 50)]$

$\Rightarrow 7 = 5[1 + (\alpha \times 50)] \Rightarrow \alpha = \frac{(7-5)}{250} = 0.008/°C$

62. (b) This is because of secondary ionisation which is possible in the gas filled in it.

64. (c) Initially the inductance will oppose the current which tries to flow through the inductance. But 10Ω and 20Ω can conduct. The current will be

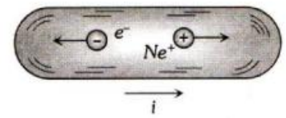
$\frac{2V}{30\Omega} = \frac{1}{15} A.$

65. (c) From $v_d = \frac{i}{neA} \Rightarrow i \propto v_d A \Rightarrow i \propto v_d r^2$

66. (d) Resistivity depends only on the material of the conductor.

67. (a) A particular temperature, the resistance of a superconductor is zero $\Rightarrow G = \frac{1}{R} = \frac{1}{0} = \infty$

68. (b) Net current $i = i_+ + i_- = \frac{(n_+)(q_+)}{t} + \frac{(n_-)(q_-)}{t}$



$\Rightarrow i = \frac{(n_+)}{t} \times e + \frac{(n_-)}{t} \times e$

$= 2.9 \times 10^{18} \times 1.6 \times 10^{-19} + 1.2 \times 10^{18} \times 1.6 \times 10^{-19}$

$\Rightarrow i = 0.66\,A$

69. (d) If E be electric field, then current density $j = \sigma E$

Also we know that current density $j = \frac{i}{A}$

Hence j is different for different area of cross-sections. When j is different, then E is also different. Thus E is not constant. The drift velocity v_d is given by $v_d = \frac{j}{ne} =$ different for different j values. Hence only current i will be constant.

71. (a) $R = \rho \frac{l}{A}$ and mass m = volume (V) × density (d) = $(A\,l)\,d$

Since wires have same material so ρ and d is same for both.

Also they have same mass $\Rightarrow Al$ = constant $\Rightarrow l \propto \frac{1}{A}$

$\Rightarrow \frac{R_1}{R_2} = \frac{l_1}{l_2} \times \frac{A_2}{A_1} = \left(\frac{A_2}{A_1}\right)^2 = \left(\frac{r_2}{r_1}\right)^4$

$\Rightarrow \frac{34}{R_2} = \left(\frac{r}{2r}\right)^4 \Rightarrow R_2 = 544\,\Omega$

72. (a) $R = \rho \frac{l}{A} \Rightarrow \frac{R_1}{R_2} = \frac{A_2}{A_1}$ [ρ, L constant] $\Rightarrow \frac{A_1}{A_2} = \frac{R_2}{R_1} = 2$

Now, when a body dipped in water, loss of weight $= V\sigma_L g = AL\sigma_L g$

So, $\frac{(\text{Loss of weight})_1}{(\text{Loss of weight})_2} = \frac{A_1}{A_2} = 2$; so A has more loss of weight.

73. (d) $R_1 = R_{1_0}(1 + \alpha_1 t_1)$; $R_2 = R_{2_0}(1 + \alpha_2 t_2)$

As $R_1 = R_2$ and $R_{1_0} = R_{2_0}$, $\therefore \frac{R_1}{R_2} = \frac{(1+\alpha_1 t_1)}{(1+\alpha_2 t_2)} = 1$

$1 + \alpha_1 t_1 = 1 + \alpha_2 t_2 \Rightarrow \frac{\alpha_1}{\alpha_2} = \frac{t_2}{t_1}$.

74. (b) $R_t = R_0(1 + \alpha t)$

Initially, $R_0(1 + 30\alpha) = 10\Omega$

Finally, $R_0(1 + \alpha t) = 11\Omega$

$\therefore \frac{11}{10} = \frac{1+\alpha t}{1+30\alpha}$

$\Rightarrow 10 + (10 \times 0.002 \times t) = 11 + 330 \times 0.002$

$\Rightarrow 0.02t = 1 + 0.66 = 1.66 \Rightarrow t = \frac{1.66}{0.02} = 83°C$

75. (a) The first two bands indicate the first two significant figures of the resistance in ohm. The third band indicates the decimal multiplier and the last band stands for the tolerance in percent about the indicated value.

76. (c) Drift velocity $v_d = \frac{i}{neA} \Rightarrow v_d \propto \frac{1}{A}$ or $v_d \propto \frac{1}{d^2}$

$$\Rightarrow \frac{v_P}{v_Q} = \left(\frac{d_Q}{d_P}\right)^2 = \left(\frac{d/2}{d}\right)^2 = \frac{1}{4} \Rightarrow v_P = \frac{1}{4} v_Q.$$

77. (c) Human body, though has a large resistance of the order, of $K\Omega$ (say $10k\Omega$), is very sensitive to minute currents even as low as a few mA. Electrons, excites and disorders the nervous system of the body and hence one fails to control the activity of the body.

79. (d) $R \propto \frac{l^2}{m} \Rightarrow R_1 : R_2 : R_3 = \frac{l_1^2}{m_1} : \frac{l_2^2}{m_2} : \frac{l_3^2}{m_3}$

$$= \frac{25}{1} : \frac{9}{3} : \frac{1}{5} = 25 : 3 : \frac{1}{5} \Rightarrow 125 : 15 : 1.$$

81. (a) $\frac{R_1}{R_2} = \left(\frac{r_2}{r_1}\right)^4 \Rightarrow \frac{R}{R_2} = \left(\frac{nr}{r}\right)^4 \Rightarrow R_2 = \frac{R}{n^4}.$

82. (d) $\frac{R_1}{R_2} = \frac{(1+\alpha t_1)}{(1+\alpha t_2)} \Rightarrow \frac{5}{6} = \frac{(1+\alpha \times 50)}{(1+\alpha \times 100)} \Rightarrow \alpha = \frac{1}{200}$ per °C

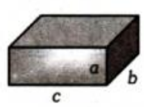
Again by $R_t = R_0(1+\alpha t)$

$$\Rightarrow 5 = R_0\left(1 + \frac{1}{200} \times 50\right) \Rightarrow R_0 = 4\Omega.$$

83. (a) $a = 1,\ b = 2,\ c = 3$

$$\Rightarrow R_{\max} = \frac{\rho.L}{A} = \frac{\rho.c}{a.b}$$

$$R_{\min} = \frac{\rho.L'}{A'} = \frac{\rho.a}{b.c}$$



$$\Rightarrow \frac{R_{\max}}{R_{\min}} = \frac{\frac{\rho.c}{a.b}}{\frac{\rho.a}{b.c}} = \frac{c}{a} \times \frac{c}{a} \Rightarrow \frac{c^2}{a^2} = \left(\frac{c}{a}\right)^2 = \left(\frac{3}{1}\right)^2 = \frac{9}{1}$$

84. (b) $\frac{r_{\text{iron}}}{r_{\text{Copper}}} = \sqrt{\frac{\rho_{\text{iron}}}{\rho_{\text{copper}}}} = \sqrt{\frac{1 \times 10^{-7}}{1.7 \times 10^{-8}}} \approx 2.4.$

85. (c) $i = ev = 1.6 \times 10^{-19} \times 6.8 \times 10^{15} = 1.1 \times 10^{-3}\, amp.$

86. (b) Resistivity of the material of the rod

$$\rho = \frac{RA}{l} = \frac{3 \times 10^{-3} \pi (0.3 \times 10^{-2})^2}{1} = 27 \times 10^{-9} \pi\, \Omega \times m$$

Resistance of disc $R = \frac{\rho\ (\text{Thickness})}{(\text{Area of cross section})}$

$$= 27 \times 10^{-9} \pi \times \frac{(10^{-3})}{\pi \times (1 \times 10^{-2})^2} = 2.7 \times 10^{-7} \Omega.$$

87. (c) By using $R_t = R_0(1+\alpha t)$

$$3 \times R_0 = R_0(1 + 4 \times 10^{-3} t) \Rightarrow t = 500^\circ C.$$

88. (a) $i = 6 \times 10^{15} \times 1.6 \times 10^{-19} = 0.96 mA.$

90. (d) $R = \frac{V}{i} = \frac{100 \pm 0.5}{10 \pm 0.2} = 10 \pm 0.25\, \Omega.$

91. (a) $R = \frac{V}{i} = \rho \frac{l}{A} \Rightarrow \frac{2}{4} = \rho \frac{50 \times 10^{-2}}{(1 \times 10^{-3})^2} \Rightarrow \rho = 1 \times 10^{-6} \Omega m.$

93. (b) $i = \frac{V}{R} = \frac{Q}{t} \Rightarrow Q = \frac{Vt}{R} = \frac{20 \times 2 \times 60}{10} = 240\, C.$

94. (d) Let area of cross-section of wire be $A mm^2$. Therefore, number of electrons per unit volume is

$$n = \frac{2 \times 10^{21}}{A \times 100}$$

Now, current is given by $I = neA\, v_d$

$$= \frac{2 \times 10^{21}}{A \times 100} \times 1.6 \times 10^{-19} \times A \times 0.25 = 0.8\, Amp.$$

96. (b) $i = neAv_d \Rightarrow \frac{(v_d)_e}{(v_d)_h} = \frac{i_e}{i_h} \times \frac{n_h}{n_e} = \frac{7}{4} \times \frac{5}{7} = \frac{5}{4}.$

97. (c) $V_d = \frac{i}{nAe} = \frac{5.4}{8.4 \times 10^{28} \times 10^{-6} \times 1.6 \times 10^{-19}}$

$$= 0.4 \times 10^{-3}\, m/sec = 0.4 mm/sec.$$

98. (a) $\frac{R_1}{R_2} = \left(\frac{l_1}{l_2}\right)^2 \Rightarrow \frac{10}{R_2} = \left(\frac{5}{20}\right)^2 = \frac{1}{16} = R_2 = 160\Omega.$

99. (c) $R \propto \frac{1}{\tau}$; where τ = Relaxation time.

When lamp is switched on, temperature of filament increases, hence τ decreases so R increases.

100. (d) $R = 91 \times 10^2 \approx 9.1 k\Omega.$

103. (c) $R = \rho \frac{l}{(\pi r^2)} \Rightarrow l \propto \frac{r^2}{\rho} \Rightarrow \frac{l_B}{l_A} = \left(\frac{r_B}{r_A}\right)^2 \times \frac{\rho_A}{\rho_B}$

$$\Rightarrow \frac{l_B}{l_A} = \left(\frac{2}{1}\right)^2 \times \left(\frac{1}{2}\right) = \frac{2}{1}$$

104. (b) $n = \frac{1 \times 10^{-3}}{1.6 \times 10^{-19}} = 6.25 \times 10^{15}.$

105. (b) $v_d = \frac{i}{ne\pi r^2} \Rightarrow v_d \propto \frac{i}{r^2} \Rightarrow \frac{v}{v'} = \frac{i_1}{i_2} \times \left(\frac{r_2}{r_1}\right)^2 \Rightarrow v' = \frac{v}{2}.$

106. (d) In series, effective resistance,

$$R_{eff} = R_1 + R_2 + R_3 \Rightarrow \frac{1}{\sigma_{eff}} = \frac{1}{\sigma_1} + \frac{1}{\sigma_2} + \frac{1}{\sigma_3}$$

$$= \frac{\sigma_2\sigma_3 + \sigma_1\sigma_3 + \sigma_1\sigma_2}{\sigma_1\sigma_2\sigma_3}$$

$$\therefore\ \sigma_{eff} = \frac{\sigma_1\sigma_2\sigma_3}{\sigma_2\sigma_3 + \sigma_1\sigma_3 + \sigma_1\sigma_2}$$

108. (c) Resistance $= \rho \frac{l}{A}$

$$\therefore\ \frac{R_1}{R_2} = \frac{\rho_1}{\rho_2} \times \frac{l_1}{l_2} \times \frac{A_2}{A_1} = \frac{2}{3} \times \frac{3}{4} \times \frac{5}{4} = \frac{5}{8}.$$

109. (d) Specific resistance doesn't depend upon length and area.

110. (d) Heating effect of current.

111. (d) $l = \frac{R\pi r^2}{\rho} = \frac{4.2\times 3.14\times (0.2\times 10^{-3})^2}{48\times 10^{-8}} = 1.1m$

112. (d) For conductors, resistance $\propto$ Temperature and for semi-conductor, resistance $\propto \frac{1}{\text{Temperature}}$

113. (a) If suppose initial length $l_1 = 100$ then $l_2 = 100 + 100 = 200$

$$\frac{R_1}{R_2} = \left(\frac{l_1}{l_2}\right)^2 = \left(\frac{100}{200}\right)^2 \Rightarrow R_2 = 4R_1$$

$$\frac{\Delta R}{R}\times 100 = \frac{R_2 - R_1}{R_1}\times 100 = \frac{4R_1 - R_1}{R_1}\times 100 = 300\%.$$

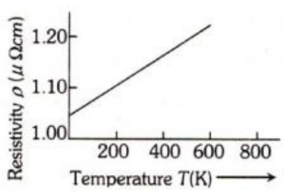
114. (a) Ammeter is always connected in series and Voltmeter is always connected in parallel.

115. (c) Same mass, same material *i.e.* volume is same or Al = constant

Also, $R = \rho\frac{l}{A} \Rightarrow \frac{R_1}{R_2} = \frac{l_1}{l_2}\times\frac{A_2}{A_1} = \left(\frac{A_2}{A_1}\right)^2 = \left(\frac{d_2}{d_1}\right)^4$

$\Rightarrow \frac{24}{R_2} = \left(\frac{d}{d/2}\right)^4 = 16 \Rightarrow R_2 = 1.5\Omega$.

116. (b) For a limited range of temperatures, the graph between resistivity and temperature is a straight line for a material like nichrome as shown in the figure.



117. (a) As steady current is flowing through the conductor, hence the number of electrons entering from one end and outgoing from the other end of any segment is equal. Hence charge will be zero.

118. (b) Conductance $C = \frac{1}{R} = \frac{A}{\rho l} \Rightarrow C \propto \frac{1}{l}$

119. (c) $i = \frac{dQ}{dt} \Rightarrow dQ = idt \Rightarrow Q = \int_{t_1}^{t_2} i\,dt = \int_0^5 (1.2t + 3)\,dt$

$$= \left[\frac{1.2t^2}{2} + 3t\right]_0^5 = 30C$$

120. (d) Here, Density of copper, $\rho = 9\times 10^3\,kgm^{-3} = 9\times 10^6\,gm^{-3}$

Avogadro number, $N_A = 6.02\times 10^{23}$

Mass of 1 mole of copper atoms, $M = 63.5\,g$

As each copper atom contributes one free electron.

Therefore, number of free electrons per volume is

$n = \frac{N_A}{M}\rho = \frac{6.02\times 10^{23}}{63.5}\times 9\times 10^6 = 0.85\times 10^{29}\,m^{-3}$.

121. (c) In stretching $R \propto l^2 \Rightarrow \frac{R_2}{R_1} = \frac{l_2^2}{l_1^2} \Rightarrow \frac{R_2}{R_1} = \left(\frac{2}{1}\right)^2$

$\Rightarrow R_2 = 4R_1$. Change in resistance $= R_2 - R_1 = 3R_1$

Now, $\frac{\text{Change in resistance}}{\text{Original resistance}} = \frac{3R_1}{R_1} = \frac{3}{1}$

122. (a)

Significant figures		Multiplier
Brown	Black	Brown
1	0	10^1

$\therefore R = 10\times 10^1 = 100\,\Omega$.

123. (a) $R = (2\pi r)(1/\pi) = 4\Omega$

Here 1 ohm and 3 ohm will now be in parallel

$\therefore R_{eff} = (3/4)\Omega \Rightarrow I = V/R_{eff} = 8A$.

124. (b) Orange has a value 3, hence the resistance

$R = 33\times 10^3 = 33\,K\Omega$

For R_{max} we will consider maximum tolerance of 20%, hence $R_{max} = (33\pm 20\%)\,K\Omega = 39.6\,K\Omega$.

125. (b) $\frac{l_1}{l_2} = \frac{3}{4}$ and $\frac{r_1}{r_2} = \frac{3}{2}$

$\frac{R_1}{R_2} = \frac{l_1}{l_2}\cdot\frac{r_2^2}{r_1^2} = \frac{3}{4}\cdot\frac{2^2}{3^2} = \frac{1}{3}$

Since $I_1 : I_2 = \frac{1}{R_1} : \frac{1}{R_2} \Rightarrow I_1 : I_2 = 3 : 1$.

Grouping of Resistances

1. (a) In the given circuit $4\,K\Omega$ and $2\,K\Omega$ are in series. This combination is in parallel with $3\,K\Omega$ resistance. Their effective resistance is

$= \frac{(4+2)\times 3}{(4+2)+3} = 2\,K\Omega$

This $2\,K\Omega$ resistance is in series with $6\,K\Omega$. Thus, the equivalent resistance of the circuit is

$R_{eq} = (2\,K\Omega) + (6\,K\Omega) = 8\,K\Omega$

Current in the circuit is

$I = \frac{72V}{8\times 10^3\,\Omega} = 9\times 10^{-3}\,A = 9\,mA$

Current through $2\,K\Omega$ resistor is

$I_1 = I\times\frac{1}{3} = \frac{9\,mA}{3} = 3\,mA$

2. (d) Equivalent resistance of parallel resistors is always less than any of the member of the resistance system.

3. (a) Each part will have a resistance $r = R/10$

Let equivalent resistance be r_R, then

$\frac{1}{r_R} = \frac{1}{r} + \frac{1}{r} + \frac{1}{r}$...........10 times

$\therefore \frac{1}{r_R} = \frac{10}{r} = \frac{10}{R/10} = \frac{100}{R} \Rightarrow r_R = \frac{R}{100} = 0.01R$

4. (a) Length of wire $= 2\pi r = 2\pi(0.1) = 0.2\pi m$.

Resistance of complete wire $= 12\times 0.2\pi = 2.4\pi\Omega$

$\therefore$ Resistance of each semicircle $= 1.2\pi\Omega$

Hence equivalent resistance $R_{AB} = \frac{1.2\pi}{2} = 0.6\pi\Omega$

5. (c) From figure,

Voltage across all the three branches is the same.

$\therefore 10I_1 = 15I_2 = 30I_3$

or $I_1 = 1.5I_2$ ...(i)

$15I_2 = 30I_3$

or $I_3 = \frac{1}{2}I_2$ ...(ii)

Also $I = I_1 + I_2 + I_3$

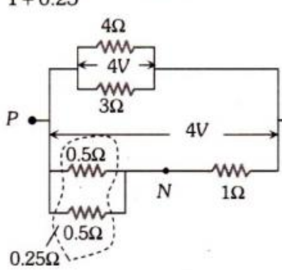
$1.2 = 1.5I_2 + I_2 + \frac{1}{2}I_2$ [Using (i) and (ii)]

$= \frac{3I_2 + 2I_2 + I_2}{2} = 3I_2 \Rightarrow I_2 = \frac{1.2}{3}A = 0.4\,A.$

6. (b) Given current through 4Ω resistance is 1A, so P.D. across upper Branch *i.e.* P.D. between *P* and *M* is 4*V*.

Hence P.D. between *M* & *N* is

$\frac{1}{1+0.25} \times 4 = 3.2V.$



7. (c) Lowest resistance will be in the case when all the resistors are connected in parallel.

$\frac{1}{R} = \frac{1}{0.1} + \frac{1}{0.1}$....... 10 times

$\frac{1}{R} = 10 + 10$.......10 times

$\frac{1}{R} = 100$ *i.e.* $R = \frac{1}{100}\Omega$

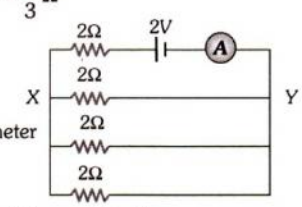
8. (b) Resistance across $XY = \frac{2}{3}\Omega$

Total resistance

$= 2 + \frac{2}{3} = \frac{8}{3}\Omega$

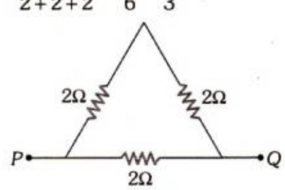
Current through ammeter

$= \frac{2}{8/3} = \frac{6}{8} = \frac{3}{4}A$



9. (a) Equivalent resistance of the combination

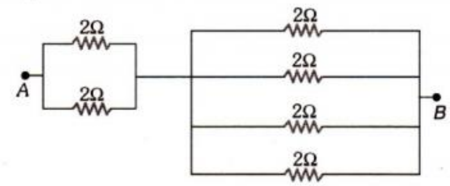
$= \frac{(2+2) \times 2}{2+2+2} = \frac{8}{6} = \frac{4}{3}\Omega$



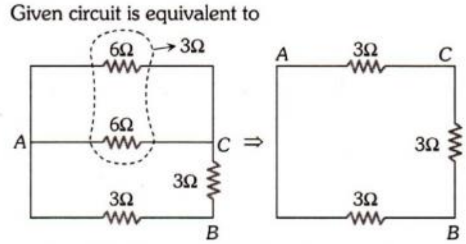
10. (b) In parallel, $x = \frac{R}{n}$ $R = nx$

In series, $R + R + R$ .... n times $= nR = n\,(nx) = n^2x$

12. (c) 2 resistance in parallel and in series with 4 resistance in parallel will give effective resistance $1.5\,\Omega$. Therefore required no. of resistance will be 6

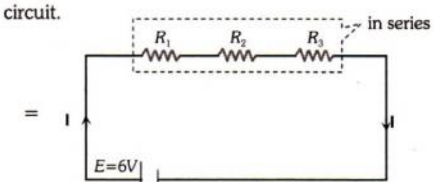


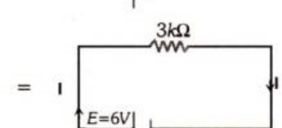
13. (b) Given circuit is equivalent to



So the equivalent resistance between points *A* and *B* is equal to $R = \frac{6 \times 3}{6+3} = 2\Omega$

14. (d) The given circuit can be simplified as shown below in circuit R_2, R_5 and R_3, R_4 are in series and then their resultant is connected parallel. Similarly R_7, R_8 and R_6, R_9 are in series and their resultant is connected parallel on simplifying this we get their equivalent circuit.





Now current in circuit

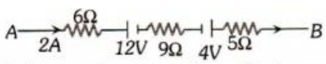
$I = \frac{V}{R} = \frac{6}{3 \times 10^3 \Omega} \times 10^3 = 2mA$

15. (b) Current through each arm *DAC* and *DBC* = 1*A*

$V_D - V_A = 2$ and $V_D - V_B = 3 \Rightarrow V_A - V_B = +1V$

16. (c) *ABD*,*ACD* are in series. They are connected in parallel

i.e., $\frac{1}{6} + \frac{1}{6} = \frac{1}{3}$ *i.e.*, $R = 3\,\Omega$

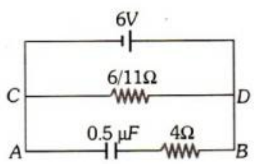
17. (d) 

This is a series connection. Further, whatever current enters A has to pass B. $I=2\,A$.

The total resistance $= 6+9+5=20\,\Omega$. The effective potential across the resistances is $20\Omega\times 2A=40V$. But $(+12-4)V$ is opposing the potential difference across AB therefore the potential difference applied across AB is $40V+8V=48V$.

18. (e) In steady state capacitor is fully charged and no current flows through it.

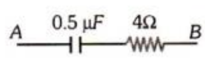
$\therefore$ No current passes through 4Ω



$$\frac{1}{R_{eff}}=\frac{1}{1}+\frac{1}{2}+\frac{1}{3}$$

$$=\frac{6+3+2}{6}=\frac{11}{6}$$

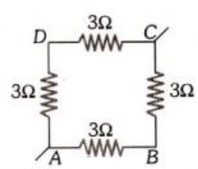
$$\Rightarrow R_{eff}=\frac{6}{11}\Omega$$



$$\text{Current}=\frac{6\times 11}{6}=11A$$

$$Q=CV=0.5\times10^{-6}\times 6=3.0\times10^{-6}\,C=3\mu C$$

19. (d) When a metallic wire of resistance $12\,\Omega$ is bent to form a square, the equivalent circuit diagram is as shown in the figure.



Resistance of arm $ABC=3\Omega+3\Omega=6\Omega$ will be parallel to resistance of arm $ADC=3\Omega+3\Omega=6\Omega$.

Their effective resistance is

$$=\frac{6\Omega\times 6\Omega}{6\Omega+6\Omega}=3\Omega$$

Hence, the resistance between diagonal points *i.e.*, between A and C is 3Ω.

20. (d) $R_{series}=R_1+R_2+R_3+\ldots\ldots$

21. (d) Because of symmetry, BE and CF are ineffective.

$\therefore$ AB, BC, CD are in series. Total resistance $R_1=6\Omega$

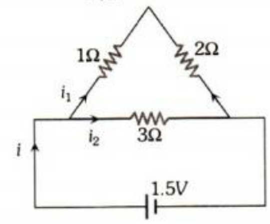
AE, EF, FD are in series. Total resistance $R_2=6\Omega$

When they are in parallel, total resistance $=3\Omega$

$$\therefore \text{Current}=\frac{3V}{3\Omega}=1.0A$$

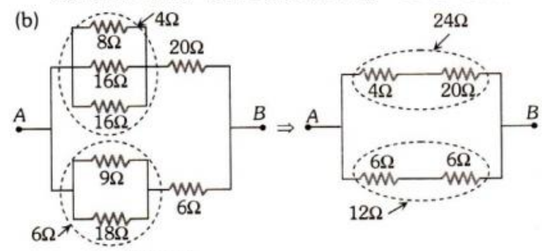
22. (a) $i=\dfrac{V}{R}\Rightarrow 2=\dfrac{6}{\dfrac{6\times 3}{6+3}+R}=\dfrac{6}{2+R}\Rightarrow R=1\,\Omega$.

24. (b) $i_1+i_2=\dfrac{1.5}{3/2}=1\,amp$



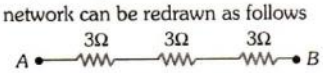
$$\frac{i_1}{i_2}=\frac{3}{3}\Rightarrow i_1=i_2\ \therefore\ i_2=0.5A=i_1$$

25. (d) Current in 9Ω is $2A$, so that in 6Ω is $3A$. Total current is $2+3=5A$. Potential drop $=5\times 2=10V$.

26. (b) 

$$R_{AB}=\frac{24\times 12}{(24+12)}=8\Omega$$

27. (d) The network can be redrawn as follows

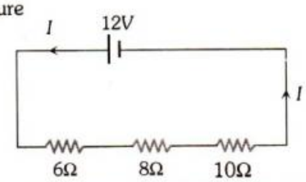


$$\Rightarrow R_{eq}=9\Omega$$

28. (d) Let the resistance of the wire be R, then we know that resistance is proportional to the length of the wire. So each of the four wires will have $R/4$ resistance and they are connected in parallel. So the effective resistance will be

$$\frac{1}{R_1}=\left(\frac{4}{R}\right)4\Rightarrow R_1=\frac{R}{16}$$

29. (c) Before connecting E, the circuit diagram is as shown in the figure



The equivalent resistance of the given circuit is
$R_{eq}=6\,\Omega+8\,\Omega+10\,\Omega=24\,\Omega$

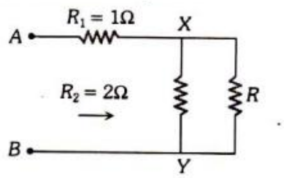
Current in the circuit, $I=\dfrac{12V}{24\,\Omega}=\dfrac{1}{2}A$

Before connecting E, the current through $8\,\Omega$ is $I=\dfrac{1}{2}A$.

After connecting E, the current through 8Ω is also $I=\dfrac{1}{2}A$

$$\therefore E=\frac{1}{2}A\times 8\,\Omega=4\,V.$$

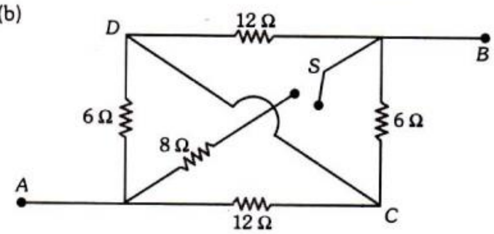
30. (c) Let the resultant resistance be R. If we add one more branch, then the resultant resistance would be the same because this is an infinite sequence.



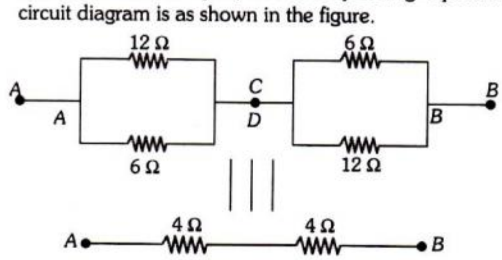
$\therefore \frac{RR_2}{R+R_2} + R_1 = R \Rightarrow 2R + R + 2 = R^2 + 2R$

$\Rightarrow R^2 - R - 2 = 0 \Rightarrow R = -1$ or $R = 2ohm$

31. (b)



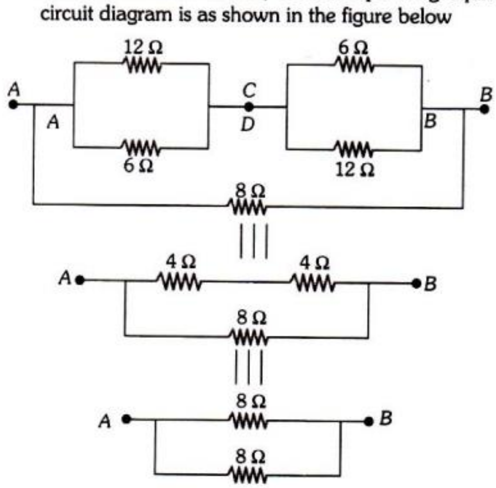
When switch S is open, the corresponding equivalent circuit diagram is as shown in the figure.



The equivalent resistance between A and B is

$R_{eq} = \frac{12\times6}{12+6} + \frac{6\times12}{6+12} = .4 + 4 = 8\Omega$

When switch S is closed, the corresponding equivalent circuit diagram is as shown in the figure below

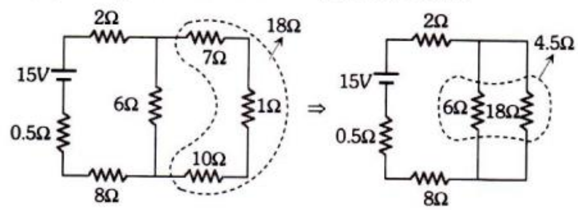


The equivalent resistance A and B is $R'_{eq} = \frac{8\times8}{8+8} = 4\Omega$

32. (d) The last two resistances are out of circuit. Now 8Ω is in parallel with $(1+1+4+1+1)\Omega$.

$\therefore R = 8\Omega \,||\, 8\Omega = \frac{8}{2} = 4\Omega \Rightarrow R_{AB} = 4 + 2 + 2 = 8\Omega$

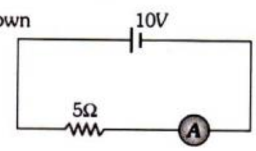
33. (a) The given circuit can be simplified as follows



On further solving equivalent resistance $R = 15\,\Omega$

Hence current from the battery $i = \frac{15}{15} = 1A$

34. (b) The circuit will be as shown



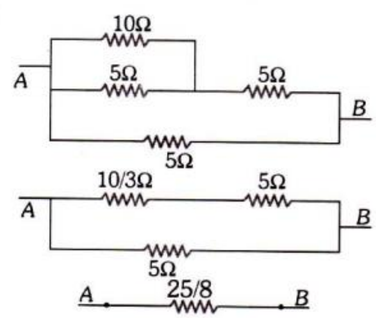
$i = \frac{10}{5} = 2A$

35. (c) The current in the circuit $= \frac{8}{5+1} = \frac{4}{3}$

Now $V_C - V_E = \frac{4}{3} \times 1 \Rightarrow V_E = -\frac{4}{3}V$

36. (b) By using $\frac{P}{Q} = \frac{R}{S} \Rightarrow \frac{2}{2} = \frac{2}{\frac{6S}{(6+S)}} \Rightarrow S = 3\Omega$.

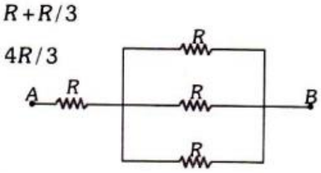
37. (a)



$R_{AB} = 3.12\Omega$.

38. (b) $R_N = R + R/3$

$= 4R/3$



39. (c) $\frac{1}{R} = \frac{1}{1} + \frac{1}{1} + \frac{1}{1} = \frac{3}{1} \Rightarrow R = \frac{1}{3} ohm$

Now such three resistance are joined in series, hence total $R = \frac{1}{3} + \frac{1}{3} + \frac{1}{3} = 1ohm$

40. (a) $i = \frac{10}{1.5 + (1 || 1)} = \frac{10}{1.5 + 0.5} = 5A$

41. (a) For same material and same length

$\frac{R_2}{R_1} = \frac{A_1}{A_2} = \frac{3}{1} \Rightarrow R_2 = 3R_1$

Resistance of thick wire $R_1 = 10\Omega$

$\therefore$ Resistance of thin wire $R_2 = 30\Omega$

Total resistance in series = 10 + 30 = 40 Ω

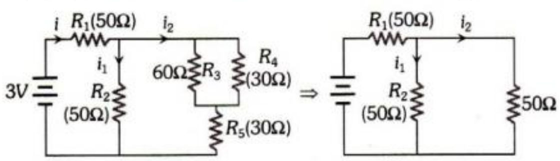
42. (c) Similar to Q. No. 30

$R = 2 + 2 + \frac{2 \times R}{2 + R} \Rightarrow 2R + R^2 = 8 + 4R + 2R$

$\Rightarrow R^2 - 4R - 8 = 0 \Rightarrow R = \frac{4 \pm \sqrt{16 + 32}}{2} = 2 \pm 2\sqrt{3}$

R cannot be negative, hence $R = 2 + 2\sqrt{3} = 5.46\Omega$

43. (a) Equivalent resistance of the given network $R_{eq} = 75\,\Omega$



$\therefore$ Total current through battery $i = \frac{3}{75}$

$i_1 = i_2 = \frac{3}{75 \times 2} = \frac{3}{150}$

Current through $R_4 = \frac{3}{150} \times \frac{60}{(30 + 60)} = \frac{3}{150} \times \frac{60}{90} = \frac{2}{150} A$

$V_4 = i_4 \times R_4 = \frac{2}{150} \times 30 = \frac{2}{5} V = 0.4\,V$

44. (d) 2Ω and 2Ω in parallel give $\frac{2 \times 2}{2 + 2} = 1\Omega$

$\therefore$ Total resistance $= 1 + 2 + 1 + 4 = 8\Omega$

$\therefore$ Current $= \frac{\text{emf}}{\text{resistance}} = \frac{4}{8} = 0.5A$

45. (a) Wheatstone's network is balanced as per resistances of P, Q, R and S given.

No current flow through galvanometer.

The upper and the lower branches are in parallel.

$\therefore$ Resistance $= \frac{25 \times 50}{25 + 50} = \frac{25 \times 50}{75} = \frac{50}{3}\Omega$

$\therefore$ Current $I = \frac{V}{R} = \frac{6}{50/3} = 0.36A$

46. (d) $R \propto l$

Hence every new piece will have a resistance $\frac{R}{10}$. If two pieces are connected in series, then their resistance $= \frac{2R}{10} = \frac{R}{5}$

If 5 such combinations are joined in parallel, then net resistance $= \frac{R}{5 \times 5} = \frac{R}{25}$

47. (c) Total resistance of the circuit

$R = [\{(4 || 4) + 4\} || 4] + 1.6 = 4\,\Omega$

Total current through battery $= \frac{4}{4} = 1\,Amp.$ and shown current.

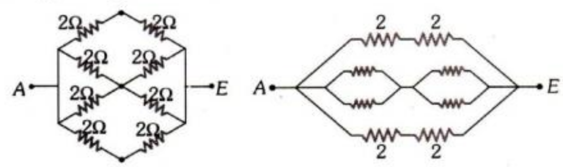
$I = 1 \times \frac{4}{4 + 6} = 0.4\,Amp.$

48. (b) Current in the given circuit $i = \frac{50}{(5 + 7 + 10 + 3)} = 2A$

Potential difference between A and B, $V_A - V_B = 2 \times 12$

$\Rightarrow V_A - 0 = 24V \Rightarrow V_A = 24\,V$

49. (b) The given circuit is



$\frac{1}{\text{Req.}} = \frac{1}{4} + \frac{1}{2} + \frac{1}{4} \Rightarrow \frac{1}{\text{Req.}} = \frac{4}{4} \Rightarrow \text{Req.} = 1\Omega$

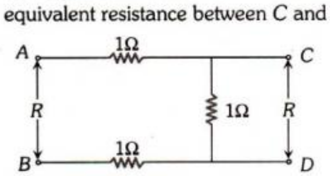
50. (d) Total external equivalent resistance $R_{eq} = 4\Omega$

Current supply by cell $i = \frac{E}{R_{eq} + r} = \frac{10}{(4 + 1)} = 2\,A$

$\therefore (V_A - V_B) = \frac{i}{2}(R_2 - R_1) = \frac{2}{2}(2 - 4) = -2V.$

51. (d) Resistance of each part will be $\frac{R}{n}$; such n parts are joined in parallel so $R_{eq} = \frac{R}{n^2}$.

52. (c) Let equivalent resistance between A and B be R, then equivalent resistance between C and D will also be R.



$R' = \frac{R}{R + 1} + 2 = R$

$\Rightarrow R^2 - 2R - 2 = 0$

$\therefore R = \frac{2 \pm \sqrt{4 + 8}}{2} = \sqrt{3} + 1$

53. (d) 6Ω and 6Ω are in series, so effective resistance is 12Ω which is in parallel with 3Ω, so

$\frac{1}{R} = \frac{1}{3} + \frac{1}{12} = \frac{15}{36}$

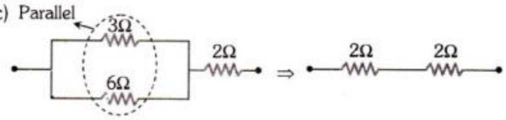
$\Rightarrow R = \frac{36}{15}$

$\therefore I = \frac{V}{R} = \frac{4.8 \times 15}{36} = 2\,A$

54. (a) Equivalent resistance of the circuit $R = \frac{3}{2}\Omega$

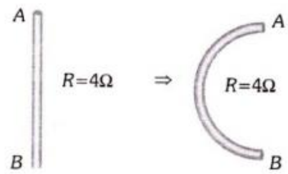
$\therefore$ Current through the circuit $i = \frac{V}{R} = \frac{3}{3/2} = 2A$

55. (c) Parallel

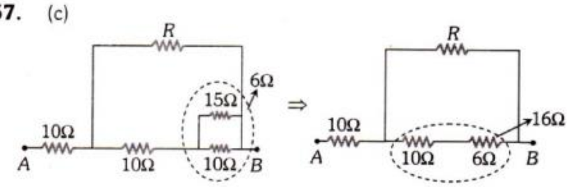


$R_{eq} = 4\Omega$

56. (c)



57. (c)



$\therefore \frac{R \times 16}{R+16} + 10 = 18$, on solving we get, $R = 16\,\Omega$.

58. (c) Current through 6Ω resistance in parallel with 3Ω resistance = 0.4 *A*

So total current = 0.8 + 0.4 = 1.2 *A*

Potential drop across $4\Omega = 1.2 \times 4 = 4.8\,V$

59. (d) Two resistances in series are connected in parallel with the third. Hence $\frac{1}{R_p} = \frac{1}{4} + \frac{1}{8} = \frac{3}{8} \Rightarrow R_p = \frac{8}{3}\Omega$

60. (c) Resistances at *C* and *B* are not in the circuit. Use laws of resistances in series and parallel excluding the two resistance.

61. (d) After simplifying the network, equivalent resistance obtained between *A* and *B* is 8Ω.

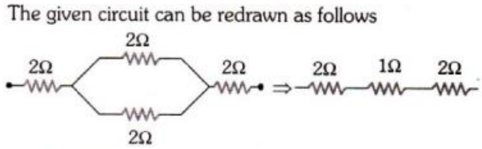
62. (c) The circuit consists of three resistances (2*R*, 2*R* and *R*) connected in parallel.

63. (c) These questions are done by hit and trial method only. You check all the options one by one till you get the final desired result.

64. (c) The voltmeter is assumed to have infinite resistance. Hence (1 + 2 + 1) + 4 = 8Ω.

65. (c) $R' = \frac{R}{n} = \frac{1}{10} = 0.1\Omega$

66. (c) The given circuit can be redrawn as follows



$\Rightarrow R_{eq} = 5\Omega$.

67. (b) $R_{AB} = R_1 + \frac{R_2 R_3}{R_2 + R_3} + R_4 = 2 + \frac{4 \times 4}{4+4} + 2 = 6\Omega$.

68. (c) Before adding, resistance is 5 ohms. After the addition, the central one is a Wheatstone's network.

$\therefore$ Total resistance is $1 + (2\ \&\ 2$ in parallel$) + 1 = 3\Omega$

$\therefore$ The ratio of resistances $= \frac{5}{3}$

69. (d) $R_{AB} = \frac{R}{3} + R = \frac{2}{3} + 2 = \frac{8}{3} = 2\frac{2}{3}\Omega$.

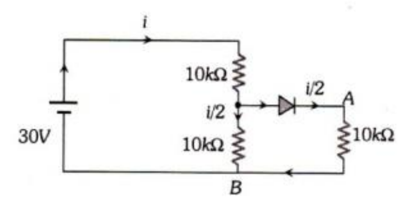
70. (b) $i = \frac{E}{R+r} \Rightarrow 0.5 = \frac{10}{R+3} \Rightarrow 10 = 0.5R + 1.5 \Rightarrow R = 17\Omega$.

71. (a) Equivalent resistance $R = 4 + \frac{3 \times 6}{3+6} = 6\Omega$ and main current $i = \frac{E}{R} = \frac{3}{6} = 0.5A$

Now potential difference across the combination of 3Ω and 6Ω, $V = 0.5 \times \left(\frac{3 \times 6}{3+6}\right) = 1 Volt$

The same potential difference also develops across 3Ω resistance.

72. (c)



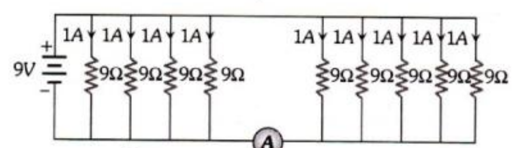
Equivalent resistance $R = 10 + \frac{10}{2} = 15\,k\Omega$

Current $i = \frac{30}{15} = 2 \times 10^{-3}\,A$

Hence, potential difference between *A* and *B*

$V = \left(\frac{2 \times 10^{-3}}{2}\right) \times 10 \times 10^3 = 10\,Volt.$

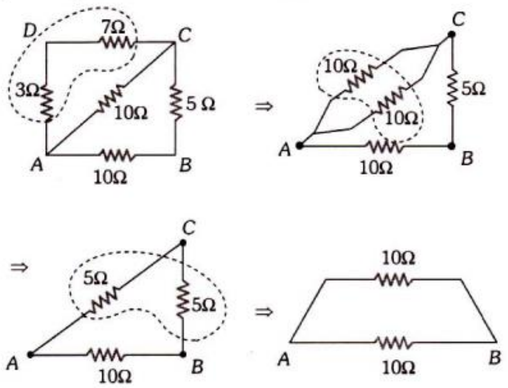
73. (a) Equivalent resistance $R = \frac{9}{9} = 1\Omega$



Current $i = \frac{9}{1} = 9A$

Current passing through the ammeter = 5*A*.

74. (b) The figure can be drawn as follows

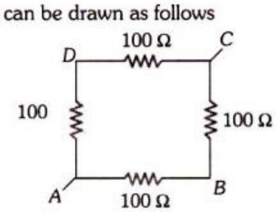


$\Rightarrow R_{AB} = 5\Omega$.

75. (a) $R_1 = \frac{\rho_1 l_1}{A}$ and $R_2 = \frac{\rho_2 l_2}{A}$. In series $R_{eq} = R_1 + R_2$

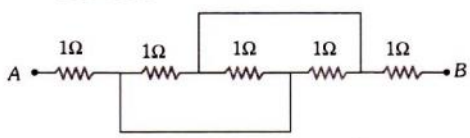
$$\frac{\rho_{eq.}(l_1 + l_2)}{A} = \frac{\rho_1 l_1}{A} + \frac{\rho_2 l_2}{A} \Rightarrow \rho_{eq} = \frac{\rho_1 l_1 + \rho_2 l_2}{l_1 + l_2}.$$

76. (c) The figure can be drawn as follows



$$R_{AC} = \frac{200 \times 200}{200 + 200} = 100\Omega.$$

77. (c)



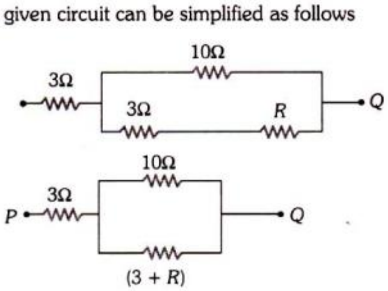
$$R_{AB} = 2 + \frac{1}{3} = 2\frac{1}{3}\Omega.$$

78. (b) ρ – same, l – same, $A_2 = \frac{1}{4}A_1$ $\left[\text{as } r_2 = \frac{r_1}{2}\right]$

By using $R = \rho\frac{l}{A} \Rightarrow \frac{R_1}{R_2} = \frac{A_2}{A_1} \Rightarrow \frac{R_1}{8} = \frac{1}{4} \Rightarrow R_1 = 2\Omega$

Hence, $R_{eq} = \frac{R_1 R_2}{R_1 + R_2} = \frac{2 \times 8}{(2+8)} = \frac{8}{5}\Omega.$

79. (c) The given circuit can be simplified as follows

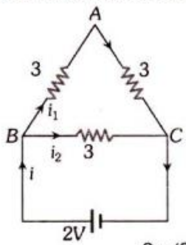


$$R = 3 + \frac{10 \times (3+R)}{10 + 3 + R} = 3 + \frac{30 + 10R}{13 + R}$$

$$R = \frac{39 + 3R + 30 + 10R}{13 + R} = \frac{69 + 13R}{13 + R}$$

$13R + R^2 = 69 + 13R \Rightarrow R = \sqrt{69}\Omega$.

80. (a) The circuit can be drawn as follows

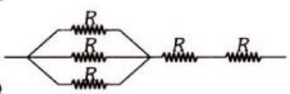


Equivalent resistance $R = \frac{3 \times (3+3)}{3 + (3+3)} = 2\Omega$

Current $i = \frac{2}{2} = 1A$. So, $i_1 = 1 \times \left(\frac{3}{3+6}\right) = \frac{1}{3}A$.

Potential difference between A and $B = \frac{1}{3} \times 3 = 1 volt$.

81. (b) $\frac{1}{R_P} = \frac{1}{R} + \frac{1}{R} + \frac{1}{R} = \frac{3}{R}$

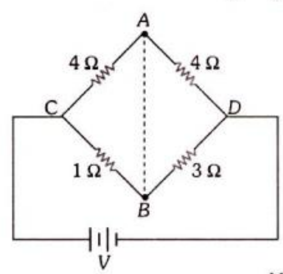


$\Rightarrow R_P = \frac{R}{3}\Omega$

$\Rightarrow R_S = R + R = 2R\Omega$

$\Rightarrow R_{net} = R_P + R_S = 2R + \frac{R}{3} = \frac{7R}{3}\Omega$

82. (b)



Current through arm CAD, $I = \frac{V}{8} amp$

Potential difference between C and $A = V_C - V_A$

$= \frac{V}{8} \times 4 = \frac{V}{2} volt$

Current through CBD, $I' = \frac{V}{4} amp$

Potential difference between C and $B = V_C - V_B$

$= \frac{V}{4} \times 1 = \frac{V}{4} volt$

Potential between A and $B = V_A - V_B$

$\therefore V_A - V_B = V_C - V_B - (V_C - V_A) = \frac{V}{4} - \frac{V}{2} = -\frac{V}{4}$

$\Rightarrow V_A - V_B < 0$ or, $V_A < V_B$

as $V_A < V_B$, so direction of current will be B to A.

83. (b) $\frac{7}{12} = \frac{1}{4} + \frac{1}{R} \Rightarrow R = 3\Omega$

84. (d) Suppose resistance of wires are R_1 and R_2 then $\frac{6}{5} = \frac{R_1 R_2}{R_1 + R_2}$. If R_2 breaks then $R_1 = 2\Omega$

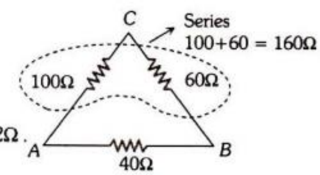
Hence, $\frac{6}{5} = \frac{2 \times R_2}{2 + R_2} \Rightarrow R_2 = 3\Omega$.

85. (d) Potential difference across PQ *i.e.* p.d. across the resistance of 20Ω is $V = i \times 20$

and $i = \frac{48}{(100 + 100 + 80 + 20)} = 0.16A$

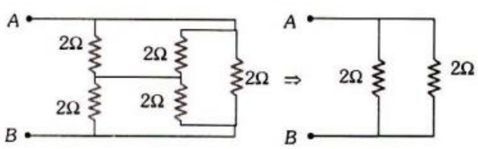
$\therefore V = 0.16 \times 20 = 3.2V$.

86. (a)



$R = \frac{160 \times 40}{160 + 40} = 32\Omega$.

87. (a)



$R_{AB} = \frac{2 \times 2}{2 + 2} = 1\Omega$.

88. (a) The given circuit is a balanced Wheatstone bridge hence. equivalent resistance $R_{eq} = \frac{30 \times 15}{(30 + 15)} = 10\,\Omega$

$\therefore i = \frac{5}{10} = 0.5\,A$.

89. (a) $\frac{P}{Q} = \frac{R}{\frac{S_1 S_2}{(S_1 + S_2)}} = \frac{R(S_1 + S_2)}{S_1 S_2}$

90. (b) $R_{eq} = R_1 + R_2 \Rightarrow \frac{\rho_{eff}\, 2l}{A} = \frac{\rho_1 l}{A} + \frac{\rho_2 l}{A} \Rightarrow \rho_{eff.} = \frac{\rho_1 + \rho_2}{2}$.

91. (b) Two resistance are in ratio 1 : 2 and third resistance is R

So, $\frac{1}{x} + \frac{1}{2x} + \frac{1}{R} = 1 \Rightarrow x = \frac{3}{2}\left(\frac{R}{R-1}\right)$

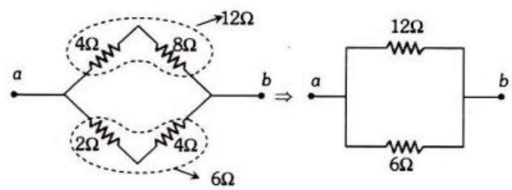
As resistance is not fractional $\Rightarrow \frac{R}{R-1} = 2$

$\Rightarrow x = 3, R = 2, 2x = 6$

Hence, the value of largest resistance = 6Ω.

92. (c) $R = \frac{(3+3) \times 3}{(3+3)+3} = 2\Omega \Rightarrow i = \frac{3}{2} = 1.5A$.

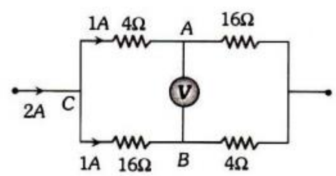
93. (b) Given circuit is a balanced Wheatstone bridge circuit, hence it can be redrawn as follows



$R_{AB} = \frac{12 \times 6}{(12 + 6)} = 4\Omega$.

94. (d) The given circuit is a balanced wheatstone bridge circuit. Hence potential difference between A and B is zero.

95. (a) In the following circuit potential difference between C and A is $V_C - V_A = 1 \times 4 = 4$ ...(i)



C and B is $V_C - V_B = 1 \times 16 = 16$ ...(ii)

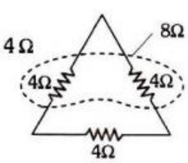
On solving equations (i) and (ii) we get

$V_A - V_B = 12V$.

96. (d) As resistance ∝ Length

$\therefore$ Resistance of each arm $= \frac{12}{3} = 4\,\Omega$

$\therefore R_{effective} = \frac{4 \times 8}{4 + 8} = \frac{8}{3}\Omega$



97. (b) $i = \frac{12}{(1+1) + 0.4} = 5A$.

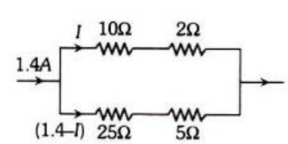
98. (b) $\frac{i_1}{i_2} = \frac{R_2}{R_1} = \frac{l_2}{l_1} \times \left(\frac{r_1}{r_2}\right)^2 = \frac{3}{4}\left(\frac{2}{3}\right)^2 = \frac{1}{3}$

99. (d) Since it's a balanced Wheatstone bridge, the circuit can be redrawn as

$12I = 30(1.4\ I)$

$12\,I = 42 - 30I$

$\therefore I = 1\,A$

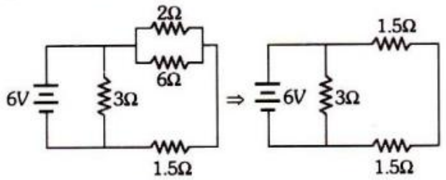


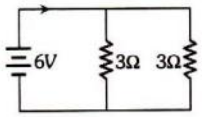
100. (b) When resistances 4Ω and 12Ω are connected in series $= 4 + 12 = 16\Omega$

When these resistance are connected in parallel.

$\frac{1}{R_P} = \frac{1}{4} + \frac{1}{12} \Rightarrow R_P = \frac{4 \times 12}{4 + 12} = \frac{4 \times 12}{16} = 3\Omega$

101. (c) Given circuit can be redrawn as follows



⇒ 

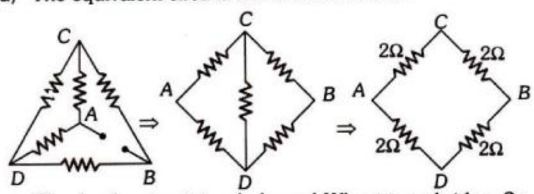
$\Rightarrow i = \frac{6}{1.5} = 4\,A$

102. (a) This is a balanced Wheatstone bridge. Therefore no current will flow from the diagonal resistance $10\,\Omega$

$\therefore$ Equivalent resistance $= \frac{(10+10)\times(10+10)}{(10+10)+(10+10)} = 10\,\Omega$

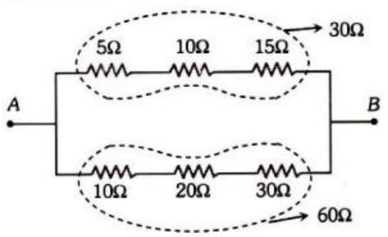
103. (b) This is a balanced Wheatstone bridge circuit. So potential at B and D will be same and no current flows through $4R$ resistance.

104. (d) The equivalent circuits are as shown below



Clearly, the circuit is a balanced Wheatstone bridge. So effective resistance between A and B is $2\,\Omega$.

105. (a) By the concept of balanced Wheatstore bridge, the given circuit can be redrawn as follows



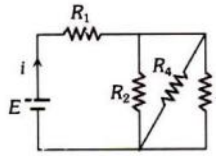
$\Rightarrow R_{AB} = \frac{30\times 60}{(30+60)} = 20\,\Omega$

106. (c) In given circuit three resistance R_2, R_4 and R_3 are parallel.

$\frac{1}{R} = \frac{1}{R_2} + \frac{1}{R_4} + \frac{1}{R_3}$

$= \frac{1}{50} + \frac{1}{50} + \frac{1}{75}$

$= \frac{75+75+50}{50\times 75}$



$R = \frac{50\times 75}{75+75+50} = \frac{50\times 75}{200} = \frac{75}{4}\,\Omega = 18.75\Omega$

This resistance is in series with R_1

$\therefore\ R_{\text{resultant}} = R_1 + R = 100 + 18.75 = 118.75\Omega$

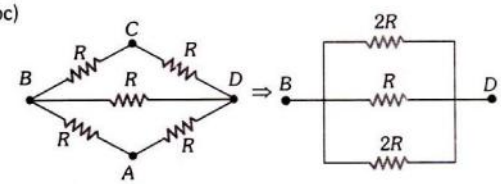
107. (b) Let current through $5\,\Omega$ resistance be i. Then

$i\times 25 = (2.1 - i)10 \Rightarrow i = \frac{10}{35}\times 2.1 = 0.6\,A$

108. (d) Let the value of shunt be r. Hence the equivalent resistance of branch containing S will be $\frac{Sr}{S+r}$

In balance condition, $\frac{P}{Q} = \frac{Sr/(S+r)}{R}$. This gives $r = 8\Omega$

109. (bc)



$\frac{1}{R_{BD}} = \frac{1}{2R} + \frac{1}{R} + \frac{1}{2R} \Rightarrow R_{BD} = \frac{R}{2}$

Between A and C circuit becomes equivalent to balanced Wheatstone bridge so $R_{AC} = R$.

110. (b) $i \propto \frac{1}{R}$

111. (d) Equivalent resistance between P and Q

$\frac{1}{R_{PQ}} = \frac{1}{(6+2)} + \frac{1}{3} + \frac{1}{(4+12)} \Rightarrow R_{PQ} = \frac{48}{25}\Omega$

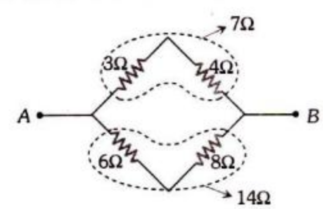
Current between P and Q; $i = 1.5A$

So, potential difference between P and Q

$V_{PQ} = 1.5\times\frac{48}{25} = 2.88V$.

112. (b) $i \propto \frac{1}{R} \Rightarrow \frac{i_1}{i_2} = \frac{R_2}{R_1} \Rightarrow \frac{5}{4} = \frac{(R+2)}{R} \Rightarrow R = 8\Omega$

113. (a) The given circuit is a balanced Wheatstone bridge, hence it can be redrawn as follows



$\Rightarrow\quad R_{eq} = \frac{7\times 14}{(7+14)} = \frac{14}{3}\Omega$.

114. (a) For a balance Wheatstone bridge.

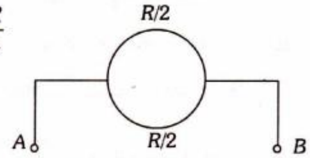
$\frac{A}{B} = \frac{D}{C} \Rightarrow \frac{10}{5} \neq \frac{4}{4}$ [Unbalanced]

$\frac{A'}{B} = \frac{D}{C} \Rightarrow \frac{A'}{5} = \frac{4}{4} \Rightarrow A' = 5\Omega$

$A'(5\Omega)$ is obtained by connecting a $10\,\Omega$ resistance in parallel with A.

115. (d) Given circuit is a balanced Wheatstone bridge circuit. So there will be no change in equivalent resistance. Hence no further current will be drawn.

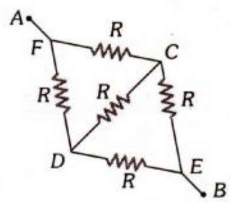
116. (a) $R_{AB} = \frac{R/2}{2} = \frac{R}{4}$



117. (b) The given network is a balanced Wheatstone bridge. It's equivalent resistance will be $R = \frac{18}{5}\Omega$

So current from the battery $i = \frac{V}{R} = \frac{V}{18/5} = \frac{5V}{18}$

118. (b) The given circuit can be redrawn as follows



Equivalent resistance between A and B is R and current $i = \frac{V}{R}$

119. (a) The equivalent resistance between C and D is

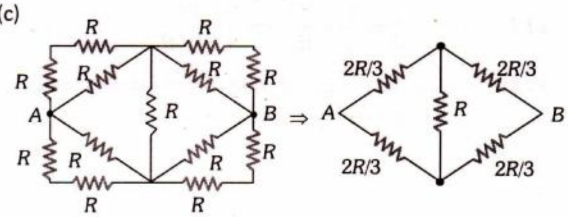
$\frac{1}{R'} = \frac{1}{6} + \frac{1}{6} + \frac{1}{3} = \frac{2}{3}$ or $R' = \frac{3}{2} = 1.5\Omega$

Now the equivalent resistance between A and B as $R' = 1.5\Omega$ and 2.5Ω are connected in series, so

$R'' = 1.5 + 2.5 = 4\Omega$

Now by ohm's law, potential difference between A and B is given by $V_A - V_B = iR = 2 \times 4.0 = 8$ *volt*

120. (c)



Hence $R_{eq} = \frac{2R}{3}$ [Since it's a balanced Wheatstone bridge].

122. (b) For balanced Wheatstone bridge $\frac{P}{Q} = \frac{R}{S}$

$\Rightarrow \frac{12}{(1/2)} = \frac{x+6}{(1/2)} \Rightarrow x = 6\Omega$

123. (b) For maximum energy equivalent resistance of combination should be minimum.

124. (c) For first balancing condition $\frac{10 + R_1}{R_2} = \frac{50}{50}$

$\Rightarrow R_2 = 10 + R_1$. For second balancing condition $\frac{R_1}{R_2} = \frac{40}{60} \Rightarrow \frac{R_1}{10 + R_1} = \frac{2}{3} \Rightarrow R_1 = 20\Omega$

125. (b) Given $R = 6\Omega$. When resistor is cut into two equal parts and connected in parallel, then

$$R_{eq} = \frac{R/2}{2} = \frac{R}{4} = \frac{6}{4} = 1.5\Omega.$$

126. (a) Resistance between P and Q

$$R_{PQ} = R\,||\left(\frac{R}{3} + \frac{R}{2}\right) = \frac{R \times \frac{5}{6}R}{R + \frac{5}{6}R} = \frac{5}{11}R$$

Resistance between Q and R

$$R_{QR} = \frac{R}{2}\,||\left(R + \frac{R}{3}\right) = \frac{\frac{R}{2} \times \frac{4R}{3}}{\frac{R}{2} + \frac{4R}{3}} = \frac{4}{11}R$$

Resistance between P and R

$$R_{PR} = \frac{R}{3}\,||\left(\frac{R}{2} + R\right) = \frac{\frac{R}{3} \times \frac{3R}{2}}{\frac{R}{3} + \frac{3R}{2}} = \frac{3}{11}R$$

Hence it is clear that R_{PQ} is maximum.

Kirchhoff's Law, Cells

1. (b) For no current through galvanometer, we have

$$\left(\frac{E_1}{500 + X}\right)X = E \Rightarrow \left(\frac{12}{500 + X}\right)X = 2 \Rightarrow X = 100\,\Omega$$

2. (c) Here, emf of the battery $= 8V$

Internal resistance of the battery, $r = 0.5\Omega$

Voltage of d.c. supply $= 120V$

External resistance, $R = 15.5\Omega$

When the battery of emf 8 V is charged from a d.c. supply of 120 V, the effective emf in the circuit is

$\varepsilon = 120V - 8V = 112V$

Total resistance of the circuit $= R + r$

$= 15.5\Omega + 0.5\Omega = 16\Omega$

$\therefore$ Current in the circuit during charging

$$I = \frac{\varepsilon}{R + r} = \frac{112V}{16\Omega} = 7A$$

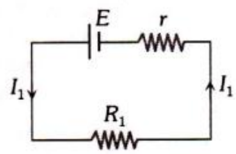
$\therefore$ Terminal voltage of the battery,

$V =$ emf of the battery + voltage drop across battery

$= 8V + Ir = 8V + (7A)(0.5\Omega) = 8V + 3.5V = 11.5V$

3. (d) Let E and r be the emf and internal resistance of a battery respectively.

In the first case

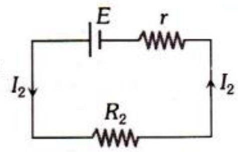


Current flowing in the circuit

$$I_1 = \frac{E}{R_1 + r}$$

or $E = I_1(R_1 + r)$ ...(i)

In the second case



Current flowing in the circuit

$$I_2 = \frac{E}{R_2 + r}$$

or $E = I_2(R_2 + r)$ ...(ii)

Equating equations (i) and (ii), we get

$$I_1(R_1 + r) = I_2(R_2 + r) \Rightarrow I_1R_1 + I_1r = I_2R_2 + I_2r$$

$$I_1R_1 - I_2R_2 = (I_2 - I_1)r \Rightarrow (I_2 - I_1)r = I_1R_1 - I_2R_2$$

$$r = \frac{I_1R_1 - I_2R_2}{I_2 - I_1}.$$

4. (a) $0.9\,(2 + r) = 0.3\,(7 + r) \Rightarrow 6 + 3r = 7 + r \Rightarrow r = 0.5\,\Omega$

5. (b) $E = V + ir \Rightarrow V = -ri + E$

Comparing it with $y = mx + c$; Slope $(m) = -r$ and intercept $= E$.

6. (b) Let the current in the circuit $= i = \frac{V}{R}$

Across the cell, $E = V + ir \Rightarrow r = \frac{E-V}{i} = \frac{E-V}{V/R} = \left(\frac{E-V}{V}\right)R$

7. (a) For maximum energy, we have

External resistance of the circuit

= Equivalent internal resistance of the circuit *i.e.* $R = \frac{r}{2}$

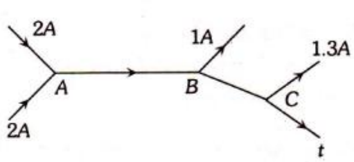
8. (a) Kirchhoff's first law is based on the law of conservation of charge.

9. (b) Kirchhoff's second law is based on the law of conservation of energy.

10. (a) According to Kirchhoff's first law

At junction A, $i_{AB} = 2 + 2 = 4A$

At junction B, $i_{AB} = i_{BC} - 1 = 3A$



At junction C, $i = i_{BC} - 1.3 = 3 - 1.3 = 1.7\,amp$

11. (a) According to kirchhoff's voltage law only option (a) is correct.

12. (c) Given $V_1 = 50\,volt$, $i_1 = 11A$; $V_2 = 60\,volt$, $i_2 = 1A$.

if *e.m.f.* and internal resistance of battery are E and r respectively then *P.D.* across terminals of battery,

$V = E - ir$

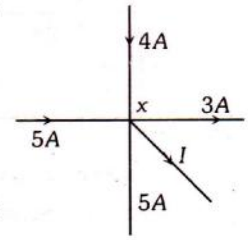
we have $50 = E - 11r$ ...(i)

and $60 = E - 1r$ ...(ii)

From (i) and (ii),

$E = 61V$ and $r = 1\Omega$.

13. (b) According to Kirchhoff's first law,



$(+5\text{ A}) + (+4\text{ A}) + (-3\text{ A}) + (-5\text{ A}) + I = 0$

$\Rightarrow I = -1\text{ A}$

–ve sign shows that current is flowing away from x

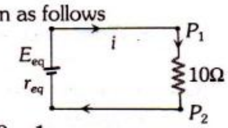
14. (d) Zero (No potential difference across voltmeter).

15. (b) Let the e.m.f. of cell be E and internal resistance be r.

Then $0.5 = \frac{E}{(r+2)}$ and $0.25 = \frac{E}{(r+5)}$

On dividing, $2 = \frac{5+r}{2+r} \Rightarrow r = 1\Omega$

16. (b) The given circuit can be redrawn as follows



$$i = \frac{E_{eq}}{R + r_{eq}}$$

$$E_{eq} = \frac{E_1r_2 - E_2r_1}{r_1 + r_2} = \frac{5\times1 - 2\times2}{2+1} = \frac{1}{3}V$$

$$r_{eq} = \frac{r_1 \times r_2}{r_1 + r_2} = \frac{1\times2}{1+2} = \frac{2}{3}\Omega$$

$$\therefore i = \frac{1/3}{10 + 2/3} = \frac{1}{32}A = 0.03A \text{ from } P_2 \text{ to } P_1$$

17. (c) Short circuit current $i_{SC} = \frac{E}{r} \Rightarrow 3 = \frac{1.5}{r} \Rightarrow r = 0.5\Omega$

18. (c) $i = \frac{50}{R+r} \Rightarrow r = \frac{50}{4.5} - 10 = \frac{5}{4.5} = 1.1\Omega$

19. (d) $E = 2.2\,V$, $R = 4\,\Omega$, $V = 2V$

$$r = \left(\frac{E}{V} - 1\right)R = \left(\frac{2.2}{2} - 1\right)\times 4 = 0.1\times4 = 0.4\,\Omega.$$

20. (c) $P_{\text{Total}} = \frac{V^2}{R_{eq}}$

So $R_{eq} = \frac{V^2}{P_{\text{Total}}} = \frac{10\times10}{30} = \frac{10}{3}$

As $R_{eq} = \frac{R_1R_2}{R_1 + R_2} \Rightarrow \frac{10}{3} = \frac{5R}{5+R} \Rightarrow R = 10\Omega.$

21. (c) The voltage across cell terminal will be given by

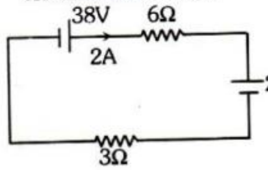
$$=\frac{E}{R+r}\times R=\frac{2}{(3.9+0.1)}\times 3.9=1.95V$$

22. (c) $E=2.2volt,\ V=1.8volt,\ R=5R$

$$r=\left(\frac{E}{V}-1\right)R=\left(\frac{2.2}{1.8}-1\right)\times 5=1.1\Omega$$

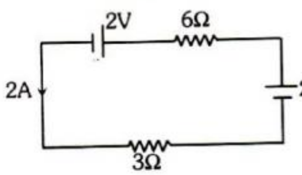
23. (b) $2\times 6+2\times 3=E-20 \Rightarrow E=38V$

for clock wise current



$\Rightarrow 2\times 6+2\times 3=20-E \Rightarrow E=2V$

For anti clock wise current



24. (c) $\because$ Current in A is max

$\therefore$ Heat produced in it will be max.

25. (a) Total e.m.f. = nE, Total resistance $R + nr \Rightarrow i=\frac{nE}{R+nr}$

26. (a) Current through R is maximum when total internal resistance of the circuit is equal to external resistance.

27. (b) Cells are joined in parallel when internal resistance is higher than external resistance. $[R<<r]$

$$i=\frac{E}{R+\frac{r}{n}}$$

28. (b) In series, $i_1=\frac{2E}{2+2r}$

In parallel, $i_2=\frac{E}{2+\frac{r}{2}}=\frac{2E}{4+r}$

Since $i_1=i_2 \Rightarrow \frac{2E}{4+r}=\frac{2E}{2+2r} \Rightarrow r=2\Omega$

29. (a) Applying Kirchhoff's law

$(2+2)=(0.1+0.3+0.2)i \Rightarrow i=\frac{20}{3}A$

Hence potential difference across A

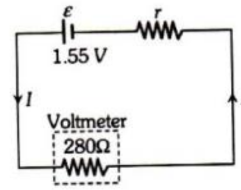
$=2-0.1\times\frac{20}{3}=\frac{4}{3}V$ [less than 2V]

Potential difference across $B=2-0.3\times\frac{20}{3}=0$

30. (d) Let ε be *emf* and r be internal resistance of the cell. When no current drawn from the cell, the potential difference between its terminals is the *emf* of the cell. It is this quantity which the potentiometer measures. Therefore, *emf* of the cell, $\varepsilon=1.55V$. When the 280Ω voltmeter is connected across the cell as shown in adjacent figure, current flows from the cell. The potential difference between its terminals is just the voltmeter reading, $1.40V$.

$\therefore\ I\times 280=1.40$

$I=\frac{1.4}{280}=5\times 10^{-3}A$



Also $I=\frac{\varepsilon}{280+r}=\frac{1.55}{28+r}$

$5\times 10^{-3}=\frac{1.55}{280+r}$

$1.4+5\times 10^{-3}r=1.55$

$5\times 10^{-3}r=0.15 \Rightarrow r=\frac{0.15}{5\times 10^{-3}}=30\Omega$

According to maximum power theorem, Load resistance, $R=r=30\,\Omega$

32. (a) In series circuit it is always preferable to use formula I^2R, because I throughout is same.

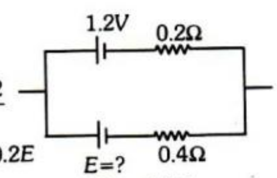
$I=\frac{120}{6+9}=8$

$\therefore P=I^2R=64\times 6=384$

33. (b) For power to be maximum

External resistance = Equivalent internal resistance of the circuit

34. (b) $E_{eq}=\frac{E_1r_2+E_2r_1}{r_1+r_2}$



$\Rightarrow 1.5=\frac{1.2\times 0.4+E\times 0.2}{0.2+0.4}$

$\Rightarrow 1.5\times 0.6=1.2\times 0.4+0.2E$

$\Rightarrow E=\frac{0.9-0.48}{0.2}=2.1Volt$.

$E_{eq}=1.5V$

35. (a) $I_1=\frac{2}{2+4}\times 6=2\ A$

$I_2=4\ Amp.$

36. (b) $V_2-V_1=E-ir=5-2\times 0.5=4volt$

$\Rightarrow V_2=4+V_1=4+10=14\ volt$

37. (a) If m = Number of rows

and n = Number of cells in a row

Then $m\times n=100$ ....(i)

Also condition of maximum current is $R=\frac{nr}{m}$

$\Rightarrow 25=\frac{1\times n}{m} \Rightarrow n=25\,m$ .....(ii)

On solving (i) and (ii), $m=2$

38. (b) According to Kirchhoff's law $i_{CD} = i_2 + i_3$

39. (b) Since $i = \left(\frac{E}{R+r}\right)$, we get

$0.5 = \frac{E}{2+r}$ ......(i)

$0.25 = \frac{E}{5+r}$ .....(ii)

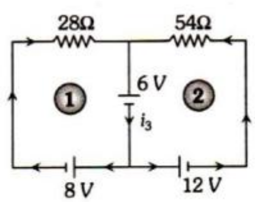
Dividing (i) by (ii), we get $2 = \frac{5+r}{2+r} \Rightarrow r = 1\Omega$

$\therefore 0.5 = \frac{E}{2+1} \Rightarrow E = 1.5V$

40. (d) $I = \frac{E}{R+r/4} = \frac{2}{2+1/4} = \frac{2}{2.25} = 0.888\ A$

41. (d) In parallel combination $E_{eq} = E = 6V$

42. (d) Suppose current through different paths of the circuit is as follows :



After applying *KVL* for loop (1) and loop (2)

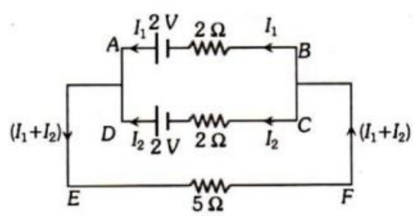
We get $28i_1 = -6-8 \Rightarrow i_1 = -\frac{1}{2}A$

and $54i_2 = -6-12 \Rightarrow i_2 = -\frac{1}{3}A$

Hence $i_3 = i_1 + i_2 = -\frac{5}{6}A$

43. (d) $V_{AB} = 4 = \frac{5X + 2\times10}{X+10} \Rightarrow X = 20\Omega$, $\left[v = \frac{E_2r_1 + E_1r_2}{r_1+r_2}\right]$

44. (d)



Applying Kirchhoff's second law for closed loop *AEFBA*, we get

$-(I_1 + I_2)\times5 - I_1\times2 + 2 = 0$ or $7I_1 + 5I_2 = 2$ ...(i)

Again, applying Kirchhoff's second law for a closed loop *DEFCD*, we get

$-(I_1 + I_2)\times5 - I_2\times2 + 2 = 0$

or $5I_1 + 7I_2 = 2$ ...(ii)

Multiplying (i) by 5 and (ii) by 7, we get

$35I_1 + 25I_2 = 10$ ...(iii)

$35I_1 + 49I_2 = 14$ ...(iv)

Subtracting (iv) from (iii) we get,

$-24I_2 = -4 \Rightarrow I_2 = \frac{1}{6}A$

Substituting the value of I_2 in equation (i), we get

$7I_1 = 2 - 5\times\frac{1}{6} \Rightarrow 7I_1 = \frac{7}{6} \Rightarrow I_1 = \frac{1}{6}A$

The current through the 5Ω is

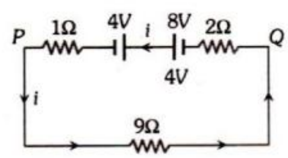
$= I_1 + I_2 = \frac{1}{6}A + \frac{1}{6}A = \frac{1}{3}A$.

45. (c) $V = E - IR = 15 - 10\times0.05 = 14.5V$

46. (c) In series $i = \frac{nE}{nr+R} \Rightarrow 0.6 = \frac{n\times1.5}{n\times0.5\times20} \Rightarrow n = 10$

48. (a) $P = \frac{W}{t} = Vi \Rightarrow V = \frac{W}{it} = \frac{1000}{2\times6\times60} = 1.38\,V$

49. (a) Applying Kirchoff's voltage law in the given loop.



$-2i + 8 - 4 - 1\times i - 9i = 0 \Rightarrow i = \frac{1}{3}A$

Potential difference across $PQ = \frac{1}{3}\times9 = 3V$

50. (d) Because cell is in open circuit.

51. (a) Total $i = \frac{6}{2+2+2} = \frac{6}{6} = 1\ Amp.$

Current at $6\ \Omega$ Resistance $= \frac{3\times1}{3+6} = \frac{1}{3}\ Amp.$

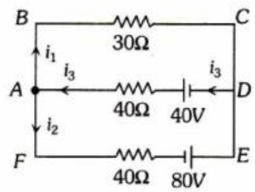
53. (b) $i = \frac{E}{r} = \frac{6}{0.5} = 12\,amp.$

54. (c) Strength = 5 × 18 = 90*AH*.

55. (a) $i = \frac{E}{R+r} = \frac{5}{4.5+0.5} = 1A$

$V = E - ir = 5 - 1\times0.5 = 4.5$ Volt

56. (b) The circuit can be simplified as follows



Applying *KCL* at junction *A*

$i_3 = i_1 + i_2$ .....(i)

Applying Kirchoff's voltage law for the loop *ABCDA*

$-30i_1 - 40i_3 + 40 = 0$

$\Rightarrow \quad -30i_1 - 40(i_1 + i_2) + 40 = 0$

$\Rightarrow \quad 7i_1 + 4i_2 = 4$ .....(ii)

Applying Kirchoff's voltage law for the loop *ADEFA*.

$-40i_2 - 40i_3 + 80 + 40 = 0$

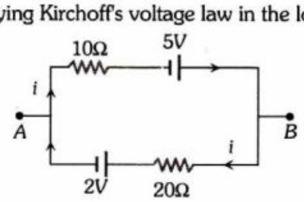
$\Rightarrow \quad -40i_2 - 40(i_1 + i_2) = -120$

$\Rightarrow \quad i_1 + 2i_2 = 3$ ....(iii)

On solving equation (ii) and (iii) $i_1 = -0.4A$.

57. (c) $V = E - ir = 12 - 60 \times 5 \times 10^{-2} = 9V.$

58. (a) Applying Kirchoff's voltage law in the loop



$-10i + 5 - 20i - 2 = 0 \Rightarrow i = 0.1A$

59. (d) $V = E - ir = 1.5 - 2 \times 0.15 = 1.20 Volt$.

60. (b) $i = \frac{E}{R+r} \Rightarrow 1 = \frac{4}{2+r} = r = 2\Omega$

Short circuit, is when terminals of battery are connected directly, then current which flows is $i_{SC} = \frac{E}{r} = \frac{4}{2} = 2A$.

61. (c) $i = \frac{2+2}{1+1.9+0.9} = \frac{4}{3.8}A$

For cell *A* $E = V + ir \Rightarrow V = 2 - \frac{4}{3.8} \times 1.9 = 0$.

62. (c) By using $i = \frac{E}{R+r}$

$\Rightarrow 0.5 = \frac{E}{11+r} \Rightarrow E = 5.5 + 0.5r$ .....(i)

and $0.9 = \frac{E}{5+r} \Rightarrow E = 4.5 + 0.9r$ .....(ii)

On solving these equations, we have $r = 2.5\Omega$

64. (b) $W = qV = 6 \times 10^{-6} \times 9 = 54 \times 10^{-6} J$.

65. (a) $P = \frac{V^2}{R_{eq}}$; for *P* to be maximum R_{eq} should be less.

Hence option (a) is correct.

66. (c) $P_{max} = \frac{E^2}{4r} = \frac{(2)^2}{4 \times 0.5} = 2W$

68. (a) Power dissipated $= i^2R = \left(\frac{E}{R+r}\right)^2 R$

$\therefore \left(\frac{E}{R_1+r}\right)^2 R_1 = \left(\frac{E}{R_2+r}\right)^2 R_2$

$\Rightarrow R_1(R_2^2 + r^2 + 2R_2r) = R_2(R_1^2 + r^2 + 2R_1r)$

$\Rightarrow R_2^2R_1 + R_1r^2 + 2R_1R_2r = R_1^2R_2 + R_2r^2 + 2R_1R_2r$

$\Rightarrow (R_1 - R_2)r^2 = (R_1 - R_2)R_1R_2 \Rightarrow r = \sqrt{R_1R_2}$

69. (c) Total cells $= m \times n = 24$ .... (i)

For maximum current in the circuit $R = \frac{mr}{n}$

$\Rightarrow 3 = \frac{m}{n} \times (0.5) \Rightarrow m = 6n$ ..... (ii)

On solving equation (i) and (ii), we get $m = 12$, $n = 2$

70. (a) Given problem is the case of mixed grouping of cells

So total current produced $i = \frac{nE}{R + \frac{nr}{m}}$

Here $m = 100$, $n = 5000$, $R = 500\Omega$

$E = 0.15V$ and $r = 0.25\Omega$

$\Rightarrow \quad i = \frac{5000 \times 0.15}{500 + \frac{5000 \times 0.25}{100}} = \frac{750}{512.5} \approx 1.5A$

72. (d) Watt hour efficiency $= \frac{\text{Discharging energy}}{\text{Charging energy}}$

$= \frac{14 \times 5 \times 15}{15 \times 8 \times 10} = 0.875 = 87.5\%$

73. (c) On applying Kirchhoff's current law $i = 13A$.

74. (b) In the given case cell is in open circuit ($i = 0$) so voltage across the cell is equal to its e.m.f.

75. (b) The internal resistance of battery is given by

$r = \left(\frac{E}{V} - 1\right)R = \left(\frac{40}{30} - 1\right) \times 9 = \frac{9 \times 10}{30} = 3\Omega$.

76. (b) $i = \frac{E}{r+R} \Rightarrow P = i^2R \Rightarrow P = \frac{E^2R}{(r+R)^2}$

Power is maximum when $r = R \Rightarrow P_{max} = E^2/4r$

77. (c) Since the current coming out from the positive terminal is equal to the current entering the negative terminal, therefore, current in the respective loop will remain confined in the loop itself.

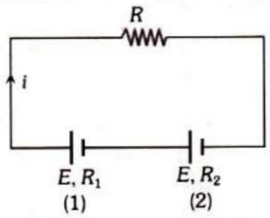
$\therefore$ Current through 2Ω resistor $= 0$

78. (c) Reading of voltmeter

$= E_{eq} = \frac{E_1r_2 + E_2r_1}{r_1 + r_2} = \frac{18 \times 1 + 12 \times 2}{1+2} = 14V$

79. (d) $i = \frac{2E}{R + R_1 + R_2}$

From cell (2) $E = V + iR_2 = 0 + iR_2$



$\Rightarrow E = \frac{2E}{R + R_1 + R_2} \times R_2 \ \Rightarrow R = R_2 - R_1$

81. (a) Applying Kirchoff's law in following figure.

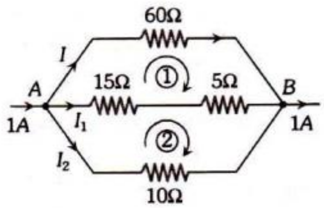
At junction A :

$i + i_1 + i_2 = 1$ .... (i)

For Loop (i)

$-60i + (15+5)i_1 = 0$

$\Rightarrow i_1 = 3i$ ...(ii)



For loop (2)

$-(15+5)\,i_1 + 10\,i_2 = 0$

$\Rightarrow i_2 = 2\,i_1 = 2(3\,i) = 6i$ ...(iii)

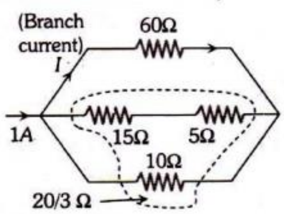
On solving equation (i), (ii) and (iii) we get $i = 0.1\,A$

Short Trick : Branch current =

main current $\left(\frac{\text{Resistance of opposite branch}}{\text{Total resistance}}\right)$

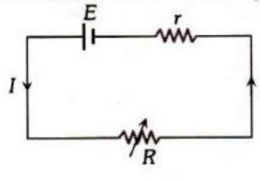
$\Rightarrow i = 1 \times \left[\frac{\frac{20}{3}}{\frac{20}{3} + 60}\right]$

$= 0.1\,A$



82. (d) Maximum current will be drawn from the circuit if resultant resistance of all internal resistances is equal to the value of external resistance if the arrangement s mixed. In series, $R >> nr$ and in parallel, the external resistance is negligible.

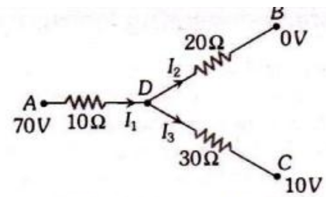
83. (b) The current drawn from the battery is $I = \frac{E}{R + r}$



The terminal potential difference, $V = IR$

When $R \to 0,\ I \to \frac{E}{r}$ and when $R \to 0,\ V \to 0$.

84. (d)



Applying Kirchhoffs law at point D, we get

$I_1 = I_2 + I_3$

$\frac{V_A - V_D}{10} = \frac{V_D - V_B}{20} + \frac{V_D - V_C}{30}$

$\frac{70 - V_D}{10} = \frac{V_D - 0}{20} + \frac{V_D - 10}{30}$

$70 - V_D = \frac{V_D}{2} + \frac{V_D - 10}{3}$

$6(70 - V_D) = 3V_D + 2(V_D - 10)$

$420 - 6V_D = 3V_D + 2V_D - 20$

$11V_D = 440 \Rightarrow V_D = 40V$

$I_1 = \frac{V_A - V_D}{10} = \frac{70 - 40}{10} = 3A$

$I_2 = \frac{V_D - V_B}{20} = \frac{40 - 0}{20} = 2A$

$I_3 = \frac{V_D - V_C}{30} = \frac{40 - 10}{30} = 1A$

85. (c) $2 = \frac{\varepsilon}{2 + r}$

$0.5 = \frac{\varepsilon}{9 + r}$ or $\frac{2}{0.5} = \frac{9 + r}{2 + r} \ \therefore\ r = \frac{1}{3}\Omega.$

86. (b) Current from D to $C = 1A$

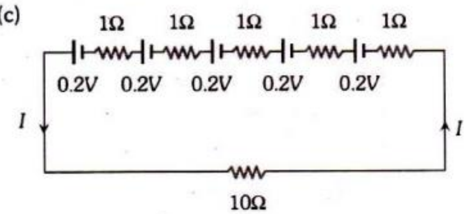
$\therefore\ V_D - V_C = 2 \times 1 = 2V$

$V_A = 0 \ \therefore\ V_C = 1V,\ \ \therefore\ V_D - V_C = 2$

$\Rightarrow\ V_D - 1 = 2 \ \therefore\ V_D = 3V$

$\therefore\ V_D - V_B = 2 \ \therefore\ 3 - V_B = 2 \ \therefore\ V_B = 1V$.

87. (c)



Here, emf of each cell, $\varepsilon = 0.2V$

Internal resistance of each cell, $r = 1\Omega$

External resistance, $R = 10\Omega$

The total emf of 5 cells $= 5\varepsilon = 5(0.2)V = 1V$

Total internal resistance of 5 cells $= 5r = 5(1)\Omega = 5\Omega$

Total resistance of the circuit $= R + 5r = 10 + 5 = 15\Omega$

The current in the external circuit,

$I = \frac{5\varepsilon}{R + 5r} = \frac{1V}{15\Omega} = \frac{1}{15}A$

88. (d) Resistance $= 150 \times 0.5 = 75\,\Omega$

$I = \frac{\Delta V}{\Delta R} = \frac{8}{0.5} = 16A$

$P = I^2R = (16)^2 \times 75W = 19200 = 19.2\,kW.$

Different Measuring Instruments

1. (a) In meter bridge experiment, it is assumed that the resistance of the L shaped plate is negligible, but actually it is not so. The error created due to this is called end error. To remove this the resistance box and the unknown resistance must be interchanged and then the mean reading must be taken.

2. (c) To convert a galvanometer into an ammeter a low value resistance called shunt is to be connected in parallel to it.

3. (d) $\frac{i}{ig}=1+\frac{G}{S}\Rightarrow\frac{5}{1}=1+\frac{60}{S}\Rightarrow S=15\Omega$

5. (c) $E_1=?$, $l_1=60\,cm$; $E_2=3V$, $l_2=45\,cm$

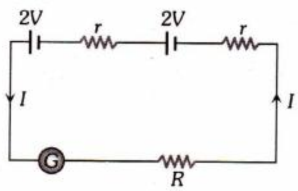
in balance condition

$$\frac{E_1}{E_2}=\frac{l_1}{l_2}\Rightarrow\frac{E_1}{3}=\frac{60}{45}\Rightarrow E_1=4\,volt.$$

6. (a) Here, emf of each cell, $\varepsilon=2V$

Let R be resistance of unknown resistor and r be internal resistance of each cell.

In circuit (a),



(a)

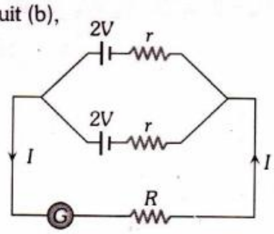
When the cells are connected in series,

Current in the circuit,

$$I=\frac{2\varepsilon}{r+r+R}=\frac{2\times2}{2r+R}\Rightarrow I=\frac{4}{2r+R}$$

$$2r+R=4 \qquad \ldots(i)$$

In circuit (b),



(b)

When the cells are connected in parallel,

Current in the circuit,

$$I=\frac{\varepsilon}{\frac{r\times r}{r+r}+R}=\frac{2}{\frac{r}{2}+R}$$

$$0.8=\frac{2}{\frac{r}{2}+R}$$

$$\frac{r}{2}+R=\frac{2}{0.8}=\frac{5}{2} \qquad \ldots(ii)$$

Subtract (ii) from (i), we get, $\frac{3}{2}r=\frac{3}{2}$ or $r=1\Omega$

7. (e) The resistance $5\Omega, 2\Omega, 6\Omega$ and 15Ω are connected in cyclic order as shown in the figure.

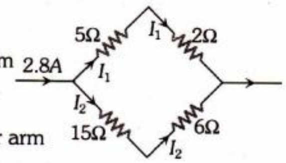
Resistance of the upper arm

$=5\Omega+2\Omega=7\Omega$

Resistance of the lower arm

$=15\Omega+6\Omega=21\Omega$

Current through the upper arm

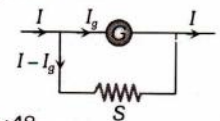


$$I_1=\frac{2.8A\times21\Omega}{7\Omega+21\Omega}=2.1A$$

Hence, the current through the 2Ω resistor is $2.1\,A$.

8. (b) Here, resistance of galvanometer, $G=48\,\Omega$

$$I_g=\frac{4}{100}I=0.04I$$



Let S be required shunt.

$$S=\frac{I_gG}{(I-I_g)}=\frac{0.04I\times48}{(I-0.04I)}=\frac{0.04\times48}{0.96}=2\Omega$$

9. (c) Ammeter is used to measure the current through the circuit.

10. (c) $S=\frac{i_gG}{(i-i_g)}=\frac{1\times0.018}{10-1}=\frac{0.018}{9}=0.002\Omega$

11. (d) A potentiometer does not draw any current from the cell whose emf is to be measured, whereas a voltmeter always draws some current. Hence, we can measure the emf of a cell accurately by using a potentiometer.

12. (c) Shunt resistances $S=\frac{i_gG}{(i-i_g)}=\frac{10\times99}{(100-10)}=11\Omega$

13. (d) By using $R=\frac{V}{i_g}-G\Rightarrow R=\frac{100}{5\times10^{-3}}-5=19{,}995\Omega$

15. (a) $\frac{55}{R}=\frac{20}{80}\Rightarrow R=220\Omega$

16. (c) $i_g=\frac{iS}{S+G}\Rightarrow10=\frac{50\times12}{12+G}\Rightarrow12+G=60\Rightarrow G=48\Omega$

17. (a) To convert a galvanometer into a voltmeter, a high value resistance is to be connected in series with it.

18. (d) Let a resistance $x\Omega$ be connected in parallel with 30Ω, for balancing the Wheatstone bridge.

Since the bridge is balanced, so

$$\frac{10}{10}=\frac{10}{\frac{30\times x}{(30+x)}} \text{ or } \frac{30x}{30+x}=10$$

or $30x=300+10x$ or $20x=300$ or $x=15\Omega$

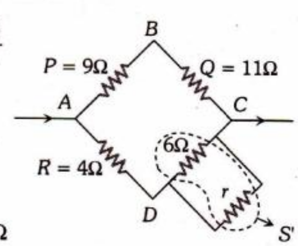
19. (c) $\frac{P}{Q}=\frac{R}{S'}$ [For balancing bridge]

$$\Rightarrow S'=\frac{4\times11}{9}=\frac{44}{9}$$

$$\Rightarrow\frac{1}{S'}=\frac{1}{r}+\frac{1}{6}$$

$$\Rightarrow\frac{9}{44}-\frac{1}{6}=\frac{1}{r}$$

$$\Rightarrow r=\frac{132}{5}=26.4\,\Omega$$



20. (a) $r = \left(\frac{l_1 - l_2}{l_2}\right)R = \left(\frac{25}{100}\right)2 = 0.5\,\Omega$

21. (b) Here, Resistance of the galvanometer, $R_G = 60\,\Omega$

When the galvanometer is shunted by a resistance r, its effective resistance is

$$R_P = \frac{R_G r}{R_G + r} = \frac{(60\,\Omega)(0.02\,\Omega)}{60\,\Omega + 0.02\,\Omega} \approx 0.02\,\Omega$$

Total resistance of the circuit $= R + R_P = R + 0.02$

Current in the circuit, $I = \frac{5}{R + 0.02}$

$$1 = \frac{5}{R + 0.02}$$

$R + 0.02 = 5 \Rightarrow R = 5 - 0.02 \approx 5\,\Omega$

22. (c) If l is the balancing length for R_1, and l' for R_2,

$$\frac{V_0}{L_0}.l = \frac{ER_1}{(r + R_1 + R_2)} \Rightarrow \frac{V_0}{L_0}.l = \frac{ER_1}{(r_1 + 9R_1)} \text{ as } R_2 = 8R_1$$

$$\frac{V_0}{L_0}l' = \frac{E.R_2}{(r_1 + 9R_1)} = \frac{E.8R_1}{(r_1 + 9R_1)}$$

$$\therefore \frac{l'}{l} = \frac{R_2}{R_1} = \frac{8R_1}{R_1} \Rightarrow l' = 8l.$$

23. (a) Here same current is passing throughout the length of the wire, hence $V \propto R \propto l$

$$\Rightarrow \frac{V_1}{V_2} = \frac{l_1}{l_2} \Rightarrow \frac{6}{V_2} = \frac{300}{50} \Rightarrow V_2 = 1\,V.$$

24. (b) Initially total resistance to the circuit $= 50 + 2950 = 3000\Omega$

Finally to reduce the deflection, suppose R resistance is added in series with galvanometer.

$$\because\ i \propto \frac{1}{R} \Rightarrow \frac{i_1}{i_2} = \frac{R_2}{R_1} \Rightarrow \frac{30}{20} = \frac{3000 + R}{3000} \Rightarrow R = 1500\Omega$$

Hence total resistance in final situation $= 2950 + 1500 = 4450\Omega$.

25. (c) Using $r = \left(\frac{l_1}{l_2} - 1\right)R \Rightarrow r = \left(\frac{110}{100} - 1\right) \times 10 = 1\Omega$.

26. (c) The percentage error in measuring resistance with a metre bridge can be minimized by adjusting the balancing point near the middle of the bridge *i.e.* close to $50\,cm$.

27. (d) $V = RI = R_{Cu} + R_{Fe} = (\rho_1 + \rho_2)\frac{\ell}{A}$

$$= (1.7 \times 10^{-6} \times 10^{-2} + 10^{-5} \times 10^{-2}) \div 0.01 \times 10^{-4}\,volt$$

$$= 0.117\,volt$$

30. (c) $L \propto l$

$$\frac{L_1}{L_2} = \frac{l_1}{l_2}$$

$$\frac{10}{11} = \frac{2.5}{l_2}$$

$$10 l_2 = 2.5 \times 11$$

$$l_2 = \frac{2.5 \times 11}{10} = 2.75\,M.$$

31. (d) $I_G = 1mA, R_G = 50\Omega$

$I_G(R_G + R_S) = 1V$

$$\Rightarrow 50\Omega + R_S = \frac{1V}{1 \times 10^{-3}A} = 10^3\,\Omega$$

$\therefore\ R_S = 10^3\,\Omega - 50\Omega$

$R_1 = R_S = 950\Omega$

For 10 V, $R_S = 10^4 - 50 = 9950\Omega$

For the second galvanometer, already 950Ω is in series.

$\therefore\ R_2 = 9950 - 950 = 9000\,\Omega$

32. (b) $\because\ i_g = 10\%$ of $i = \frac{i}{10} \Rightarrow S = \frac{G}{(n-1)} = \frac{90}{(10-1)} = 10\Omega$

33. (c) For the given meter bridge

$$\frac{P}{Q} = \frac{l_1}{100 - l_1}$$

$l_1 = 55\,cm \Rightarrow 100 - l_1 = 45\,cm$

$\because\ P = 3Q$

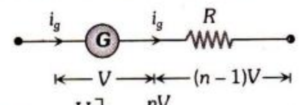
$$\Rightarrow Q = 3 \times \frac{45}{55} = 3 \times \frac{9}{11} = \frac{27}{11}\,\Omega$$

when x is connected in series with P, $l_1 = 75\,cm$

$$\Rightarrow \frac{P + x}{Q} = \frac{75\,cm}{25\,cm} \Rightarrow 3 + x = 3 \times \frac{27}{11}$$

$$\Rightarrow x = \frac{81}{11} - 3 \Rightarrow x = \frac{48}{11}\,\Omega.$$

34. (b) Suppose resistance R is connected in series with voltmeter as shown.



By Ohm's law

$i_g.R = (n-1)V$

$$\Rightarrow R = (n-1)G \left[\text{where } i_g = \frac{V}{G}\right]$$

35. (c) Ammeter is always connected in series with circuit.

36. (c) If resistance of ammeter is r then

$20 = (R + r)4 \Rightarrow R + r = 5 \Rightarrow R < 5\,\Omega$

37. (b) $S = \frac{i_g \times G}{i - i_g} = \frac{10 \times 10^{-3} \times 50}{1 - 10^{-3} \times 10} = \frac{50}{99}\,\Omega$ in parallel.

38. (c) There are 50 divisions on scale.

Initially current for 50 divisions $= \frac{1 \times 50}{10} = 5mA$

$\therefore\ I_g = 5mA$

$$\frac{I_g}{I} = \frac{S}{S + G} \Rightarrow I = \left(\frac{S + G}{S}\right)I_g$$

$$\Rightarrow I = \left(\frac{4 + 20}{4}\right)5mA = 30mA$$

39. (d) $R = \frac{V}{i_g} - G = \frac{100}{10 \times 10^{-3}} - 25 = 9975\,\Omega$

40. (b) $R_{AB} = \frac{3 \times (4+5)}{3 + (4+5)} = \frac{27}{12}$

$$R_{BC} = \frac{4 \times (3+5)}{4 + (3+5)} = \frac{32}{12}$$

$$R_{AC} = \frac{5 \times (3+4)}{5 + (3+4)} = \frac{35}{12}$$

$R_{AB} : R_{BC} : R_{AC} = 27 : 32 : 35$

41. (a) $S = \frac{G}{\frac{i}{i_g} - 1} = \frac{25}{\frac{5}{50\times10^{-6}} - 1} = \frac{25}{10^5 - 1} = \frac{25}{10^5} = 2.5\times10^{-4}\Omega$

42. (b) Potential gradient along wire

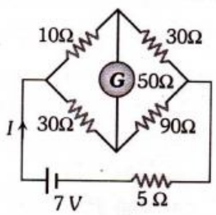
$= \frac{\text{potential difference along wire}}{\text{length of wire}}$

$\Rightarrow 0.1\times10^{-3} = \frac{I\times40}{1000} V/cm$

$\Rightarrow$ Current in wire, $I = \frac{1}{400} A$

$\Rightarrow \frac{2}{40+R} = \frac{1}{400}$ or $R = 800 - 40 = 760\Omega$

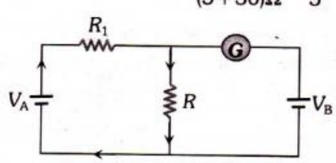
43. (c)



Total resistance of Wheatstone bridge $= \frac{(40)(120)}{40+120} = 30\Omega$

Current through celi $= \frac{7V}{(5+30)\Omega} = \frac{1}{5} A = 0..2A.$

44. (b)



Since deflection in galvanometer is zero so current will flow as shown in the above diagram.

Current $I = \frac{V_A}{R_1 + R} = \frac{12}{500+100} = \frac{12}{600}$

So $V_B = IR$

$= \frac{12}{600}\times100 = 2V$

45. (c) $I = \frac{E}{R_T} = \frac{2.5}{10+R}$ and $V = I.R = \frac{2.5\times10}{10+R} = \frac{25}{10+R}$

$x = \frac{V}{L} = \frac{25}{(10+R)L}$

$E = x.l_1$

$\Rightarrow 1 = \frac{25}{(10+R)L}\times\frac{L}{2} \Rightarrow 25 = 20 + 2R$

$\Rightarrow 2R = 5 \Rightarrow R = \frac{5}{2}$

$\therefore$ Now the resistance is doubled

$R^1 = \frac{5}{2}\times2 = 5\Omega$

$\therefore \quad x = \frac{25}{(10+5)L} = \frac{25}{15.L} = \frac{5}{3L}$

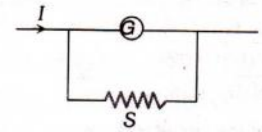
$E = x.l_2$

$\Rightarrow \quad 1 = \frac{5}{3L}.l_2 \Rightarrow l_2 = \frac{3L}{5} = 0.6L$

46. (b) In general, ammeter always reads less than the actual value because of its resistance.

47. (c) By Wheatstone bridge, $\frac{R}{80} = \frac{AC}{BC} = \frac{20}{80} \Rightarrow R = 20\,\Omega$

48. (a)



$\frac{GS}{G+S} = \frac{V_G}{I} = \frac{25\times10^{-3}}{25}$

$\frac{GS}{G+S} = 0.001\,\Omega$

Here S << G So

$S = 0.001\,\Omega$

49. (b) $r = \left(\frac{l_1 - l_2}{l_2}\right)\times R' = \left(\frac{l_1 - 2}{2}\right)\times5$ ... (i)

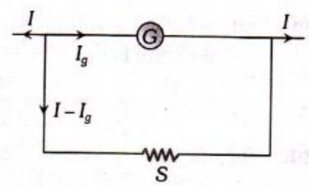
and $r = \left(\frac{l_1 - 3}{3}\right)\times10$ ... (ii)

On solving (i) and (ii), $r = 10\,\Omega$

50. (b) Here, $I_g = 1A$

$I = 10A$

From figure



$I_g G = (I - I_g)S$

$\frac{G}{S} = \frac{I - I_g}{I_g}$

Substituting the given values, we get

$\frac{G}{S} = \frac{10A - 1A}{1A} = \frac{9}{1}$

51. (b) In the part *c b d*,

$V_c - V_b = V_b - V_d \Rightarrow V_b = \frac{V_c + V_d}{2}$

In the part *c a d*

$V_c - V_a > V_a - V_d \Rightarrow \frac{V_c + V_d}{2} > V_a \Rightarrow V_b > V_a$

52. (c) In balance condition, no current will flow through the branch containing *S*.

53. (d) The bridge *ABCD* is balanced if

$\frac{10}{R_1} = \frac{30}{9} \Rightarrow R_1 = 3\,\Omega$

When the bridge is balanced, no current flows in the arm *BD*. Therefore, R_2 can have any finite value.

54. (b) $E = x\,l = \frac{V}{l} = \frac{iR}{L}\times l \Rightarrow E = \frac{e}{(R + R_h + r)}\times\frac{R}{L}\times l$

$\Rightarrow E = \frac{10}{(5+4+1)}\times\frac{5}{5}\times3 = 3\,V$

55. (a) Potential gradient $= \frac{V}{L} = \frac{iR}{L} = \frac{i\rho L}{AL} = \frac{i\rho}{A}$

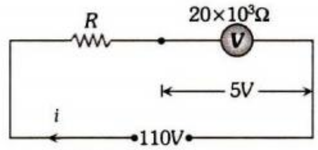
$= \frac{0.2\times40\times10^{-8}}{8\times10^{-6}} = 10^{-2}\,V/m$

56. (a) Potential gradient $x = \frac{e}{(R+R_h+r)} \cdot \frac{R}{L}$

$$\Rightarrow \frac{0.2\times10^{-3}}{10^{-2}} = \frac{2}{(R+490+0)} \times \frac{R}{1} \Rightarrow R = 4.9\,\Omega.$$

57. (d) The resistance of an ideal voltmeter is considered as infinite.

58. (c)



Here $i = \frac{110}{20\times10^3 + R}$

$$\because\ V = iR \Rightarrow 5 = \left(\frac{110}{20\times10^3+R}\right)\times 20\times10^3$$

$$\Rightarrow 10^5 + 5R = 22\times10^5 \Rightarrow R = 21\times\frac{10^5}{5} = 420\,K\Omega$$

59. (c) Due to the negligible temperature co-efficient of resistance of constantan wire, there is no change in it's resistance value with change in temperature.

60. (d) The resistance of voltmeter is too high, so that it draws negligible current from the circuit, hence potential drop in the external circuit is also negligible.

61. (c) $R = kl_1$ and $R + X = kl_2$

62. (a) Since potential difference for full length of wire = 2 V

$$\therefore \text{ P.D. per unit length of wire} = \frac{2}{4} = 0.5\frac{V}{m}$$

63. (d) $\frac{X}{1} = \frac{20}{80} \Rightarrow X = \frac{1}{4}\Omega = 0.25\,\Omega$.

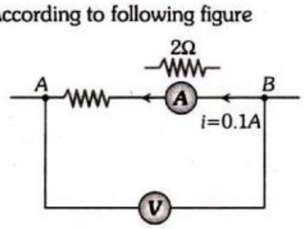
64. (a) Reading of galvanometer remains same whether switch S is open or closed, hence no current will flow through the switch *i.e.* R and G will be in series and same current will flow through them. $I_R = I_G$.

65. (d) Pressing the key does not disturb current in all resistances as the bridge is balanced. Therefore, deflection in the galvanometer in whatever direction it was, will stay.

66. (b) $i_g S = (i - i_g)G \Rightarrow i_g(S+G) = iG$

$$\Rightarrow \frac{i_g}{i} = \frac{G}{S+G} = \frac{8}{2+8} = 0.8$$

67. (a) According to following figure



Reading of voltmeter = Potential difference between A and B = $i\,(R + 2) \Rightarrow 12 = 0.1\,(R + 2) \Rightarrow R = 118\,\Omega$.

68. (c) Let S be larger and R be smaller resistance connected in two gaps of meter bridge.

$$\therefore\ S = \left(\frac{100-l}{l}\right)R = \frac{100-20}{20}R = 4R \quad .....(i)$$

When 15Ω resistance is added to resistance R, then

$$S = \left(\frac{100-40}{40}\right)(R+15) = \frac{6}{4}(R+15) \quad .... (ii)$$

From equations (i) and (ii), $R = 9\Omega$

69. (c) Resistance of shunted ammeter $= \frac{GS}{G+S}$

Also $\frac{i}{i_g} = 1 + \frac{G}{S} \Rightarrow \frac{GS}{G+S} = \frac{i_g.G}{i}$

$$\Rightarrow \frac{GS}{G+S} = \frac{0.05\times120}{10} = 0.6\,\Omega$$

70. (a) Let E_A, E_B and E_C be the emf of three cells A, B and C respectively.

As per question

$E_A + E_B + E_C = kl_1 = k\times740$ ...(i)

$E_A + E_B = kl_2 = k\times440$ ...(ii)

$E_B + E_C = kl_3 = k\times540$ ...(iii)

Inserting the value of $E_A + E_B$ from (ii) into (i), we get

$E_C = 300k$

Inserting the value of $E_B + E_C$ from (iii) into (i), we get

$E_A = 200k$

Inserting this value of E_A into (ii), we get

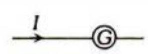
$E_B = 240k$

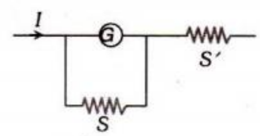
$E_A : E_B : E_C = 200k : 240k : 300k$

$= 10 : 12 : 15 = 1 : 1.2 : 1.5$

$E_A = 1V, E_B = 1.2V, E_C = 1.5V$

71. (a)





$$G = \left(\frac{GS}{G+S}\right) + S'$$

$$G - \frac{GS}{G+S} = S' \quad \therefore\ S' = \frac{G^2}{G+S}$$

72. (a) $I_G \times G = (I - I_G)S \Rightarrow I = \left(1 + \frac{G}{S}\right)I_G$

$\Rightarrow I = 100.1\ mA$

73. (a) $\frac{i}{i_g} = \frac{G+S}{S} \Rightarrow \frac{i_g}{i} = \frac{S}{G+S} = \frac{2.5}{27.5} = \frac{1}{11}$

74. (b) $l_1 = 52 + 1 = 53\ cm$, $l_2 = 48 + 2 = 50\ cm$

$$\frac{l_1}{l_2} = \frac{X}{R} \Rightarrow \frac{53}{50} = \frac{X}{10}$$

$X = 10.6\,\Omega.$

75. (a) Potential gradient $x = \frac{V}{L} = \frac{iR}{L} = \frac{i\left(\frac{\rho L}{A}\right)}{L} = \frac{i\rho}{A}$

76. (d) Here $n = \frac{10}{2} = 5$

$\therefore\ R = (n-1)G = (5-1)2000 = 8000\,\Omega$

77. (d) $E = \frac{V}{l}$; E is constant (volt. gradient).

$\Rightarrow \frac{V_1}{l_1} = \frac{V_2}{l_2} \Rightarrow \frac{1.1}{140} = \frac{V}{180} \Rightarrow V = \frac{180 \times 1.1}{140} = 1.41V$

79. (b) $V = i.R. = \frac{e}{(R+R_h+r)}.R \Rightarrow 10^{-3} = \frac{2}{(10+R+r)} \times 10$

$\Rightarrow R = 19{,}989\Omega$.

81. (c) $2R > 20 \Rightarrow R > 10\Omega$.

82. (c) $\frac{i}{i_g} = 1 + \frac{G}{S} \Rightarrow \frac{4}{1} = 1 + \frac{R}{S} \Rightarrow S = \frac{R}{3}$.

83. (a) When ammeter is connected in parallel to the circuit, net resistance of the circuit decreases. Hence more current is drawn from the battery, which damages the ammeter.

84. (a) $r = \left(\frac{l_1 - l_2}{l_2}\right) \times R' \Rightarrow r = \left(\frac{55-50}{50}\right) \times 10 = 1\Omega$.

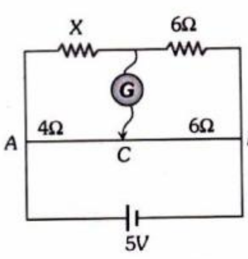
85. (b) $r = R\left(\frac{l_1}{l_2} - 1\right) = 2\left(\frac{240}{120} - 1\right) = 2\Omega$

87. (c) $R = \frac{V}{i_g} - G = \frac{6}{6 \times 10^{-3}} - 25 = 975\Omega$ [In series].

88. (d) $i_g = i\frac{S}{G+S} \Rightarrow 0.01 = 10\frac{S}{25+S}$

$\Rightarrow 1000S = 25 + S \Rightarrow S = \frac{25}{999}\Omega$.

89. (c)



Resistance of the part AC

$R_{AC} = 0.1 \times 40 = 4\Omega$ and $R_{CB} = 0.1 \times 60 = 6\Omega$

In balanced condition $\frac{X}{6} = \frac{4}{6} \Rightarrow X = 4\Omega$

Equivalent resistance $R_{eq} = 5\Omega$ so current drawn from battery $i = \frac{5}{5} = 1A$.

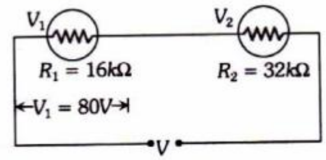
90. (a) $(R+G)i_g = V \Rightarrow (R+G) = \frac{V}{i_g}$

$= \frac{3}{30 \times 16 \times 10^{-6}} = 6.25k\Omega$

$\therefore$ Value of R is nearly equal to $6k\Omega$

This is connected in series in a voltmeter.

91. (d)



$R_1 = 80 \times 200 = 16000\,\Omega = 16\,k\Omega$

Current flowing through $V_1 =$ Current flowing through $V_2 = \frac{80}{16 \times 10^3} = 5 \times 10^{-3}A$.

So, potential differences across V_2 is

$V_2 = 5 \times 10^{-3} \times 32 \times 10^3 = 160$ volt

Hence, line voltage $V = V_1 + V_2 = 80 + 160 = 240V$.

92. (d) $V = xl \Rightarrow iR = xl$

$\Rightarrow i \times 10 = \left(\frac{2 \times 10^{-3}}{10^{-2}}\right) \times 50 \times 10^{-2} = 0.1$

$\Rightarrow i = 10 \times 10^{-3}A = 10mA$.

93. (d) $E = \frac{e}{(R+R_h+r)}\frac{R}{L} \times l = \frac{2}{(10+40+0)} \times \frac{10}{1} \times 0.4 = 0.16V$.

94. (c) $\frac{i}{i_g} = 1 + \frac{G}{S} \Rightarrow \frac{5}{2} = 1 + \frac{12}{S} \Rightarrow S = 8\Omega$ [In parallel].

95. (d) $\frac{i_g}{i} = \frac{S}{G+S} \Rightarrow \frac{5}{100} = \frac{S}{G+S} \Rightarrow S = \frac{G}{19}$

96. (a) $R = G(n-1) = 50 \times 10^3(3-1) = 10^5\,\Omega$.

97. (c) $\frac{E_1}{E_2} = \frac{l_1 + l_2}{l_1 - l_2} = \frac{58+29}{58-29} = \frac{3}{1}$

98. (a) $R = \frac{V}{i_g} - G = \frac{10}{10 \times 10^{-3}} - 1 = 999\Omega$.

99. (d) For conversion of galvanometer (of resistances) into voltmeter, a resistance R is connected in series.

$\therefore\ i_g = \frac{V_1}{R+G}$ and $i_g = \frac{V_2}{2R+G}$

$\Rightarrow \frac{V_1}{R+G} = \frac{V_2}{2R+G} \Rightarrow \frac{V_2}{V_1} = \frac{2R+G}{R+G} = \frac{2(R+G)-G}{(R+G)}$

$= 2 - \frac{G}{(R+G)} \Rightarrow V_2 = 2V_1 - \frac{V_1 G}{(R+G)} \Rightarrow V_2 < 2V_1$

100. (d) If the voltmeter is ideal then given circuit is an open circuit, so reading of voltmeter is equal to the e.m.f. of cell *i.e.*, 6V.

101. (c) $\frac{i_g}{i} = \frac{S}{G+S} = \frac{4}{36+4} = \frac{1}{10}$ *i.e.* 10%.

102. (d) After connecting a resistance R in parallel with voltmeter its effective resistance decreases. Hence less voltage appears across it *i.e.* V will decreases. Since overall resistance decreases so more current will flow *i.e.* A will increase.

103. (c) Potential gradient $x = \frac{e}{(R + R_h + r)} \cdot \frac{R}{L}$

$$\Rightarrow \quad \frac{10^{-3}}{10^{-2}} = \frac{2}{(3 + R_h + 0)} \times \frac{3}{1} \Rightarrow R_h = 57\Omega .$$

104. (c) $\frac{i}{i_g} = 1 + \frac{G}{S} \Rightarrow \quad \frac{1}{10^{-3}} = 1 + \frac{20}{S} \Rightarrow S = \frac{20}{999} \approx 0.02\Omega .$

105. (a) Resistance of voltmeter should be high.

106. (c) If ammeter is used in place of voltmeter (*i.e.* in parallel) it may damage due to large current in circuit. Hence to control this large amount of current a high resistance must be connected in series.

107. (c) Potential gradient $x = \frac{e}{(R + R_h + r)} \cdot \frac{R}{L}$

$$= \frac{3}{(20 + 10 + 0)} \times \frac{20}{10} = 0.2$$

108. (d) $\frac{E_1}{E_2} = \frac{l_1 + l_2}{l_1 - l_2} = \frac{(6+2)}{(6-2)} = \frac{2}{1}$

109. (c) Manganin or constantan are used for making the potentiometer wire.

111. (a) $\frac{i}{i_g} = 1 + \frac{G}{S} \Rightarrow \frac{i.G}{V_g} = 1 + \frac{G}{S} \Rightarrow \frac{100 \times 10^{-3} \times 40}{800 \times 10^{-3}} = 1 + \frac{40}{S}$

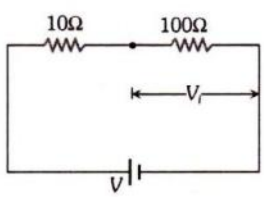
$\Rightarrow S = 10\Omega .$

112. (a) $i_g = i\frac{S}{G+S} \Rightarrow 10 \times 10^{-3} = \frac{S}{100 + S} \times 100 \times 10^{-3}$

$$90\,S = 1000 \Rightarrow S = \frac{1000}{90} = 11.11\,\Omega .$$

113. (c) Before connecting the voltmeter, potential difference across 100Ω resistance

$V_i = \frac{100}{(100+10)} \times V = \frac{10}{11} V$

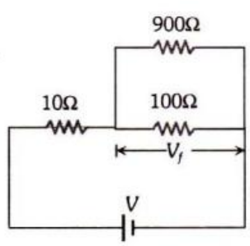


Finally after connecting voltmeter across 100Ω equivalent resistance

$\frac{100 \times 900}{(100 + 900)} = 90\Omega$

Final potential difference

$V_f = \frac{90}{(90+10)} \times V = \frac{9}{10} V$



% error $= \frac{V_i - V_f}{V_i} \times 100$

$$= \frac{\frac{10}{11}V - \frac{9}{10}V}{\frac{10}{11}V} \times 100 = 1.0.$$

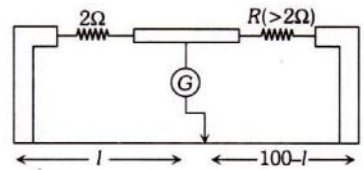
114. (b) Potential gradient $= \frac{e.R}{(R + r).L} = \frac{10 \times 3}{(3+3) \times 5}$.

$= 1V/m = 10\,mV/cm.$

115. (a) Potential difference per unit length $= \frac{V}{L} = \frac{2}{4} = 0.5\,V/m$

116. (d) $\frac{i_g}{i} = \frac{S}{G+S} = \frac{4}{36+4} = \frac{4}{40} = \frac{1}{10}$

117. (a)



$\frac{l}{2} = \frac{100 - l}{R}$ ... (i)

In the second case

$\frac{l + 20}{R} = \frac{80 - l}{2}$ ... (ii)

Solving eq. (i) & (ii)

$R = 3\Omega.$

118. (b) $i_g = i\frac{S}{G+S} \Rightarrow \frac{0.01}{10} = \frac{S}{50+S} \Rightarrow S = \frac{50}{999} = 0.05\Omega .$

119. (d) $S = \left(\frac{100 - l}{l}\right).R$

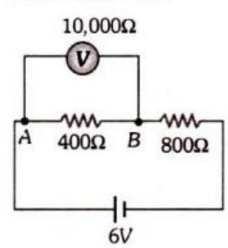
Initially, $30 = \left(\frac{100 - l}{l}\right) \times 10 \Rightarrow l = 25cm$

Finally, $10 = \left(\frac{100 - l}{l}\right) \times 30 \Rightarrow l = 75cm$

So, shift = $50cm$.

120. (c) Potential gradient (x) $= \frac{i\rho}{A} = \frac{0.1 \times 10^{-7}}{10^{-6}} = 10^{-2}\,V/m$

121. (d) Before connecting voltmeter potential difference across 400Ω resistance is



$V_i = \frac{400}{(400 + 800)} \times 6 = 2V$

After connecting voltmeter equivalent resistance between A and B $= \frac{400 \times 10{,}000}{(400 + 10{,}000)} = 384.6\Omega$

Hence, potential difference measured by voltmeter $V_f = \frac{384.6}{(384.6 + 800)} \times 6 = 1.95V$

Error in measurement $= V_i - V_f = 2 - 1.95 = 0.05V.$

122. (c) $\frac{i}{i_g} = 1 + \frac{G}{S} \Rightarrow \frac{5}{0.05} = 1 + \frac{50}{S}$

$$\Rightarrow S = \frac{50}{99} = \frac{\rho \times l}{A} \Rightarrow l = \frac{50}{99} \times \frac{2.97\times10^{-2}\times10^{-4}}{5\times10^{-7}} = 3m.$$

123. (a) $\frac{i}{i_g} = 1 + \frac{G}{S} \Rightarrow \frac{10}{1} = 1 + \frac{0.81}{S} \Rightarrow S = 0.09\Omega$.

124. (a) From the principle of potentiometer $V \propto l$

$\Rightarrow \frac{V}{E} = \frac{l}{L}$; where V = emf of battery, E = emf of standard cell, L = Length of potentiometer wire

$V = \frac{El}{L} = \frac{30E}{100}$.

125. (b) $E = \frac{e}{(R + R_h + r)} \cdot \frac{R}{L} \times l$

$$\Rightarrow 10\times10^{-3} = \frac{2}{(10 + R + 0)} \times \frac{10}{1} \times 0.4 \Rightarrow R = 790\Omega$$

126. (d) $E = \frac{e}{(R + R_h + r)} \cdot \frac{R}{L} \times l \Rightarrow 0.4 = \frac{5}{(5 + 45 + 0)} \times \frac{5}{10} \times l$

$\Rightarrow l = 8\ m$

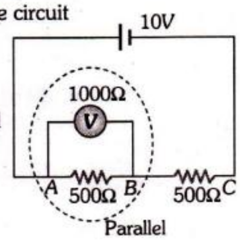
127. (d) Resistance between A and B = $\frac{1000\times500}{(1500)} = \frac{1000}{3}$

So, equivalent resistance of the circuit

$R_{eq} = 500 + \frac{1000}{3} = \frac{2500}{3}$

$\therefore$ Current drawn from the cell

$i = \frac{10}{(2500/3)} = \frac{3}{250} A$



Reading of voltmeter *i.e.*

potential difference across $AB = \frac{3}{250} \times \frac{1000}{3} = 4V$

128. (d) $i_g = \frac{i}{10}$ ⇒ Required shunt $S = \frac{G}{(n-1)} = \frac{90}{(10-1)} = 10\Omega$

129. (b) $R = \frac{50}{10\times10^{-3}} - 40 = 4960\ \Omega$.

130. (c) Post office box is based on the principle of Wheatstone's bridge

131. (d) Full deflection current $i_g = 25\times4\times10^{-4} = 100\times10^{-4} A$

Using $R = \frac{V}{I_g} - G = \frac{25}{100\times10^{-4}} - 50 = 2450\,\Omega$ in series.

132. (a) In balancing condition, $\frac{R_1}{R_2} = \frac{l_1}{l_2} = \frac{l_1}{100 - l_1}$

$\Rightarrow \frac{X}{Y} = \frac{20}{80} = \frac{1}{4}$ .....(i)

and $\frac{4X}{Y} = \frac{l}{100 - l}$ .....(ii)

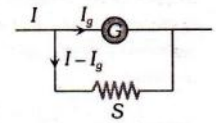
$\Rightarrow \frac{4}{4} = \frac{l}{100 - l}$ $\Rightarrow l = 50\,cm$.

133. (b) Potentiometer is based on null deflection.

134. (a) G and S are in parallel

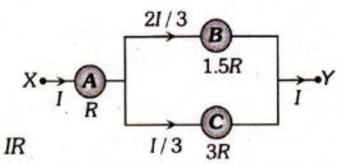
$I_g G = (I - I_g)S$ ... (i)

and $I_g = \frac{10}{500} = \frac{1}{50}$ ... (ii)



from (i) and (ii), $S = 1\Omega$.

135. (a)

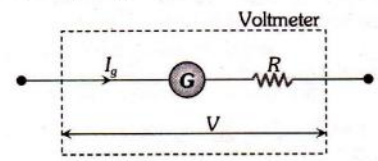


$V_1 = IR$

$V_2 = \frac{2I}{3} \times 1.5R = IR;\ V_3 = \frac{I}{3} \times 3R = IR$

$\therefore V_1 = V_2 = V_3$

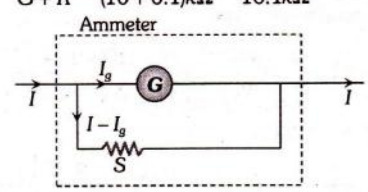
137. (e)



Here, $V = 10V, R = 10k\Omega, G = 100\Omega = 0.1k\Omega$

$V = I_g(G + R)$

$$I_g = \frac{V}{G + R} = \frac{10V}{(10 + 0.1)k\Omega} = \frac{10V}{10.1k\Omega} = 0.99mA \approx 1mA$$



Here, $I = 1A$, $(I - I_g)S = I_g G$

$S = \frac{I_g G}{I - I_g} = \frac{1\times10^{-3}\times100}{1 - 1\times10^{-3}}$

$\approx \frac{100\times10^{-3}}{1} = \frac{100}{1000}\Omega = \frac{1}{10}\Omega = 0.1\Omega$.

138. (a) $r = \left(\frac{l_1}{l_2} - 1\right)R$

$= \left(\frac{3}{2.85} - 1\right)9.5\,\Omega = \frac{0.15}{2.85} \times 9.5\,\Omega = 0.5\Omega$.

139. (c) For balanced meter bridge

$\frac{X}{R} = \frac{\ell}{(100 - \ell)}$

$\frac{X}{40} = \frac{90}{60} \Rightarrow x = 60\Omega$

$X = R\frac{\ell}{(100 - \ell)}$

$\frac{\Delta X}{X} = \frac{\Delta\ell}{\ell} + \frac{\Delta\ell}{100 - \ell} = \frac{0.1}{40} + \frac{0.1}{60}$

$\Delta X = 0.25$

So $X = (60 \pm 0.25)\Omega$.

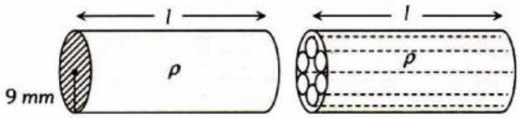
Critical Thinking Questions

1. (a) Initially : Resistance of given cable

$$R = \rho \frac{l}{\pi \times (9 \times 10^{-3})^2} \quad \text{... (i)}$$

Finally : Resistance of each insulated copper wire is

$R' = \rho \frac{l}{\pi \times (3 \times 10^{-3})^2}$. Hence equivalent resistance of cable $R_{eq} = \frac{R'}{6} = \frac{1}{6} \times \left(\rho \frac{l}{\pi \times (3 \times 10^{-3})^2} \right)$ ...(ii)



On solving equation (i) and (ii), we get $R_{eq} = 7.5\,\Omega$

2. (e) Let R be resistance of each bulb. When the bulbs are connected in series, $R_S = 3R$

$$\therefore P_S = \frac{V^2}{R_S} = \frac{V^2}{3R} \quad \text{...(i)}$$

When the bulbs are connected in parallel,

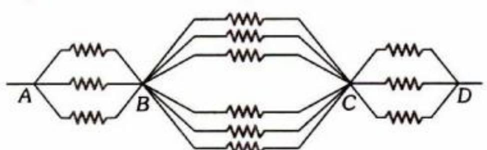
$$\frac{1}{R_P} = \frac{1}{R} + \frac{1}{R} + \frac{1}{R} \text{ or } R_P = \frac{R}{3}$$

$$\therefore P_P = \frac{V^2}{R_P} = \frac{V^2}{(R/3)} = \frac{3V^2}{R} \quad \text{...(ii)}$$

Divide (ii) by (i), we get, $\frac{P_P}{P_S} = \frac{3V^2}{R} \times \frac{3R}{V^2} = 9$

$P_P = 9P_S = 9 \times 20W = 180W$

3. (c) The given circuit can be simplified as follows



$$\therefore R_{AD} = \frac{5R}{6}$$

4. (c) Suppose n resistors are used for the required job. Suppose equivalent resistance of the combination is R' and according to energy conservation it's current rating is i'.

Energy consumed by the combination = n × (Energy consumed by each resistance)

$$\Rightarrow i'^2 R' = n \times i^2 R \Rightarrow n = \left(\frac{i'}{i}\right)^2 \times \left(\frac{R'}{R}\right) = \left(\frac{4}{1}\right)^2 \times \left(\frac{5}{10}\right) = 8$$

5. (c) From the figure net resistance

$R_1 = 1$ ohm, $R_2 = \frac{1}{2}$ ohm, $R_3 = 2$ ohm

It is clear that $R_3 > R_1 > R_2 \;\therefore P_3 < P_1 < P_2 \left[\text{As } P = \frac{V^2}{R}\right]$

6. (b) No current flows through the capacitor branch in steady state. Total current supplied by the battery

$i = \frac{6}{2.8 + 1.2} = \frac{3}{2}$.

Current through 2 Ω resistor $= \frac{3}{2} \times \frac{3}{5} = 0.9A$

7. (d) At time $t = 0$ *i.e.* when capacitor is charging, current

$i = \frac{2}{1000} = 2mA$

When capacitor is full charged, no current will pass through it, hence current through the circuit

$i = \frac{2}{2000} = 1mA$

8. (d) Current in the bulb $= \frac{P}{V} = \frac{4.5}{1.5} = 3A$

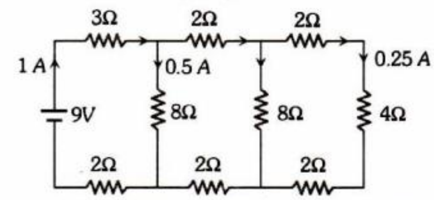
Current in 1 Ω resistance $= \frac{1.5}{1} = 1.5A$

Hence total current from the cell $i = 3 + 1.5 = 4.5A$

By using $E = V + ir \Rightarrow E = 1.5 + 4.5 \times (2.67) = 13.5V$

9. (d) Equivalent resistance of the circuit $R = 9\Omega$

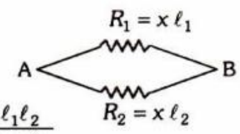
$\therefore$ Main current $i = \frac{V}{R} = \frac{9}{9} = 1A$



After proper distribution, the current through 4Ω resistance is 0.25 A.

10. (d) Let x is the resistance per unit length then

Equivalent resistance



$$R = \frac{R_1 R_2}{R_1 + R_2}$$

$$\Rightarrow \frac{8}{3} = \frac{(x\ell_1)(x\ell_2)}{x\ell_1 + x\ell_2} \Rightarrow \frac{8}{3} = x\frac{\ell_1 \ell_2}{\ell_1 + \ell_2}$$

$$\Rightarrow \frac{8}{3} = x\frac{\ell_1}{\frac{\ell_1}{\ell_2} + 1} \quad \text{...(i)}$$

Also $R_0 = x\ell_1 + x\ell_2 \Rightarrow 12 = x(\ell_1 + \ell_2)$

$$\Rightarrow 12 = x\ell_2\left(\frac{\ell_1}{\ell_2} + 1\right) \quad \text{...(ii)}$$

Dividing eq. (i) by eq. (ii)

$$\frac{\frac{8}{3}}{\frac{12}{1}} = \frac{\frac{x\ell_1}{\left(\frac{\ell_1}{\ell_2}+1\right)}}{x\ell_2\left(\frac{\ell_1}{\ell_2}+1\right)} = \frac{\ell_1}{\ell_2\left(\frac{\ell_1}{\ell_2}+1\right)^2} \Rightarrow \left(\frac{\ell_1}{\ell_2}+1\right)^2 \times \frac{8}{36} = \frac{\ell_1}{\ell_2}$$

$$\Rightarrow (y^2 + 1 + 2y) \times \frac{8}{36} = y \quad \left[\text{Where } y = \frac{\ell_1}{\ell_2}\right]$$

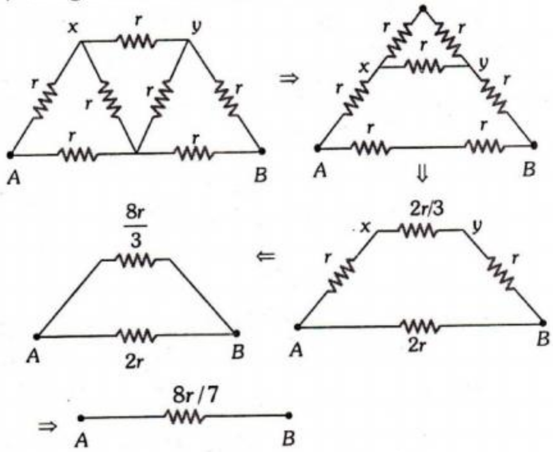
$$\Rightarrow 8y^2 + 8 + 16y = 36y$$

$$\Rightarrow 8y^2 - 20y + 8 = 0$$

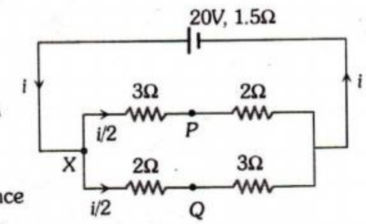
On solving, we get $y = \frac{1}{2}$ or 2

$\therefore y = \frac{\ell_1}{\ell_2} = \frac{1}{2}$ or 2

11. (d) The given circuit can be simplified as follows.



12. (d) $R_{eq} = \frac{5}{2}\Omega$



$i = \frac{20}{\frac{5}{2}+1.5} = 5A$

Potential difference between X and P,

$V_X - V_P = \left(\frac{5}{2}\right)\times 3 = 7.5V$ ....(i)

$V_X - V_Q = \frac{5}{2}\times 2 = 5V$ ...(ii)

On solving (i) and (ii) $V_P - V_Q = -2.5$ *volt*; $V_Q > V_P$.

Short Trick : $(V_P - V_Q) = \frac{i}{2}(R_2 - R_1) = \frac{5}{2}(2-3) = -2.5$

$\Rightarrow V_Q > V_P$

13. (c) $R_{t_1} = R_1(1+\alpha_1 t)$ and $R_{t_2} = R_2(1+\alpha_2 t)$

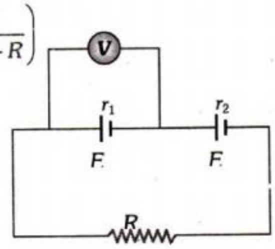
Also $R_{eq} = R_{t_1} + R_{t_2} \Rightarrow R_{eq} = R_1 + R_2 + (R_1\alpha_1 + R_2\alpha_2)t$

$\Rightarrow R_{eq} = (R_1+R_2)\left[1+\left(\frac{R_1\alpha_1 + R_2\alpha_2}{R_1+R_2}\right).t\right]$

So $\alpha_{eff} = \frac{R_1\alpha_1 + R_2\alpha_2}{R_1+R_2}$

14. (b) Let the voltage across any one cell is V, then

$V = E - ir = E - r_1\left(\frac{2E}{r_1+r_2+R}\right)$



But $V = 0$

$\Rightarrow E - \frac{2Er_1}{r_1+r_2+R} = 0$

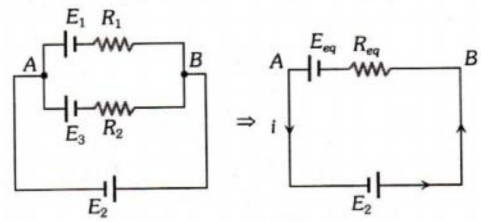
$\Rightarrow r_1 + r_2 + R = 2r_1$

$\Rightarrow R = r_1 - r_2$

15. (b) Emf $E = 5V$, Internal resistance $r = \frac{5}{10} = 0.5\Omega$

Current through the resistance $i = \frac{5}{(2+0.5)} = 2A$

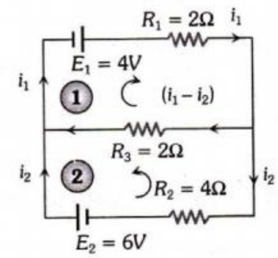
16. (b) The given circuit can be redrawn



$E_{eq} = \frac{E_1R_2 + E_3R_1}{R_1+R_2} = \frac{2\times 4 + 2\times 4}{4+4} = 2V$ and

$R_{eq} = \frac{4}{2} = 2\Omega$. Current $i = \frac{2+2}{2} = 2A$ from A to B through E_2.

17. (b) Applying Kirchhoff's law for the loops (1) and (2) as shown in figure



For loop (1)

$-2i_1 - 2(i_1 - i_2) + 4 = 0$

$\Rightarrow 2i_1 - i_2 = 2$ ...(i)

For loop (2)

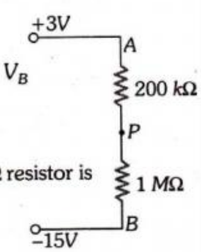
$-2(i_1 - i_2) + 4i_2 - 6 = 0$

$\Rightarrow -i_1 + 3i_2 = 3$ ...(ii)

On solving equation (i) and (ii), $i_1 = 1.8A$.

18. (c) Potential difference across 1 $M\Omega$ resistor is

$V_P - V_B = \frac{18V\times 1\times 10^6\Omega}{(0.2+1)\times 10^6\Omega} = \frac{18V\times 1\times 10^6\Omega}{1.2\times 10^6\Omega} = 15V$



$V_B = -15V$ [Given]

$\therefore V_P - V_B = 15V$ or $V_P = 15V + V_B$

$= 15V - 15V = 0V$

Potential difference across 200 $k\Omega$ resistor is

$V_A - V_P = \frac{18V\times 0.2\times 10^6\Omega}{(0.2+1)\times 10^6\Omega}$

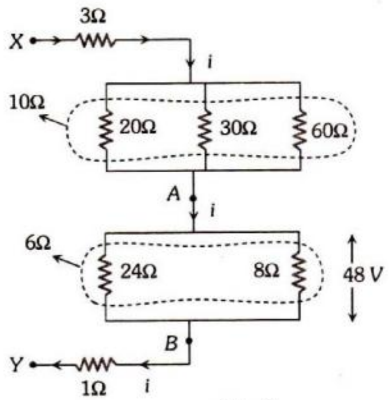
$= \frac{18V\times 0.2\times 10^6\Omega}{1.2\times 10^6\Omega} = 3V$

$V_A = +3V$ [Given]

$\therefore V_A - V_P = 3V$ or $V_P = V_A - 3V$

$= +3V - 3V = 0V$

19. (a) The given circuit can be redrawn as follows



Resistance between A and $B = \frac{24\times8}{32} = 6\,\Omega$

Current between A and B = Current between X and Y

$= i = \frac{48}{6} = 8A$

Resistance between X and $Y = (3+10+6+1) = 20\,\Omega$

$\Rightarrow$ Potential difference between X and $Y = 8\times20 = 160\,V$

20. (d) $R_1 + R_2 = R_1(1+\alpha t) + R_2(1-\beta t)$

$$\Rightarrow R_1 + R_2 = R_1 + R_2 + R_1\alpha t - R_2\beta t \Rightarrow \frac{R_1}{R_2} = \frac{\beta}{\alpha}$$

21. (d) Current density of drifting electrons $j = nev$

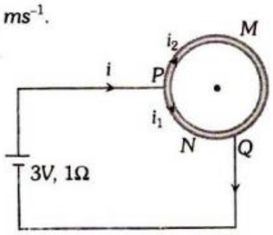
$n = 5\times10^7 cm^{-3} = 5\times10^7\times10^6 m^{-3}$.

$v = 0.4 ms^{-1}, e = 1.6\times10^{-19}C \Rightarrow j = 3.2\times10^{-6} Am^{-2}$

Current density of ions $= (4-3.2)\times10^{-6} = 0.8\times10^{-6}\,\frac{A}{m^2}$

This gives v for ions $= 0.1\ ms^{-1}$.

22. (a) In the following figure



Resistance of part PNQ;

$R_1 = \frac{10}{4} = 2.5\Omega$ and

Resistance of part PMQ;

$R_2 = \frac{3}{4}\times10 = 7.5\Omega$

$$R_{eq} = \frac{R_1R_2}{R_1+R_2} = \frac{2.5\times7.5}{(2.5+7.5)} = \frac{15}{8}\Omega.$$

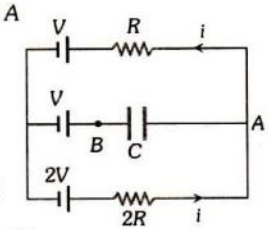
$$\text{Main Current } i = \frac{3}{\frac{15}{8}+1} = \frac{24}{23}A$$

$$\text{So, } i_1 = i\times\left(\frac{R_2}{R_1+R_2}\right) = \frac{24}{23}\times\left(\frac{7.5}{2.5+7.5}\right) = \frac{18}{23}A$$

$$\text{and } i_2 = i - i_1 = \frac{24}{23} - \frac{18}{23} = \frac{6}{23}A.$$

23. (c) As I is independent of R_6, no current flows through R_6 this requires that the junction of R_1 and R_2 is at the same potential as the junction of R_3 and R_4. This must satisfy the condition $\frac{R_1}{R_2} = \frac{R_3}{R_4}$, as in the Wheatstone bridge.

24. (c) Moving anticlockwise from A



$-iR - V + 2V - 2iR = 0$

or $3iR = V$ or $i = \frac{V}{3R}$

$V_A - V_B = iR + V - V = iR$

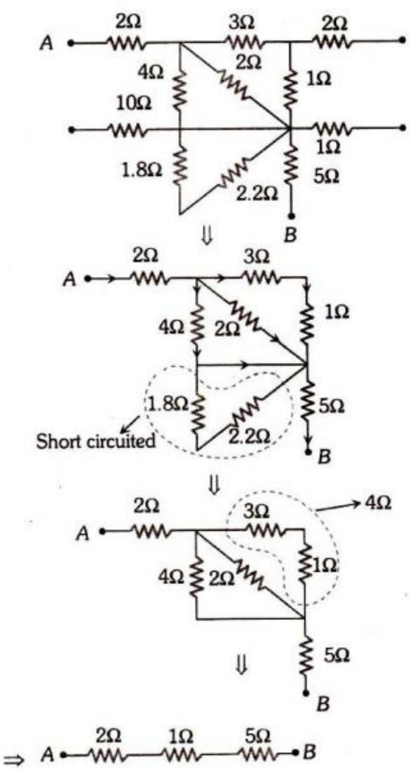
$\Rightarrow$ Potential drop across $C = \frac{V}{3}$

25. (b) Let R and m be the resistance and mass of the first wire, then the second wire has resistance $2R$ and mass $2m$. Let E = emf of each cell, S = specific heat capacity of the material of the wire. For the first wire, current $i_1 = \frac{3E}{R}$ and $i_1^2Rt = mS\Delta T$

For the second wire, $i_2 = \frac{NE}{2R}$ and $i_2^2(2R)t = 2mS\Delta T$.

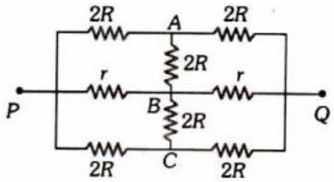
Thus, $i_1 = i_2$ or $N = 6$.

26. (b)



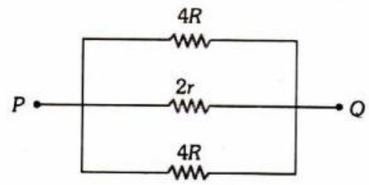
$R_{AB} = 8\Omega$.

27. (a)



In a circuit, any circuit element placed between points at the same potential can be removed, without affecting the rest of the circuit. Here, by symmetry, points A, B and C are at same potential, for any potential difference between P and Q.

The circuit can therefore be reduced as shown below



Effective resistance $R_{eq} = \dfrac{2Rr}{R+r}$.

28. (d) Potential difference between A and B

$V_A - V_B = 1 \times 1.5$

$\Rightarrow V_A - 0 = 1.5V \Rightarrow V_A = 1.5V$

Potential difference between B and C

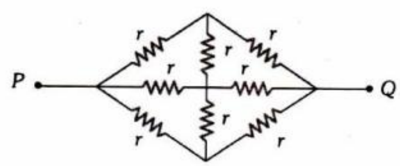
$V_B - V_C = 1 \times 2.5 = 2.5V$

$\Rightarrow 0 - V_C = 2.5V \Rightarrow V_C = -2.5V$

Potential difference between C and D

$V_C - V_D = -2V \Rightarrow -2.5 - V_D = -2 \Rightarrow V_D = -0.5V$.

29. (b) The given circuit can be simplifies as follows



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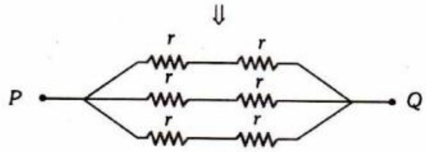

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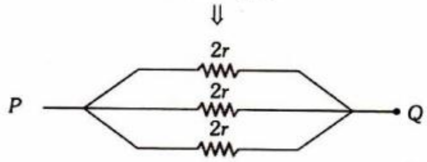


$R' = \dfrac{2r}{3} = \dfrac{2}{3} \times \dfrac{3}{2} = 1\Omega$.

30. (b) $dQ = Idt \Rightarrow Q = \int_{t=2}^{t=3} Idt = \left[2\int_2^3 tdt + 3\int_2^3 t^2 dt\right]$

$= \left[t^2\right]_2^3 + \left[t^3\right]_2^3 = (9-4) + (27-8) = 5 + 19 = 24C.$

31. (d) $i = \dfrac{E_1 + E_2 + E_3 + ... + E_n}{(r_1 + r_2 + r_3 + ... + r_n)}$

$= \dfrac{1.5(r_1 + r_2 + r_3 + ... + r_n)}{(r_1 + r_2 + r_3 + ... + r_n)} = 1.5A$.

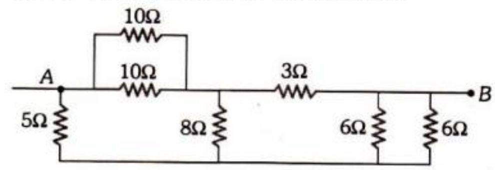
32. (a) Balancing length is independent of the cross sectional area of the wire.

33. (c) Resistance of bulb is constant

$P = \dfrac{\upsilon^2}{R} \Rightarrow \dfrac{\Delta P}{P} = \dfrac{2\Delta V}{V} + \dfrac{\Delta R}{R}$

$\dfrac{\Delta P}{P} = 2 \times 2.5 + 0 = 5\%$

34. (b) The given circuit can be simplified as follows



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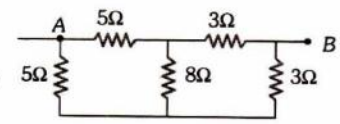
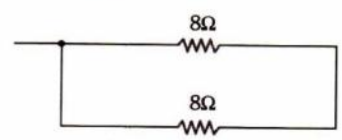


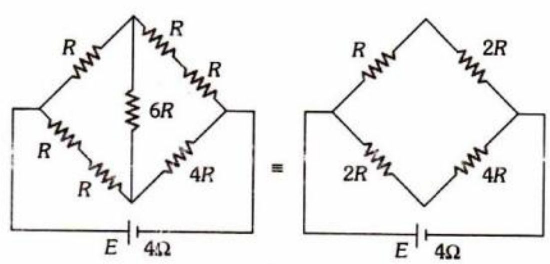
Now it is a balanced Wheatstone bridge.

So,



$\Rightarrow R_{AB} = \dfrac{8 \times 8}{8+8} = \dfrac{64}{16} = 4\Omega$

35. (c) The equivalent network is

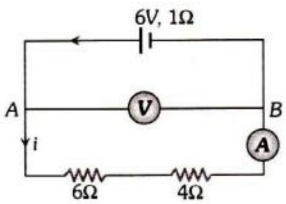


Clearly, the network of resistances is a balanced Wheatstone bridge. So R_{AB} is given by

$\dfrac{1}{R_{AB}} = \dfrac{1}{3R} + \dfrac{1}{6R} = \dfrac{2+1}{6R} = \dfrac{1}{2R} \Rightarrow R_{AB} = 2R$

For maximum power transfer $2R = 4\Omega \Rightarrow R = \dfrac{4}{2} = 2\Omega$

36. (c) The given circuit can be redrawn as follows



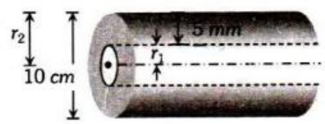
Current $i = \frac{6}{6+4+1} = \frac{6}{11} A$

P.D. between A and B, $V = \frac{6}{11} \times 10 = \frac{60}{11} V$.

37. (a) By using $R = \rho . \frac{l}{A}$; here $A = \pi(r_2^2 - r_1^2)$

Outer radius $r_2 = 5cm$

Inner radius $r_1 = 5 - 0.5 = 4.5\, cm$



So $R = 1.7 \times 10^{-8} \times \frac{5}{\pi\{(5\times10^{-2})^2 - (4.5\times10^{-2})^2\}}$

$= 5.6 \times 10^{-5} \Omega$.

38. (a) Here $R_{XWY} = \frac{R}{2\pi r} \times (r\alpha) = \frac{R\alpha}{2\pi}$ $\left[\because \alpha = \frac{l}{r}\right]$

and $R_{XZY} = \frac{R}{2\pi r} \times r(2\pi - \alpha) = \frac{R}{2\pi}(2\pi - \alpha)$

$$R_{eq} = \frac{R_{XWY}R_{XZY}}{R_{XWY} + R_{XZY}} = \frac{\frac{R\alpha}{2\pi} \times \frac{R}{2\pi}(2\pi - \alpha)}{\frac{R\alpha}{2\pi} + \frac{R(2\pi-\alpha)}{2\pi}} = \frac{R\alpha}{4\pi^2}(2\pi - \alpha)$$

39. (d) Battery is short circuited so potential difference is zero.

40. (a) $\alpha_S = \frac{\alpha_1 R_{01} + \alpha_2 R_{02}}{R_{01} + R_{02}}$

$R_{01} = R_{02} = R_0$ [Given]

$\alpha_S = \frac{\alpha_1 + \alpha_2}{2}$

For parallel combination

$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$

$\Rightarrow \frac{1}{R_{eq}} = \frac{1}{R_0(1+\alpha_1 t)} + \frac{1}{R_0(1+\alpha_2 t)}$

$\frac{1}{\frac{R_0}{2}(1+\alpha_p t)} = \frac{1}{R_0(1+\alpha_1 t)} + \frac{1}{R_0(1+\alpha_2 t)}$

$2(1+\alpha_p t)^{-1} = (1+\alpha_1 t)^{-1} + (1+\alpha_2 t)^{-1}$

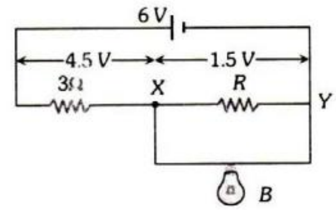
Using binomial expansion

$2 - 2\alpha_p t = 1 - \alpha_1 t + 1 - \alpha_2 t$

$\Rightarrow \alpha_p = \frac{\alpha_1 + \alpha_2}{2}$.

41. (a) $E = xl = i\rho l \Rightarrow i = \frac{E}{\rho l} = \frac{2.4\times10^{-3}}{1.2\times5} = 4\times10^{-4} A$.

42. (b) When bulb glows with full intensity, then voltage across it will be 1.5 V and voltage across 3 Ω resistance will be 4.5 V.



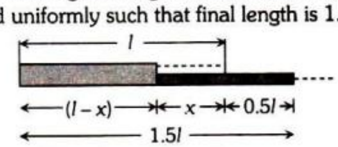
Current through 3 Ω resistance $i = \frac{4.5}{3} = 1.5A$

Same current will flow between X and Y

So $V_{XY} = iR_{XY} \Rightarrow 1.5 = 1.5R_{XY} \Rightarrow R_{XY} = 1\Omega$

43. (c) To verify Ohm's law one galvanometer is used as ammeter and other galvanometer is used as voltmeter. Voltmeter should have high resistance and ammeter should have low resistance as voltmeter is used in parallel and ammeter in series that is in option (c).

44. (a) Let l be the original length of wire and x be its length stretched uniformly such that final length is 1.5 l



Then $4R = \rho\frac{(l-x)}{A} + \rho\frac{(0.5l+x)}{A'}$ where $A' = \frac{x}{(0.5l+x)}A$

$\therefore 4\rho\frac{l}{A} = \rho\frac{l-x}{A} + \rho\frac{(0.5l+x)^2}{xA}$

or $4l = l - x + \frac{1}{4}\frac{l^2}{x} + \frac{x^2}{x} + \frac{lx}{x}$ or $\frac{x}{l} = \frac{1}{8}$

45. (b) In series : Potential difference $\propto R$

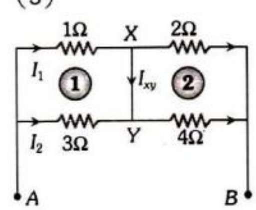
When only S_1 is closed $V_1 = \frac{3}{4}E = 0.75E$

When only S_2 is closed $V_2 = \frac{6}{7}E = 0.86E$

and when both S_1 and S_2 are closed combined resistance of $6R$ and $3R$ is $2R$

$\therefore \quad V_3 = \left(\frac{2}{3}\right)E = 0.67E \Rightarrow V_2 > V_1 > V_3$

46. (c)



$-i_1 + 0\times i_{xy} + 3i_2 = 0$ i.e. $i_1 = 3i_2$ ......(i)

Also $-2(i_1 - i_{xy}) + 4(i_2 + i_{xy}) = 0$

i.e. $2i_1 - 4i_2 = 6i_{xy}$ ....(ii)

Also $V_{AB} - 1\times i_1 - 2(i_1 - i_{xy}) = 0 \Rightarrow 50 = i_1 + 2(i_1 - i_{xy})$

$= 3i_1 - 2i_{xy}$ .... (iii)

Solving (i), (ii) and (iii), $i_{xy} = 2A$

47. (b) Let n be the number of wrongly connected cells.
Number of cells helping one another $= (12-n)$
Total e.m.f. of such cells $= (12-n)E$
Total e.m.f. of cells opposing $= nE$
Resultant e.m.f. of battery $= (12-n)E - nE = (12-2n)E$
Total resistance of cells $= 12r$
($\because$ resistance remains same irrespective of connections of cells)
With additional cells
(a) Total e.m.f. of cells when additional cells help battery $= (12-2n)E + 2E$
Total resistance $= 12r + 2r = 14r$

$$\therefore \frac{(12-2n)E+2E}{14r} = 3 \quad \text{......(i)}$$

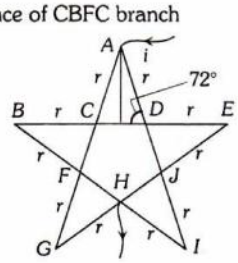
(b) Similarly when additional cells oppose the battery

$$\frac{(12-2n)E-2E}{14r} = 2 \quad \text{......(ii)}$$

Solving (i) and (ii), $n = 1$

48. (a) All the conductors have equal lengths. Area of cross-section of A is $\{(\sqrt{3}\,a)^2 - (\sqrt{2}\,a)^2\} = a^2$
Similarly area of cross-section of B = Area of cross-section of $C = a^2$
Hence according to formula $R = \rho\frac{l}{A}$; resistances of all the conductors are equal i.e. $R_A = R_B = R_C$

49. (b) Resistance of CD arm $= 2r\cos 72° = 0.62r$
Resistance of CBFC branch



$$\frac{1}{R} = \frac{1}{2r} + \frac{1}{0.62r} = \frac{1}{r}\left(\frac{2.62}{2\times 0.62}\right)$$

$$\frac{1}{R} = \frac{2.62}{1.24r} \qquad \therefore R = \frac{1.24r}{2.62}$$

Equivalent $R' = 2R + r = 2\times\frac{1.24r}{2.62} + r$

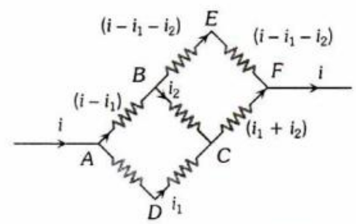
$$= r\left(\frac{2.48}{2.62}+1\right) = 1.946r$$

Because the star circuit is symmetrical about the line AH
$\therefore$ Equivalent resistance between A and H

$$\frac{1}{R_{eq}} = \frac{1}{R'} + \frac{1}{R'}$$

$$\Rightarrow R_{eq} = \frac{R'}{2} = \frac{1.946}{2}r = 0.973r$$

50. (a)



Applying Kirchoff's law in mesh $ABCDA$

$$-10(i-i_1) - 10i_2 + 20i_1 = 0 \Rightarrow 3i_1 - i_2 = i \quad \text{....(i)}$$

and in mesh $BEFCB$

$$-20(i-i_1-i_2) + 10(i_1+i_2) + 10i_2 = 0$$

$$\Rightarrow 3i_1 + 4i_2 = 2i \quad \text{....(ii)}$$

From equation (i) and (ii)

$$i_1 = \frac{2i}{5}, i_2 = \frac{i}{5} \Rightarrow i_{AD} = \frac{2i}{5}$$

51. (d) Let the current in 12 Ω resistance is i
Applying loop theorem in closed mesh $AEFCA$
$12i = -E + E = 0$
$\therefore i = 0$

52. (b) Current flowing in the circuit $i = \frac{E}{R} = \frac{10-4}{20+10} = \frac{1}{5}A$
P.D. across $AC = \frac{1}{5}\times 20 = 4V$
P.D. across $AN = 4 + 4 = 8V$

53. (a) If two resistances are R_1 and R_2 then

$$S = R_1 + R_2 \text{ and } P = \frac{R_1R_2}{(R_1+R_2)}$$

From given condition $S = nP$

$$\text{i.e. } (R_1+R_2) = n\left(\frac{R_1R_2}{R_1+R_2}\right)$$

$$\Rightarrow (R_1+R_2)^2 = n\,R_1R_2$$

$$\Rightarrow (R_1-R_2)^2 + 4R_1R_2 = nR_1R_2$$

$$\text{So } n = 4 + \frac{(R_1-R_2)^2}{R_1R_2}.$$

Hence minimum value of n is 4.

54. (b) Voltage sensitivity $= \frac{\text{Current sensitivity}}{\text{Resistance of galvanometer G}}$

$$\Rightarrow G = \frac{10}{2} = 5\,\Omega.$$

Here i_g = Full scale deflection current $= \frac{150}{10} = 15mA$.
V = Voltage to be measured $= 150 \times 1 = 150\,V$.
Hence $R = \frac{V}{i_g} - G = \frac{150}{15\times 10^{-3}} - 5 = 9995\,\Omega$.

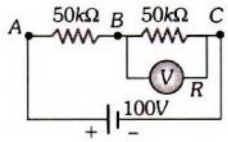
55. (c) $R = \frac{\rho l}{A}$

$$R = \frac{\rho L}{tL} = \frac{\rho}{t}$$

Independent of L.

56. (c) Internal resistance of voltmeter is R

Therefore effective resistance across B and C, R' is given by



$$\frac{1}{R'} = \frac{1}{R} + \frac{1}{50} = \frac{50+R}{50R}$$

$$\Rightarrow R' = \left(\frac{50R}{50+R}\right)$$

According to ohm's law

$V' = IR'$

$$\Rightarrow \frac{100}{3} = I.\left(\frac{50R}{50+R}\right)$$

$$\Rightarrow \frac{100}{3}\left(\frac{50+R}{50R}\right) = I \quad ...(i)$$

Now, total resistance of circuit

$$R'' = 50 + \frac{50R}{50+R}$$

$$\Rightarrow R'' = \frac{(2500+100R)}{(50+R)}$$

Now, $V'' = IR''$

$$\Rightarrow 100 = \frac{100}{3}\left(\frac{50+R}{50R}\right)\frac{2500+100R}{(50+R)}$$

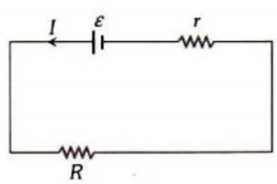
$$\Rightarrow 150R = 2500 + 100R$$

$$\Rightarrow R = 50\ k\Omega.$$

Graphical Questions

1. (a) For ohmic resistance $V \propto i \Rightarrow V = Ri$ (here R is constant)

2. (c) $I = \left(\frac{\varepsilon}{R+r}\right)$



$$V = IR = \left(\frac{\varepsilon}{R+r}\right)R$$

$$V = \frac{\varepsilon}{\left(1+\frac{r}{R}\right)}$$

when $R = 0,\ V = 0,\ R = \infty,\ V = \varepsilon.$

3. (a) Slope of the V-i curve at any point equals to resistance at that point. From the curve slope for T_1 > slope for T_2 $\Rightarrow R_{T_1} > R_{T_2}$. Also at higher temperature resistance will be higher so $T_1 > T_2$

4. (c) For portion CD slope of the curve is negative *i.e.* resistance is negative.

5. (d) Slope of V-i curve $= R\left(=\frac{\rho l}{A}\right)$. But in given curve axes of i and V are interchanged. So slope of given curve $= \frac{1}{R}\left(=\frac{A}{\rho l}\right)$ *i.e.* with the increase in length of the wire slope of the curve will decrease.

6. (c) $E = \frac{iR}{L} = \frac{i.\rho}{A} = \frac{neAv_d\rho}{A} \Rightarrow v_d \propto E$ [Straight line]

$$P = i^2R = \left(\frac{EA}{\rho}\right)^2 R \Rightarrow P \propto E^2 \text{ [Symmetric parabola]}$$

Also $P \propto i^2$ (parabola)

Hence all graphs a, b, d are correct and c is incorrect.

7. (b) When we move in the direction of the current in a uniform conductor, the potential difference decreases linearly. When we pass through the cell, from it's negative to it's positive terminal, the potential increases by an amount equal to it's potential difference. This is less than it's emf, as there is some potential drop across it's internal resistance when the cell is driving current.

8. (a) For LED, in forward bias, intensity increases with voltage.

9. (d) Slope of V-i curve = resistance. Hence $R = \frac{1}{1} = 1\Omega$

10. (a) At point A the slope of the graph will be negative. Hence resistance is negative.

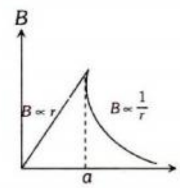
11. (b) E.m.f. is the value of voltage, when no current is drawn from the circuit so $E = 2V$. Also r = slope $= \frac{2}{5} = 0.4\Omega$

12. (a) Magnetic field due to a long straight wire of radius a carrying current I at a point distant r from the centre of the wire is given as follows

$$B = \frac{\mu_0 Ir}{2\pi a^2} \text{ for } r < a$$

$$B = \frac{\mu_0 I}{2\pi a} \text{ for } r = a$$

$$B = \frac{\mu_0 I}{2\pi r} \text{ for } r > a$$



The variation of magnetic field B with distance r from the centre of wire is shown in the figure

13. (a) According to ohm's law $V = iR$

$$\Rightarrow \log_e V = \log_e i + \log_e R \Rightarrow \log_e i = \log_e V - \log_e R$$

The graph between $\log_e I$ and $\log_e V$ will be a straight line which cuts $\log_e V$ axis and it's gradient will be positive.

14. (c) As we know, for conductors, resistance $\propto$ temperature.

From figure $R_1 \propto T_1 \Rightarrow \tan\theta \propto T_1 \Rightarrow \tan\theta = kT_1$ ... (i)

and $R_2 \propto T_2 \Rightarrow \tan(90° - \theta) \propto T_2 \Rightarrow \cot\theta = kT_2$ ....(ii)

From equation (i) and (ii), $k(T_2 - T_1) = (\cot\theta - \tan\theta)$

$$(T_2 - T_1) = \left(\frac{\cos\theta}{\sin\theta} - \frac{\sin\theta}{\cos\theta}\right) = \frac{(\cos^2\theta - \sin^2\theta)}{\sin\theta\cos\theta} = 2\cot 2\theta$$

$$\Rightarrow (T_2 - T_1) \propto \cot 2\theta$$

15. (b) Let resistivity at a distance 'x' from left end be $\rho = (\rho_0 + \alpha x)$. Then electric field intensity at a distance 'x' from left end will be equal to $E = \frac{i\rho}{A} = \frac{i(\rho_0 + \alpha x)}{A}$

where i is the current flowing through the conductor. It means $E \propto \rho$ or E varies linearly with distance 'x'. But at $x = 0$, E has non-zero value. Hence (b) is correct.

16. (d) At an instant approach the student will choose $\tan\theta$ will be the right answer. But it is to be seen here the curve makes the angle θ with the V-axis. So it makes an angle $(90 - \theta)$ with the i-axis.

So resistance = slope = $\tan(90 - \theta) = \cot\theta$.

17. (d) Short circuited current $i = \frac{nE}{nr} = \frac{E}{r}$ *i.e.* i doesn't depend upon n.

18. (b) Here internal resistance is given by the slope of graph *i.e.* $\frac{x}{y}$. But conductance $= \frac{1}{\text{Resistance}} = \frac{y}{x}$

19. (a) $R_{Parallel} < R_{Series}$. From graph it is clear that slope of the line A is lower than the slope of the line B. Also slope = resistance, so line A represents the graph for parallel combination.

20. (b) To make range n times, the galvanometer resistance should be G/n, where G is initial resistance.