Alternating Current, Voltage and Power

1. An electric bulb marked as $50\,W - 200\,V$ is connected across a $100\,V$ supply. The present power of the bulb is **[WB-JEE 2012]**

(a) $37.5\,W$ (b) $25\,W$

(c) $12.5\,W$ (d) $10\,W$

2. The potential difference V and the current I flowing through an instrument in an ac circuit of frequency f are given by $V = 5\cos\omega t$ *volts* and $I = 2\sin\omega t$ *amperes* (where $\omega = 2\pi f$). The power dissipated in the instrument is **[CPMT 1977, 80; MP PET 1999]**

(a) Zero (b) $10\,W$

(c) $5\,W$ (d) $2.5\,W$

3. In an ac circuit, V and I are given by

$V = 100\sin(100\,t)$ volts, $I = 100\sin\left(100t + \frac{\pi}{3}\right)mA$. The power dissipated in circuit is **[MP PET 1989; RPMT 1997; RPET 1999; MP PMT 1999, 2002; Similar NCERT 1990; CBSE PMT (Mains) 2012]**

(a) 10^4 *watt* (b) 10 *watt*

(c) 2.5 *watt* (d) 5 *watt*

4. Alternating current can not be measured by dc ammeter because **[AIEEE 2004]**

(a) ac cannot pass through dc ammeter

(b) Average value of complete cycle is zero

(c) ac is virtual

(d) ac changes its direction

5. An alternating current in a circuit is given by $I = 20\sin(100\pi + 0.05\pi)A$. The r.m.s. value and the frequency of current respectively are **[WB-JEE 2013]**

(a) $10\,A$ & $100\,Hz$ (b) $10\,A$ & $50\,Hz$

(c) $10\sqrt{2}A$ & $50\,Hz$ (d) $10\sqrt{2}A$ & $100\,Hz$

6. If instantaneous current is given by $I = 4\cos(\omega t + \phi)$ *amperes*, then the r.m.s. value of current is **[RPET 2000]**

(a) 4 amperes (b) $2\sqrt{2}$ amperes

(c) $4\sqrt{2}$ amperes (d) Zero amperes

7. In an ac circuit, peak value of voltage is 423 *volts*. Its effective voltage is **[JIPMER 1997]**

(a) 400 *volts* (b) 323 *volts*

(c) 300 *volts* (d) 340 *volts*

8. Power dissipated in an LCR series circuit connected to an a.c. source of *emf* E is **[CBSE PMT 2009]**

(a) $\dfrac{E^2R}{\left[R^2+\left(L\omega-\dfrac{1}{C\omega}\right)^2\right]}$ (b) $\dfrac{E^2\sqrt{R^2-\left(L\omega-\dfrac{1}{C\omega}\right)^2}}{R}$

(c) $\dfrac{E^2\left[R^2-\left(L\omega-\dfrac{1}{C\omega}\right)^2\right]}{R}$ (d) $\dfrac{E^2R}{\sqrt{R^2+\left(L\omega-\dfrac{1}{C\omega}\right)^2}}$

9. An alternating current of rms value 10 A is passed through a $12\,\Omega$ resistor. The maximum potential difference across the resistor is **[WB-JEE 2009]**

(a) $20V$ (b) $50\,V$

(c) $169.68\,V$ (d) None of these

10. A generator produces a voltage that is given by $V = 240\sin 120\,t$, where t is in seconds. The frequency and r.m.s. voltage are **[MP PMT 1990; MP PET 1993]**

(a) $60\,Hz$ and $240\,V$ (b) $19\,Hz$ and $120\,V$

(c) $19\,Hz$ and $170\,V$ (d) $754\,Hz$ and $70\,V$

11. If E_0 represents the peak value of the voltage in an ac circuit, the r.m.s. value of the voltage will be **[CPMT 1972; MP PMT 1996]**

(a) $\dfrac{E_0}{\pi}$ (b) $\dfrac{E_0}{2}$

(c) $\dfrac{E_0}{\sqrt{\pi}}$ (d) $\dfrac{E_0}{\sqrt{2}}$

12. The peak value of 220 *volts* of ac mains is **[CPMT 1990; AFMC 1996; MP PMT 1999; MP PET 2000; RPET 2001; RPMT 2005]**

(a) 155.6 *volts* (b) 220.0 *volts*

(c) 311.0 *volts* (d) 440 *volts*

13. If $V = 100\sin(100t)$ volt and $I = 100\sin\left(100t + \frac{\pi}{3}\right)mA$ are the instantaneous values of voltage and current, then the r.m.s. values of voltage and current are respectively **[Kerala PET 2011]**

(a) $70.7V$, $70.7mA$ (b) $70.7V$, $70.7A$

(c) $141.4V$, $141.4mA$ (d) $141.4V$, $141.4A$

(e) $100V$, $100mA$

14. 220 V, 50 Hz. ac is applied to a resistor. The instantaneous value of voltage is **[Odisha JEE 2009]**

(a) $220\sqrt{2}\sin 100\pi t$ (b) $220\sin 100\pi t$

(c) $220\sqrt{2}\sin 50\pi t$ (c) $220\sin 50\pi t$

15. The frequency of ac mains in India is **[MP PMT/PET 1988; RPMT 1997; RPET 2000]**

(a) 30 *c/s* or Hz (b) 50 *c/s* or Hz

(c) 60 *c/s* or Hz (d) 120 *c/s* or Hz

16. The r.m.s. value of an ac of $50\,Hz$ is 10 *amp*. The time taken by the alternating current in reaching from zero to maximum value and the peak value of current will be **[MP PET 1993; KCET 2003]**

(a) 2×10^{-2} *sec* and 14.14 *amp*

(b) 1×10^{-2} *sec* and 7.07 *amp*

(c) 5×10^{-3} *sec* and 7.07 *amp*

(d) 5×10^{-3} *sec* and 14.14 *amp*

17. The instantaneous voltage through a device of impedance $20\,\Omega$ is $e = 80\sin 100\,\omega t$. The effective value of the current is **[Kerala PMT 2007]**

(a) $3\,A$ (b) $2.828\,A$

(c) $1.732\,A$ (d) $4\,A$

18. The peak value of an alternating e.m.f. E given by $E = E_0 \cos \omega t$ is 10 *volts* and its frequency is 50 *Hz*. At time $t = \frac{1}{600}$ *sec*, the instantaneous e.m.f. is **[MP PMT 1990; MP PET 2004]**

(a) 10 *V* (b) $5\sqrt{3}$ *V*

(c) 5 *V* (d) 1 *V*

19. If a current I given by $I_0 \sin\left(\omega t - \frac{\pi}{2}\right)$ flows in an ac circuit across which an ac potential of $E = E_0 \sin \omega t$ has been applied, then the power consumption P in the circuit will be **[CPMT 1986; Roorkee 1992; MP PMT 1994; SCRA 1996; RPET 2001; MP PET 2001, 02, 12; AIEEE 2007]**

(a) $P = \frac{E_0 I_0}{\sqrt{2}}$ (b) $P = \sqrt{2} E_0 I_0$

(c) $P = \frac{E_0 I_0}{2}$ (d) $P = 0$

20. An electric heater rated 220 V and 550 W is connected to A.C. mains. The current drawn by it is **[KCET 2009]**

(a) 0.8 *A* (b) 2.5 *A*

(c) 0.4 *A* (d) 1.25 *A*

21. The maximum value of a.c. voltage in a circuit is 707V. Its *r.m.s.* value is **[MP PET 2005]**

(a) 70.7 *V* (b) 100 *V*

(c) 500 *V* (d) 707 *V*

22. In general in an alternating current circuit **[MP PMT 1994]**

(a) The average value of current is zero

(b) The average value of square of the current is zero

(c) Average power dissipation is zero

(d) The phase difference between voltage and current is zero

23. If an alternating voltage is represented as $E = 141 \sin(628t)$, then the *rms* value of the voltage and the frequency are respectively **[Kerala PET 2005]**

(a) 141*V*, 628*Hz* (b) 100*V*, 50*Hz*

(c) 100*V*, 100*Hz* (d) 141*V*, 100*Hz*

24. In an ac circuit, the current is given by $i = 5 \sin\left(100t - \frac{\pi}{2}\right)$ and the ac potential is $V = 200 \sin(100)$ *volt*. Then the power consumption is **[CBSE PMT 1995; MH CET 1999; CPMT 2002; Similar RPET 1999]**

(a) 20 *watts* (b) 40 *watts*

(c) 1000 *watts* (d) 0 *watt*

25. What is the approximate peak value of an alternating current producing four times the heat produced per second by a steady current of 2.0 *A* in a resistor **[BCECE 2006]**

(a) 2.8 *A* (b) 4.0 *A*

(c) 5.6 *A* (d) 8.0 *A*

26. In a circuit, the value of the alternating current is measured by hot wire ammeter as 10 *ampere*. Its peak value will be **[MP PET 1996; AMU (Med.) 1999; KCET (Engg./Med.) 2000; CPMT 2003; RPMT 2006]**

(a) 10 *A* (b) 20 *A*

(c) 14.14 *A* (d) 7.07 *A*

27. The voltage of domestic ac is 220 *volt*. What does this represent **[MP PMT 1996]**

(a) Mean voltage (b) Peak voltage

(c) Root mean voltage (d) Root mean square voltage

28. An alternating voltage $e = 200 \sin 100t$ is applied to a series combination of $R = 30\,\Omega$ and an inductor of 400 *mH*. The power factor of the circuit is **[Kerala PET 2008]**

(a) 0.01 (b) 0.2

(c) 0.05 (d) 0.042

(e) 0.6

29. The process by which ac is converted into dc is known as

(a) Purification (b) Amplification

(c) Rectification (d) Current amplification

30. In an ac circuit with voltage V and current I, the power dissipated is **[CBSE PMT 1997]**

(a) VI

(b) $\frac{1}{2} VI$

(c) $\frac{1}{\sqrt{2}} VI$

(d) Depends on the phase between V and I

31. In the transmission of a.c. power through transmission lines, when the voltage is stepped up n times, the power loss in transmission **[Kerala PMT 2008]**

(a) Increases n times (b) Decreases n times

(c) Increases n^2 times (d) Decreases n^2 times

(e) Decreases n^4 times

32. A bulb is connected first with dc and then ac of same voltage it will shine brightly with **[RPET 2000]**

(a) AC

(b) DC

(c) Brightness will be in ratio 1/1.4

(d) Equally with both

33. An ac supply gives 30 *V r.m.s.* which passes through a $10\,\Omega$ resistance. The power dissipated in it is **[AMU (Med.) 2001]**

(a) $90\sqrt{2}$ *W* (b) 90 *W*

(c) $45\sqrt{2}$ *W* (d) 45 *W*

34. The frequency of an alternating voltage is 50 *cycles/sec* and its amplitude is 120*V*. Then the *r.m.s.* value of voltage is **[BHU 1999; MH CET (Med.) 2001; KCET (Med.) 2001; MH CET 2003]**

(a) 101.3*V* (b) 84.8*V*

(c) 70.7*V* (d) 56.5*V*

35. A resistance of 20 *ohms* is connected to a source of an alternating potential $V = 220 \sin(100\pi t)$. The time taken by the current to change from its peak value to *r.m.s* value is **[MP PET 2001]**

(a) 0.2 *sec* (b) 0.25 *sec*

(c) 25×10^{-3} *sec* (d) 2.5×10^{-3} *sec*

36. Voltage and current in an ac circuit are given by $V = 5\sin\left(100\pi t - \frac{\pi}{6}\right)$ and $I = 4\sin\left(100\pi t + \frac{\pi}{6}\right)$ **[Kerala PET 2001]**

(a) Voltage leads the current by $30°$
(b) Current leads the voltage by $30°$
(c) Current leads the voltage by $60°$
(d) Voltage leads the current by $60°$

37. If an ac main supply is given to be 220 V. What would be the average e.m.f. during a positive half cycle **[MH CET 2002]**

(a) 198V (b) 386V
(c) 256V (d) None of these

38. In an ac circuit, the *r.m.s.* value of current, I_{rms} is related to the peak current, I_0 by the relation **[AFMC 2002]**

(a) $I_{rms} = \frac{1}{\pi} I_0$ (b) $I_{rms} = \frac{1}{\sqrt{2}} I_0$
(c) $I_{rms} = \sqrt{2} I_0$ (d) $I_{rms} = \pi I_0$

39. An alternating voltage is represented as $E = 20\sin 300t$. The average value of voltage over one cycle will be **[MP PMT 2002]**

(a) Zero (b) 10 *volt*
(c) $20\sqrt{2}$ *volt* (d) $\frac{20}{\sqrt{2}}$ *volt*

40. The ratio of peak value and *r.m.s* value of an alternating currer.t is **[MP PMT 2002; Similar VITEEE 2006]**

(a) 1 (b) $\frac{1}{2}$
(c) $\sqrt{2}$ (d) $1/\sqrt{2}$

41. A 280 *ohm* electric bulb is connected to 200V electric line. The peak value of current in the bulb will be **[MP PET 2002; Odisha JEE 2011; Similar MP PET 1992]**

(a) About one ampere (b) Zero
(c) About two ampere (d) About four ampere

42. An ac source is rated at 220V, 50 *Hz*. The time taken for voltage to change from its peak value to zero is **[Odisha JEE 2003]**

(a) 50 *sec* (b) 0.02 *sec*
(c) 5 *sec* (d) 5×10^{-3} *sec*

43. If the value of potential in an ac circuit is 10V, then the peak value of potential is **[CPMT 2003]**

(a) $\frac{10}{\sqrt{2}}$ (b) $10\sqrt{2}$
(c) $20\sqrt{2}$ (d) $\frac{20}{\sqrt{2}}$

44. A lamp consumes only 50% of peak power in an a.c. circuit. What is the phase difference between the applied voltage and the circuit current **[MP PMT 2004]**

(a) $\frac{\pi}{6}$ (b) $\frac{\pi}{3}$
(c) $\frac{\pi}{4}$ (d) $\frac{\pi}{2}$

45. Two electric bulbs marked $25W - 220V$ and $100W - 220V$ are connected in series to a $440V$ supply. Which of the bulbs will fuse **[AIEEE 2012]**

(a) Both (b) 100 *W*
(c) 25 *W* (d) Neither

46. An electric current has both D.C. and A.C. Components. D.C. Component of 8A and A.C. Component is given as $I = 6\sin \omega t\ A$. So I_{rms} value of resultant current is **[GUJCET 2014]**

(a) 8.05 *A* (b) 9.05 *A*
(c) 11.58 *A* (d) 13.58 *A*

ac Circuits

1. The impedance of a certain a.c. circuit is 50 *ohms*. If the net resistance in the circuit is 25 *ohms* then the power factor of the circuit will be **[MP PMT 2012]**

(a) Zero (b) 0.5
(c) 1 (d) 0.25

2. A choke coil has **[RPET 1999; AIIMS 1999]**

(a) High inductance and low resistance
(b) Low inductance and high resistance
(c) High inductance and high resistance
(d) Low inductance and low resistance

3. Time constant of LC circuit is **[MP PMT 2009]**

(a) $\frac{1}{2\pi LC}$ (b) $\frac{1}{2\pi L^2C^2}$
(c) $\frac{LC}{2\pi}$ (d) $2\pi\sqrt{LC}$

4. A resistor and a capacitor are connected in series with an a.c. source. If the potential drop across the capacitor is 5 V and that across resistor is 12 V, the applied voltage is **[KCET 2009]**

(a) 13 V (b) 17 V
(c) 5 V (d) 12 V

5. The phase angle between e.m.f. and current in *LCR* series ac circuit is **[MP PMT/PET 1998]**

(a) 0 to $\frac{\pi}{2}$ (b) $\frac{\pi}{4}$
(c) $\frac{\pi}{2}$ (d) π

6. In an a.c. circuit the e.m.f (e) and the current (i) at any instant are given respectively by

$e = E_0 \sin \omega t$ $\quad i = I_0 \sin(\omega t - \phi)$

The average power in the circuit over one cycle of a.c. is **[CBSE PMT 2008; Kerala PET 2011]**

(a) $\frac{E_0 I_0}{2}\cos\phi$ (b) $E_0 I_0$
(c) $\frac{E_0 I_0}{2}$ (d) $\frac{E_0 I_0}{2}\sin\phi$

7. An alternating e.m.f. is applied to purely capacitive circuit. The phase relation between e.m.f. and current flowing in the circuit is **or**

In a circuit containing capacitance only **[MP PET 1996; AIIMS 1997]**

(a) e.m.f. is ahead of current by $\pi/2$
(b) Current is ahead of e.m.f. by $\pi/2$
(c) Current lags behind e.m.f. by π
(d) Current is ahead of e.m.f. by π

8. The instantaneous value of current in an A.C. circuit is $I = 2\sin(100\pi t + \pi/3)\,A$. The current will be maximum for the first time at **[MP PET 2008; Similar DPMT 2003]**

(a) $t = \frac{1}{100}\,s$ (b) $t = \frac{1}{200}\,s$

(c) $t = \frac{1}{400}\,s$ (d) $t = \frac{1}{600}\,s$

9. The average power dissipated in a pure inductor of inductance L when an ac current is passing through it, is **[CPMT 1974; RPMT 1997; MP PET 1999]**

(a) $\frac{1}{2}LI^2$ (b) $\frac{1}{4}LI^2$

(c) $2Li^2$ (d) Zero

(Inductance of the coil L and current I)

10. An alternating current of frequency 'f' is flowing in a circuit containing a resistance R and a choke L in series. The impedance of this circuit is **[CPMT 1978; MP PMT 1993; MP PET 1999; AIIMS 2000; RPET 2001, 03; Pb. PET 2004]**

(a) $R + 2\pi fL$ (b) $\sqrt{R^2 + 4\pi^2 f^2 L^2}$

(c) $\sqrt{R^2 + L^2}$ (d) $\sqrt{R^2 + 2\pi fL}$

11. The resistance of an R–L circuit is $10\,\Omega$. An *e.m.f.* E_0 applied across the circuit at $\omega = 20\ rad/s$. If the current in the circuit is $\frac{I_0}{\sqrt{2}}$, what is the value of L **[Odisha JEE 2008]**

(a) $1\,H$ (b) $2\,H$

(c) $3\,H$ (d) $0.5\,H$

12. Power delivered by the source of the circuit becomes maximum, when **[DCE 2004; Similar J & K CET 2008]**

(a) $\omega L = \omega C$ (b) $\omega L = \frac{1}{\omega C}$

(c) $\omega L = -\left(\frac{1}{\omega C}\right)^2$ (d) $\omega L = \sqrt{\omega C}$

13. An alternating voltage is connected in series with a resistance R and an inductance L. If the potential drop across the resistance is 200 V and across the inductance is 150 V, then the applied voltage is **[CPMT 1990; Similar AFMC 1998; BHU 1999]**

(a) 350 V (b) 250 V

(c) 500 V (d) 300 V

14. A resistor 30 Ω, inductor of reactance 10Ω and capacitor of reactance 10 Ω are connected in series to an a.c. voltage source $e = 300\sqrt{2}\sin(\omega t)$. The current in the circuit is **[Kerala PET 2008]**

(a) $10\sqrt{2}\,A$ (b) 10 A

(c) $30\sqrt{11}A$ (d) $30/\sqrt{11}A$

(e) 5 A

15. At resonance frequency in an a.c. circuit containing L, C and R, in series **[MP PMT 2012]**

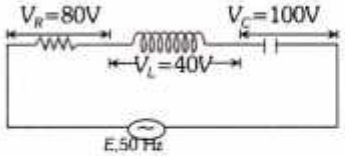
(a) The voltage and current will be in the same phase

(b) The voltage will lead the current

(c) The voltage will lag behind the current

(d) None of these

16. The value of alternating emf E in the given circuit will be **[KCET 2008; MP PET 2010]**



(a) 100 V (b) 20 V

(c) 220 V (d) 140 V

17. The time constant of a $L-R$ circuit is **[MP PET 2012]**

(a) R/L (b) L/R

(c) LR (d) $1/LR$

18. In a pure inductive circuit **or** In an ac circuit containing inductance only, the current **[MP PMT 1993; CPMT 1996; Kerala PET 2002; J & K CET 2006]**

(a) Leads the e.m.f. by 90°

(b) Lags behind the e.m.f. by 90°

(c) Sometimes leads and sometime lags behind the e.m.f.

(d) Is in phase with the e.m.f.

19. A 20 *volts* ac is applied to a circuit consisting of a resistance and a coil with negligible resistance. If the voltage across the resistance is 12 V, the voltage across the coil is **[MP PMT 1989; RPMT 1997]**

(a) 16 *volts* (b) 10 *volts*

(c) 8 *volts* (d) 6 *volts*

20. For a series LCR circuit at resonance, the statement which is not true is **[KCET 2008]**

(a) Wattless current is zero

(b) Power factor is zero

(c) Peak energy stored by a capacitor = peak energy stored by an inductor

(d) Average power = apparent power

21. The power factor of LCR circuit at resonance is **[MP PMT 1991; RPMT 1999; UPSEAT 1999; RPET 2001; Kerala PET 2012]**

(a) 0.707 (b) 1

(c) Zero (d) 0.5

22. An inductance of 1 mH a condenser of 10 μF and a resistance of 50 Ω are connected in series. The reactances of inductor and condensers are same. The reactance of either of them will be

(a) 100 Ω (b) 30 Ω

(c) 3.2 Ω (d) 10 Ω

23. The natural frequency of a L-C circuit is equal to **[CPMT 1978, 97; J & K CET 2008]**

(a) $\frac{1}{2\pi}\sqrt{LC}$ (b) $\frac{1}{2\pi\sqrt{LC}}$

(c) $\frac{1}{2\pi}\sqrt{\frac{L}{C}}$ (d) $\frac{1}{2\pi}\sqrt{\frac{C}{L}}$

24. An alternating voltage $E = 200\sqrt{2}\sin(100t)$ is connected to a 1 *microfarad* capacitor through an ac ammeter. The reading of the ammeter shall be **[NCERT 1984; MNR 1995; MP PET 1999; RPET 1999; UPSEAT 2000; CBSE PMT (Pre.) 2011]**

(a) 10 *mA* (b) 20 *mA*

(c) 40 *mA* (d) 80 *mA*

25. An ac circuit consists of an inductor of inductance 0.5 *H* and a capacitor of capacitance 8 μF in series. The current in the circuit is maximum when the angular frequency of ac source is **[CPMT 1986; Similar RPMT 1999]**

(a) 500 *rad/sec* (b) 2×10^5 *rad/sec*

(c) 4000 *rad/sec* (d) 5000 *rad/sec*

26. The average power dissipation in a pure capacitance in ac circuit is **[DPMT 1987; MP PMT/PET 1998; Similar Kerala PMT 2009]**

(a) $\frac{1}{2}CV^2$ (b) CV^2

(c) $\frac{1}{4}CV^2$ (d) Zero

27. In a region of uniform magnetic induction $B = 10^{-2}$ *tesla*, a circular coil of radius 30 *cm* and resistance π^2 *ohm* is rotated about an axis which is perpendicular to the direction of *B* and which forms a diameter of the coil. If the coil rotates at 200 *rpm* the amplitude of the alternating current induced in the coil is **[CBSE PMT 1990]**

(a) $4\pi^2$ *mA* (b) 30 *mA*

(c) 6 *mA* (d) 200 *mA*

28. An inductive circuit contains a resistance of 10 *ohm* and an inductance of 2.0 *henry*. If an ac voltage of 120 *volt* and frequency of 60 *Hz* is applied to this circuit, the current in the circuit would be nearly **[CPMT 1990; MP PET 2002; Similar Kerala PMT 2004]**

(a) 0.32 *amp* (b) 0.16 *amp*

(c) 0.48 *amp* (d) 0.80 *amp*

29. A charged capacitor $C = 30\,\mu F$ is connected to an inductor $L = 27\,mH$. The angular frequency of their oscillations is **[AMU (Engg.) 2012]**

(a) 9.1×10^3 (b) 3.0×10^3

(c) 1.1×10^3 (d) 0.3×10^3

30. In a series LCR circuit $R = 200\Omega$ and the voltage and the frequency of the main supply is 220 *V* and 50 *Hz* respectively. On taking out the capacitance from the circuit the current lags behind the voltage by 30°. On taking out the inductor from the circuit the current leads the voltage by 30°. The power dissipated in the LCR circuit is **[AIEEE 2010]**

(a) 242 *W* (b) 305 *W*

(c) 210 *W* (d) Zero *W*

31. An *LCR* series circuit with $R = 100\Omega$ is connected to a 200 V, 50 *Hz* a.c. source when only the capacitance is removed, the current leads the voltage by 60°. When only the inductance is removed, the current leads the voltage by 60° The current in the circuit is **[AMU PMT 2009]**

(a) 2*A* (b) 1*A*

(c) $\frac{\sqrt{3}}{2}A$ (d) $\frac{2}{\sqrt{3}}A$

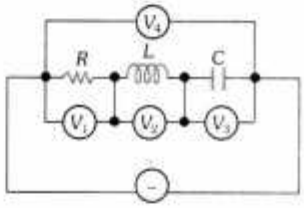
32. If ϕ is the phase difference between the instantaneous values of voltage *V* and current *I* in an *AC* circuit, then the average power loss over a complete cycle is **[Kerala PMT 2012]**

(a) $VI\sin\phi$ (b) $VI\cos\phi$

(c) VI (d) $\frac{VI}{2}$

(e) $\frac{VI\cos\phi}{2}$

33. An ideal resistance *R*, ideal inductance *L*, ideal capacitance *C* and *AC* volt meters V_1, V_2, V_3 and V_4 are connected to an *AC* source as shown. At resonance **[KCET 2012]**



(a) Reading in V_3 = reading in V_1

(b) Reading in V_1 = reading in V_2

(c) Reading in V_2 = reading in V_4

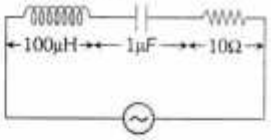
(d) Reading in V_2 = reading in V_3

34. The power factor of a good choke coil is **[MP PMT 1994]**

(a) Nearly zero (b) Exactly zero

(c) Nearly one (d) Exactly one

35. The following series *L–C–R* circuit, when driven by an *e.m.f.* source of angular frequency 70 kilo-radians per second, the circuit effectively behaves like **[EAMCET 2009]**



(a) Purely resistive circuit

(b) Series *R-L* circuit

(c) Series *R-C* circuit

(d) Series *L-C* circuit with $R=0$

36. A resistor of 500Ω, an inductance of 0.5 *H* are in series with an a.c. which is given by $V = 100\sqrt{2}\sin(1000t)$. The power factor of the combination is **[KCET 2012]**

(a) $1/\sqrt{2}$ (b) $1/\sqrt{3}$

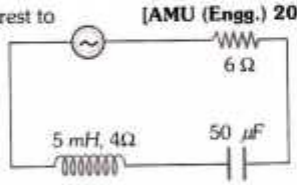
(c) 0.5 (d) 0.6

64. An ideal choke draws a current of 8 *A* when connected to an AC supply of 100 *V*, 50 *Hz*. A pure resistor draws a current of 10 *A* when connected to the same source. The ideal choke and the resistor are connected in series and then connected to the AC source of 150 *V*, 40 *Hz*. The current in the circuit becomes **[KCET 2010]**

(a) $\frac{15}{\sqrt{2}}A$ (b) 8 *A*

(c) 18 *A* (d) 10 *A*

65. In the circuit shown below, the ac source has voltage $V = 20\cos(\omega t)$ volts with $\omega = 2000$ *rad/sec*. The amplitude of the current will be nearest to **[AMU (Engg.) 2000]**



(a) 2*A*

(b) 3.3*A*

(c) $2/\sqrt{5}A$

(d) $\sqrt{5}A$

66. When a d.c. voltage of 200*V* is applied to a coil of self inductance $(2\sqrt{3}/\pi)H$, a current of 1*A* flows through it. But by replacing d.c. source with a.c. source of 200*V*, the current in the coil is reduced to 0.5*A*. Then the frequency of a.c. supply is **[Kerala PET 2007]**

(a) 30*Hz* (b) 60*Hz*

(c) 75*Hz* (d) 50*Hz*

67. The quality factor of *LCR* circuit having resistance (*R*) and inductance (*L*) at resonance frequency (ω) is given by **[AFMC 2000; CBSE PMT 2000]**

(a) $\frac{\omega L}{R}$ (b) $\frac{R}{\omega L}$

(c) $\left(\frac{\omega L}{R}\right)^{1/2}$ (d) $\left(\frac{\omega L}{R}\right)^{2}$

68. Power factor is maximum in an *LCR* circuit when **[RPET 2000]**

(a) $X_L = X_C$ (b) $R = 0$

(c) $X_L = 0$ (d) $X_C = 0$

69. In an ac circuit the reactance of a coil is $\sqrt{3}$ times its resistance, the phase difference between the voltage across the coil to the current through the coil will be **[KCET (Engg.) 2000; RPMT 2006; CBSE PMT (Pre.) 2011; Similar GUJCET 2014]**

(a) $\pi/3$ (b) $\pi/2$

(c) $\pi/4$ (d) $\pi/6$

70. The capacity of a pure capacitor is 1 *farad*. In dc circuits, its effective resistance will be **[MP PMT 2000]**

(a) Zero (b) Infinite

(c) 1 *ohm* (d) 1/2 *ohm*

71. In an ac circuit, the current lags behind the voltage by $\pi/3$. The components in the circuit are **[MP PMT 2000]**

(a) *R* and *L* (b) *R* and *C*

(c) *L* and *C* (d) Only *R*

72. The reactance of a coil when used in the domestic ac power supply (220 *volts*, 50 cycles per second) is 50 *ohms*. The inductance of the coil is nearly **[MP PMT 2000; Similar MP PMT 1996]**

(a) 2.2 *henry* (b) 0.22 *henry*

(c) 1.6 *henry* (d) 0.16 *henry*

73. A capacitor and an inductance coil are connected in separate AC circuits with a bulb glowing in both the circuits. The bulb glows more brightly when **[KCET 2010]**

(a) An iron rod is introduced into the inductance coil

(b) The number of turns in the inductance coil is increased

(c) Separation between the plates of the capacitor is increased

(d) A dielectric is introduced into the gap between the plates of the capacitor

74. A resistance of 40 *ohm* and an inductance of 95.5 *millihenry* are connected in series in a 50 *cycles/second* ac circuit. The impedance of this combination is very nearly **[MP PET 2000]**

(a) 30 *ohm* (b) 40 *ohm*

(c) 50 *ohm* (d) 60 *ohm*

75. For high frequency, a capacitor offers **[CPMT 1999; CBSE PMT 1999; AFMC 2001; Pb. PET 2001; J & K CET 2004]**

(a) More reactance (b) Less reactance

(c) Zero reactance (d) Infinite reactance

76. The coil of choke in a circuit **[AIIMS 2001, 07]**

(a) Increases the current

(b) Decreases the current

(c) Does not change the current

(d) Has high resistance to dc circuit

77. In a circuit, the current lags behind the voltage by a phase difference of $\pi/2$. The circuit contains which of the following **[AIIMS 2001]**

(a) Only *R* (b) Only *L*

(c) Only *C* (d) *R* and *C*

78. The inductive reactance of an inductor of $\frac{1}{\pi}$ *henry* at 50 *Hz* frequency is **[MP PET 2001, 02]**

(a) $\frac{50}{\pi}$ *ohm* (b) $\frac{\pi}{50}$ *ohm*

(c) 100 *ohm* (d) 50 *ohm*

79. An oscillator circuit consists of an inductance of 0.5*mH* and a capacitor of 20 μF. The resonant frequency of the circuit is nearly **[Kerala PET 2002; RPMT 2006; Similar CBSE PMT 2007]**

(a) 15.92 *Hz* (b) 159.2 *Hz*

(c) 1592 *Hz* (d) 15910 *Hz*

80. Reactance of a capacitor of capacitance *C*μF for ac frequency $\frac{400}{\pi}$ *Hz* is 25Ω. The value *C* is **[MH CET 2002]**

(a) 50μF (b) 25μF

(c) 100μF (d) 75μF

81. The power factor of an ac circuit having resistance (R) and inductance (L) connected in series and an angular velocity ω is **[MP PET 2000; AIEEE 2002]**

(a) $R/\omega L$ (b) $R/(R^2+\omega^2L^2)^{1/2}$

(c) $\omega L/R$ (d) $R/(R^2-\omega^2L^2)^{1/2}$

82. A circuit has a resistance of 11Ω, an inductive reactance of 25Ω and a capacitative resistance of 18Ω. It is connected to an ac source of $260V$ and $50Hz$. The current through the circuit (in amperes) is **[Kerala PMT 2002]**

(a) 11 (b) 15

(c) 18 (d) 20

83. A 0.7 *henry* inductor is connected across a $120V - 60\ Hz$ ac source. The current in the inductor will be very nearly **[MP PMT 2002; Similar MP PET 1994; AFMC 2000]**

(a) 4.55 *amp* (b) 0.355 *amp*

(c) 0.455 *amp* (d) 3.55 *amp*

84. There is a 5Ω resistance in an ac, circuit. Inductance of $0.1H$ is connected with it in series. If equation of ac e.m.f. is $5\sin 50t$, then the phase difference between current and e.m.f. is **[RPET 2003]**

(a) $\frac{\pi}{2}$ (b) $\frac{\pi}{6}$

(c) $\frac{\pi}{4}$ (d) 0

85. An inductor of inductance L and resistor of resistance R are joined in series and connected by a source of frequency ω. Power dissipated in the circuit is **[AIEEE 2002; RPET 2003]**

(a) $\frac{(R^2+\omega^2L^2)}{V}$ (b) $\frac{V^2R}{(R^2+\omega^2L^2)}$

(c) $\frac{V}{(R^2+\omega^2L^2)}$ (d) $\frac{\sqrt{R^2+\omega^2L^2}}{V^2}$

86. In ac circuit of capacitance the current from potential is **[CPMT 2003]**

(a) Forward

(b) Backward

(c) Both are in the same phase

(d) None of these

87. A coil of 200Ω resistance and 1.0 H inductance is connected to an ac source of frequency $200/2\pi$ Hz. Phase angle between potential and current will be **[MP PMT 2003]**

(a) 30° (b) 90°

(c) 45° (d) 0°

88. In LCR circuit the pd between the terminals of the inductance is $60V$, between the terminals of the capacitor is $30V$ and that between the terminals of resistance is $40V$. The supply voltage will be equal to **[KCET 2004, 06; Similar KCET 1994; MP PMT 2013]**

(a) 50 V (b) 70 V

(c) 130 V (d) 10 V

89. Radio frequency choke uses core of **[AFMC 2004]**

(a) Air (b) Iron

(c) Air and iron (d) None of these

90. In a LCR circuit capacitance is changed from C to $2C$. For the resonant frequency to remain unchanged, the inductance should be change from L to **[AIEEE 2004; Similar MP PMT 1986; BHU 1998]**

(a) $4L$ (b) $2L$

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

91. In an LCR series ac circuit, the voltage across each of the components, L, C and R is $50V$. The voltage across the LC combination will be **[AIEEE 2004]**

(a) $50V$ (b) $50\sqrt{2}\ V$

(c) $100V$ (d) 0 V (zero)

92. An inductance of $(200/\pi)\ mH$, a capacitance of $(10^{-3}/\pi)\ F$ and a resistance of $10\ \Omega$ are connected in series with an a.c. source 220 V, 50 Hz. The phase angle of the circuit is **[KCET 2007]**

(a) $\pi/6$ (b) $\pi/4$

(c) $\pi/2$ (d) $\pi/3$

93. The current in series LCR circuit will be maximum when ω is **[Kerala PMT 2004]**

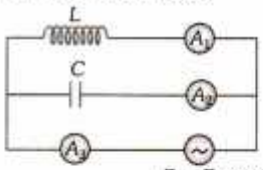
(a) As large as possible

(b) Equal o natural frequency of LCR system

(c) $\sqrt{LC}$

(d) $\sqrt{1/LC}$

94. An inductor L and a capacitor C are connected in the circuit as shown in the figure. The frequency of the power supply is equal to the resonant frequency of the circuit. Which ammeter will read zero ampere **[DCE 2002]**



(a) A_1 (b) A_2

(c) A_3 (d) None of these

95. Which of the following components of an LCR circuit, with ac supply, dissipates energy **[DCE 2004]**

(a) L (b) R

(c) C (d) All of these

96. In a circuit L, C and R are connected in series with an alternating voltage source of frequency f. The current leads the voltage by 45°. The value of C is **[CBSE PMT 2005]**

(a) $\frac{1}{2\pi f(2\pi fL+R)}$ (b) $\frac{1}{\pi f(2\pi fL+R)}$

(c) $\frac{1}{2\pi f(2\pi fL-R)}$ (d) $\frac{1}{\pi f(2\pi fL-R)}$

97. In an A.C. circuit the current **[CPMT 2005]**

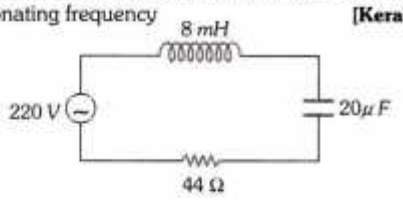
(a) Always leads the voltage

(b) Always lags behind the voltage

(c) Is always in phase with the voltage

(d) May lead or lag behind or be in phase with the voltage

98. For the series LCR circuit shown in the figure, what is the resonance frequency and the amplitude of the current at the resonating frequency **[Kerala PET 2005]**



(a) $2500\,rad-s^{-1}$ and $5\sqrt{2}\,A$

(b) $2500\,rad-s^{-1}$ and $5A$

(c) $2500\,rad-s^{-1}$ and $\frac{5}{\sqrt{2}}A$

(d) $25\,rad-s^{-1}$ and $5\sqrt{2}\,A$

99. In a choke coil, the reactance X_L and resistance R are such that **[RPMT 1996]**

(a) $X_L = R$ (b) $X_L >> R$

(c) $X_L << R$ (d) $X_L = \infty$

100. The phase difference between the ac and emf is $\pi/2$. Which of the following cannot be the constituent of the circuit **[AIEEE 2005]**

(a) LC (b) L alone

(c) C alone (d) R, L

101. A transistor-oscillator using a resonant circuit with an inductor L (of negligible resistance) and a capacitor C in series produce oscillation of frequency f. If L is doubled and C is changed to $4C$, the frequency will be **[CBSE PMT 2006]**

(a) $f/2\sqrt{2}$ (b) $f/2$

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

102. In a series resonant LCR circuit, the voltage across R is 100 volts and R = 1 kΩ with $C = 2\mu F$. The resonant frequency ω is 200 rad/s. At resonance the voltage across L is **[AIEEE 2006; KCET 2010]**

(a) 40 V (b) 250 V

(c) 4×10^{-3} V (d) 2.5×10^{-2} V

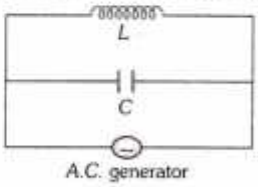
103. In the alternating current shown in the figure, the currents through inductor and capacitor are 1.2 *amp* and 1.0 *amp* respectively. The current drawn from the generator is **[DCE 2006]**

(a) 0.4 *amp*

(b) 0.2 *amp*

(c) 1.0 *amp*

(d) 1.2 *amp*



104. Q-factor can be increased by having a coil of **[VITEEE 2006]**

(a) Large inductance, small ohmic resistance

(b) Large inductance, large ohmic resistance

(c) Small inductance, large ohmic resistance

(d) Small inductance, small ohmic resistance

105. Current in the LCR circuit becomes extremely large when **[VITEEE 2006; J & K CET 2010]**

(a) Frequency of *AC* supply is increased

(b) Frequency of *AC* supply is decreased

(c) Inductive reactance becomes equal to capacitive reactance

(d) Inductance becomes equal to capacitance

106. In a series *LCR* circuit the frequency of a 10*V*, AC voltage source is adjusted in such a fashion that the reactance of the inductor measure 15 Ω and that of the capacitor 11 Ω. If $R=3\Omega$, the potential difference across the series combination of *L* and *C* will be **[BHU 2006]**

(a) 8 *V* (b) 10 *V*

(c) 22 *V* (d) 52 *V*

107. A coil of inductive reactance 31Ωhas a resistance of 8Ω. It is placed in series with a condenser of capacitative reactance 25Ω. The combination is connected to an a.c. source of 110 *volt*. The power factor of the circuit is **[CBSE PMT 2006]**

(a) 0.80 (b) 0.33

(c) 0.56 (d) 0.64

108. The self inductance of the motor of an electric fan is 10*H*. In order to impart maximum power at 50 *Hz*, it should be connected to a capacitance of **[BCECE 2006]**

(a) 1 μF (b) 2 *mF*

(c) 4 *mF* (d) 8 *mF*

109. A *LCR* series *A.C.* circuit is tuned to resonance. The impedence of the circuit is now **[Gujarat CET 2007]**

(a) R

(b) $\left[R^2+\left(\frac{1}{\omega C}-\omega L\right)^2\right]^{1/2}$

(c) $\left[R^2+(\omega L)^2+\left(\frac{1}{\omega C}\right)^2\right]^{1/2}$

(d) $\left[R^2+\left(\omega L-\frac{1}{\omega C}\right)^2\right]^{1/2}$

110. In an *LCR* series resonant circuit which one of the following cannot be the expression for the Q-factor **[Kerala PMT 2008; J & K CET 2010]**

(a) $\frac{\omega L}{R}$ (b) $\frac{1}{\omega CR}$

(c) $\sqrt{\frac{L}{C}}\frac{1}{R}$ (d) $\frac{R}{LC}$

111. An *LCR* series ac circuit is at resonance with 10 V each across *L*, *C* and *R*, If the resistance is halved, the respective voltages across *L*, *C* and *R* are **[Kerala PET 2010]**

(a) 10 V, 10 V and 5 V (b) 10 V, 10 V and 10 V

(c) 20 V, 20 V and 5 V (d) 20 V, 20 V and 10 V

(e) 5 V, 5 V and 5 V

112. An *LCR* series circuit is at resonance. Then **[Kerala PET 2010]**

(a) The phase difference between current and voltage is 90°

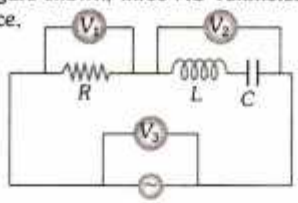
(b) The phase difference between current and voltage is 45°

(c) Its impedance is purely resistive

(d) Its impedance is zero

(e) The current is minimum

113. In the figure shown, three AC voltmeters are connected. At resonance, **[Kerala PMT 2010]**



(a) $V_2 = 0$ (b) $V_1 = 0$

(c) $V_3 = 0$ (d) $V_1 = V_2 \neq 0$

(e) $V_3 = V_2 \neq 0$

114. A 50 volt a.c. is applied across an *RC* (series) network. The rms voltage across the resistance is 40 volt, then the potential across the capacitance would be **[AMU (Engg.) 2010]**

(a) 10 *V* (b) 20 *V*

(c) 30 *V* (d) 40 *V*

115. A pure inductance coil of 30*mH* is connected to an a.c. source of 220 *V*. The rms current in the coil is **[AMU (Engg.) 2010]**

(a) 50.35*A* (b) 23.4*A*

(c) 30.5*A* (d) 12.3*A*

116. A light bulb is rated 100 *W* for a 220 *V* supply. The resistance of the bulb and the peak voltage of the source respectively are **[AMU (Med.) 2010]**

(a) 242 Ω and 311 *V* (b) 484 Ω and 311 *V*

(c) 484 Ω and 440 *V* (d) 242 Ω and 440 *V*

117. A pure inductor of 25 *mH* is connected to a source of 220 *V*. Given the frequency of the source as 50 *Hz*, the *rms* current in the circuit is **[AMU (Med.) 2010]**

(a) 7 *A* (b) 14 *A*

(c) 28 *A* (d) 42 *A*

118. An ac voltage is applied to a resistance *R* and inductor *L* in series. If *R* and the inductive reactance are both equal to 3Ω, the phase difference between the applied voltage and the current in the circuit is **[CBSE PMT (Pre.) 2011]**

(a) Zero (b) $\pi/6$

(c) $\pi/4$ (d) $\pi/2$

119. A coil has resistance 30 ohm and inductive reactance 20 Ohm at 50 Hz frequency. If an ac source, of 200 volt, 100 Hz, is connected across the coil, the current in the coil will be **[CBSE PMT (Mains) 2011]**

(a) $\frac{20}{\sqrt{13}}A$ (b) 2.0*A*

(c) 4.0*A* (d) 8.0*A*

120. An *AC* ammeter is used to measure current in a circuit. When a given direct current passes through the circuit, the *AC* ammeter reads 3 *A*. When another alternating current passes through the circuit, the *AC* ammeter reads 4 *A*. Then the reading of this ammeter, if *DC* and *AC* flow through the circuit simultaneously, is **[AIIMS 2010]**

(a) 3 *A* (b) 4 *A*

(c) 7 *A* (d) 5 *A*

121. A transmitter transmit at a wavelength of 300 *m*. A condenser of capacitance 2.4 μF is being used. The value of the inductance for the resonant circuit is approximately **[AIIMS 2010]**

(a) $10^{-4}H$ (b) $10^{-6}H$

(c) $10^{-8}H$ (d) $10^{-10}H$

122. A capacitor of capacitance $1\mu F$ is charged to a potential of 1 *V*. It is connected in parallel to an inductor of inductance $10^{-3}H$. The maximum current that will flow in the circuit has the value **[AIIMS 2010]**

(a) $\sqrt{1000}\,mA$ (b) 1 *A*

(c) 1 *mA* (d) 1000 *mA*

123. A fully charged capacitor *C* with initial charge q_0 is connected to a coil of self inductance *L* at $t = 0$. The time at which the energy is stored equally between the electric and the magnetic fields is **[AIEEE 2011]**

(a) $\pi\sqrt{LC}$ (b) $\frac{\pi}{4}\sqrt{LC}$

(c) $2\pi\sqrt{LC}$ (d) $\sqrt{LC}$

124. In *AC* series circuit, the resistance, inductive reactance and capacitive reactance are 3Ω, 10Ω and 14Ω respectively. The impedance of the circuit is **[Odisha JEE 2011]**

(a) 5Ω (b) 4Ω

(c) 7Ω (d) 10Ω

125. In an electrical circuit *R*,*L*,*C* and an a.c. voltage source are all connected in series. When *L* is removed from the circuit, the phase difference between the voltage and the current in the circuit is $\pi/3$. If instead, *C* is removed from the circuit, the phase difference is again $\pi/3$. The power factor of the circuit is **[CBSE PMT (Pre.) 2012]**

(a) 1/2 (b) $1/\sqrt{2}$

(c) 1 (d) $\sqrt{3}/2$

126. The supply voltage to room is 120 *V*. The resistance of the lead wires is 6 Ω. A 60 *W* bulb is already switched on. What is the decrease of voltage across the bulb, when a 240 *W* heater is switched on in parallel to the bulb **[JEE (Mains) 2013]**

(a) Zero *Volt* (b) 2.9 *Volt*

(c) 13.3 *Volt* (d) 10.40 *Volt*

127. A coil is self-inductance *L* is connected in series with a bulb *B* and an *AC* source. Brightness of the bulb decreases when **[NEET 2013]**

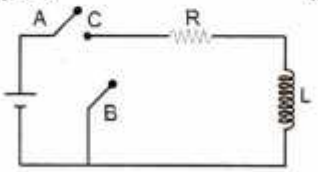
(a) An iron rod is inserted in the coil

(b) Frequency of the AC source is decreased

(c) Number of turns in the coil is reduced

(d) A capacitance of reactance $X_C = X_L$ is included in the same circuit

128. In the circuit shown here, the point '*C*' is kept connected to point '*A*' till the current flowing through the circuit becomes constant. Afterward, suddenly point '*C*' is disconnected from point '*A*' and connected to point '*B*' at time $t = 0$. Ratio of the voltage across resistance and the inductor at $t = L/R$ will be equal to **[JEE (Mains) 2014]**



(a) $\frac{e}{1-e}$ (b) 1

(c) −1 (d) $\frac{1-e}{e}$

129. The frequency of the output signal becomes _____ times by doubling the value of the capacitance in the LC oscillator circuit **[GUJCET 2014]**

(a) $\frac{1}{\sqrt{2}}$ (b) $\sqrt{2}$

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

Critical Thinking

1. An alternating emf $e = 220\sqrt{2}\sin 100t$ V is applied to a capacitor $1\,\mu F$. The current flowing through the capacitor is **[Odisha JEE 2012]**

(a) $22\,mA$ (b) $12\,mA$

(c) $32\,mA$ (d) $42\,mA$

2. In an LR-circuit, the inductive reactance is equal to the resistance R of the circuit. An e.m.f. $E=E_0\cos(\omega t)$ is applied to the circuit. The power consumed in the circuit is **[MP PMT 1997]**

(a) $\frac{E_0^2}{R}$ (b) $\frac{E_0^2}{2R}$

(c) $\frac{E_0^2}{4R}$ (d) $\frac{E_0^2}{8R}$

3. One 10 V, 60 W bulb is to be connected to 100 V line. The required induction coil has self inductance of value (f=50 Hz) **[RPET 1997; Similar KCET 2007]**

(a) 0.052 H (b) 2.42 H

(c) 16.2 mH (d) 1.62 mH

4. An AC voltage source of variable angular frequency ω and fixed amplitude V connected in series with a capacitance C and an electric bulb of resistance R (inductance zero). When ω is increased **[IIT-JEE 2010]**

(a) The bulb glows dimmer

(b) The bulb glows brighter

(c) Total impedence of the circuit is unchanged

(d) Total impedence of the circuit increases

5. The readings of ammeter and voltmeter in the following circuit are respectively **[RPET 1996; Kerala PMT 2008; CBSE PMT 2010; Similar Odisha JEE 2012]**

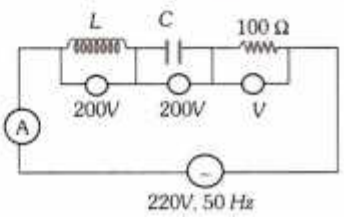
(a) 2A, 200V

(b) 1.5A, 100V

(c) 2.7A, 220V

(d) 1.7 A, 200V

(e) 2.2 A, 220 V



6. In a series circuit $C = 2\mu F, L = 1mH$ and $R = 10\,\Omega$. When the current in the circuit is maximum, at that time the ratio of the energies stored in the capacitor and the inductor will be

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

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

7. An alternating e.m.f. of angular frequency ω is applied across an inductance. The instantaneous power developed in the circuit has an angular frequency **[Roorkee 1999]**

(a) $\omega/4$ (b) $\omega/2$

(c) ω (d) 2ω

8. The voltage of an ac source varies with time according to the equation $V=100\sin 100\pi t\cos 100\pi t$ where t is in seconds and V is in volts. Then **[MP PMT 1996, 2000]**

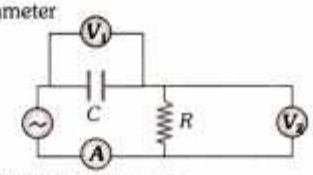
(a) The peak voltage of the source is 100 *volts*

(b) The peak voltage of the source is 50 *volts*

(c) The peak voltage of the source is $100/\sqrt{2}$ *volts*

(d) The frequency of the source is 50 *Hz*

9. The diagram shows a capacitor C and a resistor R connected in series to an ac source. V_1 and V_2 are voltmeters and A is an ammeter



Consider the following statements

I. Readings in A and V_2 are always in phase

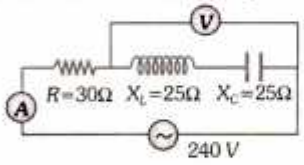
II. Reading in V_1 is ahead in phase with reading in V_2

III. Readings in A and V_1 are always in phase. Which of these statements are/is correct **[AMU (Med.) 2001]**

(a) I only (b) II only

(c) I and II only (d) II and III only

10. In the circuit shown in figure neglecting source resistance the voltmeter and ammeter reading will respectively be **[KCET (Engg.) 2001]**



(a) 0V, 3A (b) 150V, 3A

(c) 150V, 6A (d) 0V, 8A

11. The voltage of an ac supply varies with time (t) as $V=120\sin 100\pi t\cos 100\pi t$. The maximum voltage and frequency respectively are **[MP PMT 2001; MP PET 2002]**

(a) 120 *volts*, 100 *Hz* (b) $\frac{120}{\sqrt{2}}$ *volts*, 100 *Hz*

(c) 60 *volts*, 200 *Hz* (d) 60 *volts*, 100 *Hz*

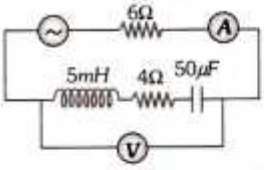
12. In the circuit shown in the figure, the ac source gives a voltage $V=20\cos(2000t)$. Neglecting source resistance, the voltmeter and ammeter reading will be **[KCET (Engg.) 2002]**

(a) 0V, 0.47A

(b) 1.68V, 0.47A

(c) 0V, 1.4 A

(d) 5.6V, 1.4 A



13. A telephone wire of length 200 *km* has a capacitance of 0.014 μF per *km*. If it carries an ac of frequency 5 *kHz*, what should be the value of an inductor required to be connected in series so that the impedance of the circuit is minimum

(a) 0.35 *mH* (b) 35 *mH*

(c) 3.5 *mH* (d) Zero

14. If the total charge stored in the *LC* circuit is Q_0, then for $t \geq 0$ **[IIT-JEE 2006]**

(a) The charge on the capacitor is $Q = Q_0 \cos\left(\frac{\pi}{2} + \frac{t}{\sqrt{LC}}\right)$

(b) The charge on the capacitor is $Q = Q_0 \cos\left(\frac{\pi}{2} - \frac{t}{\sqrt{LC}}\right)$

(c) The charge on the capacitor is $Q = -LC\frac{d^2Q}{dt^2}$

(d) The charge on the capacitor is $Q = \frac{1}{\sqrt{LC}}\frac{d^2Q}{dt^2}$

15. A resistance *R*, inductance *L* and capacitor *C* are connected in series to an oscillator of frequency *f*. If resonant frequency is f_r then current will lag the voltage when **[MP PMT 2006]**

(a) $f = 0$ (b) $f < f_r$

(c) $f = f_r$ (d) $f > f_r$

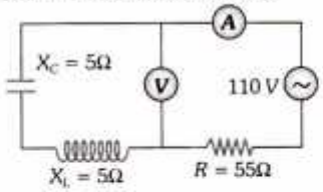
16. The reading of ammeter in the circuit shown will be

(a) 2A

(b) 2.4 A

(c) Zero

(d) 1.7 A



17. An ac source of angular frequency ω is fed across a resistor *r* and a capacitor *C* in series. The current registered is *I*. If the frequency of source is changed to $\omega 3$ (maintaining the same voltage), the current in the circuit is found to be halved. Calculate the ratio of reactance to resistance at the original frequency ω **[Roorkee 1996; AIIMS 2008]**

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

(c) $\sqrt{\frac{1}{5}}$ (d) $\sqrt{\frac{4}{5}}$

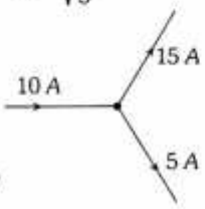
18. Is it possible

(a) Yes

(b) No

(c) Cannot be predicted

(d) Insufficient data to reply



19. A virtual current of 4A and 50 *Hz* flows in an ac circuit containing a coil. The power consumed in the coil is 240 *W*. If the virtual voltage across the coil is 100 *V* its inductance will be

(a) $\frac{1}{3\pi}H$ (b) $\frac{1}{5\pi}H$

(c) $\frac{1}{7\pi}H$ (d) $\frac{1}{9\pi}H$

20. A circuit draws 330 W from a 110 V, 60 Hz AC line. The power factor is 0.6 and the current lags the voltage. The capacitance of a series capacitor that will result in a power factor of unity is equal to **[BHU 2006]**

(a) 31 μF (b) 54 μF

(c) 151 μF (d) 201 μF

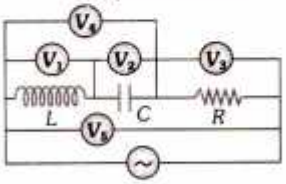
21. In the adjoining ac circuit the voltmeter whose reading will be zero at resonance is **[Similar Kerala PMT 2010]**

(a) V_1

(b) V_2

(c) V_3

(d) V_4



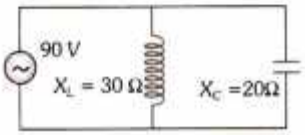
22. In the adjoining figure the impedance of the circuit will be

(a) 120 *ohm*

(b) 50 *ohm*

(c) 60 *ohm*

(d) 90 *ohm*



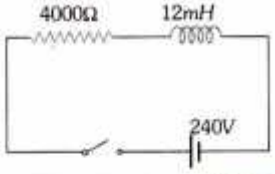
23. In the inductive circuit given in the figure, the current rises after the switch is closed. At instant when the current is 15 *mA*, then potential difference across the inductor will be **[RPMT 2005]**

(a) Zero

(b) 240V

(c) 180V

(d) 60V

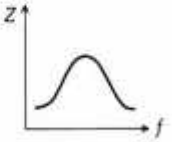


GQ Graphical Questions

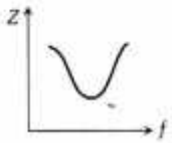
1. Which one of the following curves represents the variation of impedance (*Z*) with frequency *f* in series *LCR* circuit

(a)

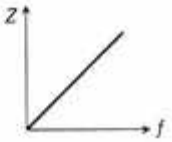
(b)



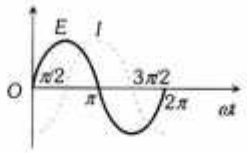
(c)



(d)



2. The variation of the instantaneous current (I) and the instantaneous emf (E) in a circuit is as shown in fig. Which of the following statements is correct



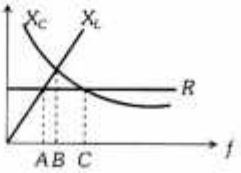
(a) The voltage lags behind the current by $\pi/2$

(b) The voltage leads the current by $\pi/2$

(c) The voltage and the current are in phase

(d) The voltage leads the current by π

3. The figure shows variation of R, X_L and X_C with frequency f in a series L, C, R circuit. Then for what frequency point, the circuit is inductive



(a) A (b) B

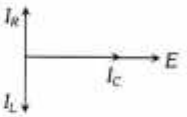
(c) C (d) All points

4. An alternating emf is applied across a parallel combination of a resistance R, capacitance C and an inductance L. If I_R, I_L, I_C are the currents through R, L and C respectively, then the diagram which correctly represents the phase relationship among I_R, I_L, I_C and source emf E, is given by

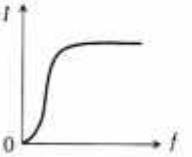
(a) 

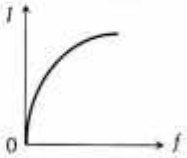
(b) 

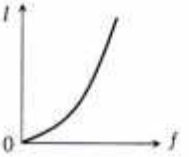
(c) 

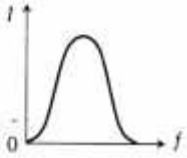
(d) 

5. An ac source of variable frequency f is connected to an LCR series circuit. Which of the graphs in figure represents the variation of current I in the circuit with frequency f

(a) 

(b) 

(c) 

(d) 

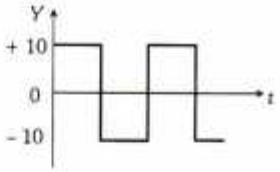
6. The $r.m.s.$ voltage of the wave form shown is

(a) 10 V

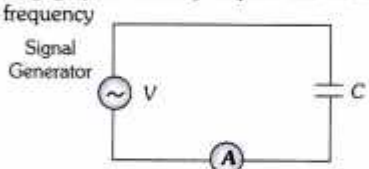
(b) 7 V

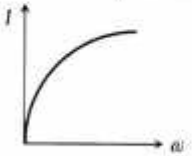
(c) 6.37 V

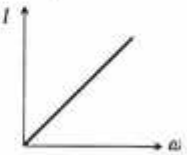
(d) None of these



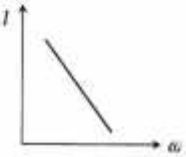
7. A constant voltage at different frequencies is applied across a capacitance C as shown in the figure. Which of the following graphs correctly depicts the variation of current with frequency



(a) 

(b) 

(c) 

(d) 

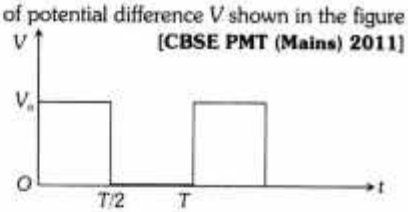
8. The $r.m.s.$ value of potential difference V shown in the figure is **[CBSE PMT (Mains) 2011]**

(a) $V_0/2$

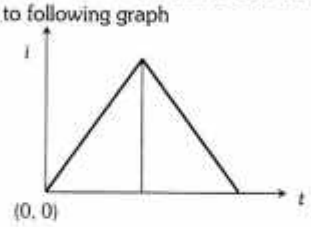
(b) $V_0/\sqrt{3}$

(c) V_0

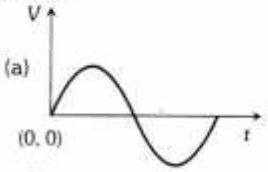
(d) $V_0/\sqrt{2}$

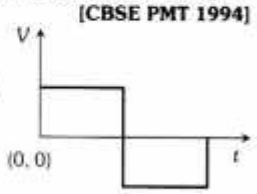


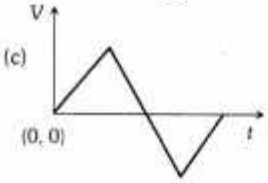
9. The current 'i' in an inductance coil varies with time 't' according to following graph

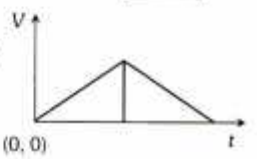


which of the following plots shows the variation of voltage in the coil **[CBSE PMT 1994]**

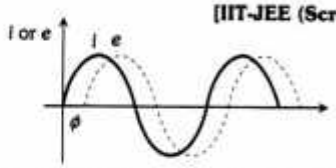
(a) 

(b) 

(c) 

(d) 

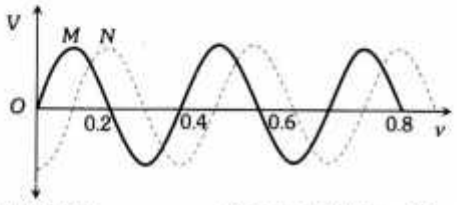
10. When an ac source of e.m.f. $e = E_0 \sin(100t)$ is connected across a circuit, the phase difference between the e.m.f. e and the current i in the circuit is observed to be $\pi/4$, as shown in the diagram. If the circuit consists possibly only of RC or LC in series, find the relationship between the two elements **[IIT-JEE (Screening) 2003]**



(a) $R = 1k\Omega, C = 10\mu F$ (b) $R = 1k\Omega, C = 1\mu F$

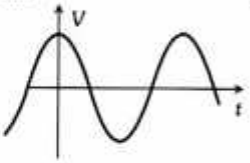
(c) $R = 1k\Omega, L = 10H$ (d) $R = 1k\Omega, L = 1H$

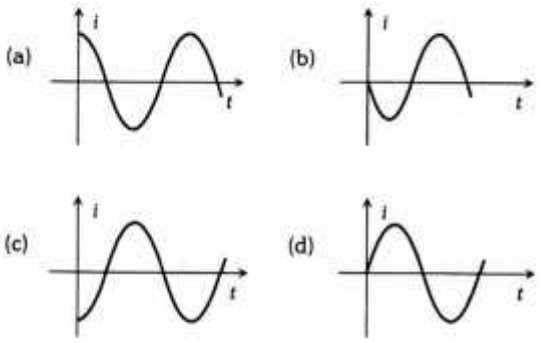
11. Two sinusoidal voltages of the same frequency are shown in the diagram. What is the frequency, and the phase relationship between the voltages



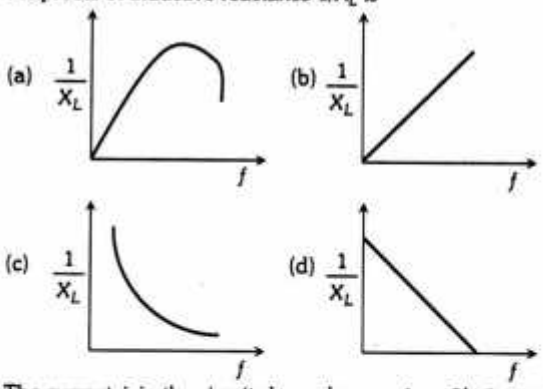
Frequency in Hz	Phase lead of N over M in radians
(a) 0.4	$-\pi/4$
(b) 2.5	$-\pi/2$
(c) 2.5	$+\pi/2$
(d) 2.5	$-\pi/4$

12. The voltage across a pure inductor is represented by the following diagram. Which of the following diagrams will represent the current **[MP PMT 1995]**

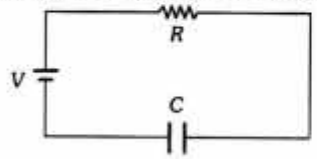


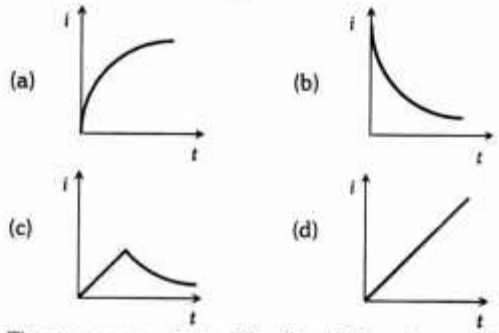


13. In pure inductive circuit, the curves between frequency f and reciprocal of inductive reactance $1/X_L$ is

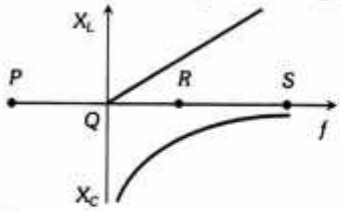


14. The current i in the circuit shown here varies with time t is **[MP PET 2006]**





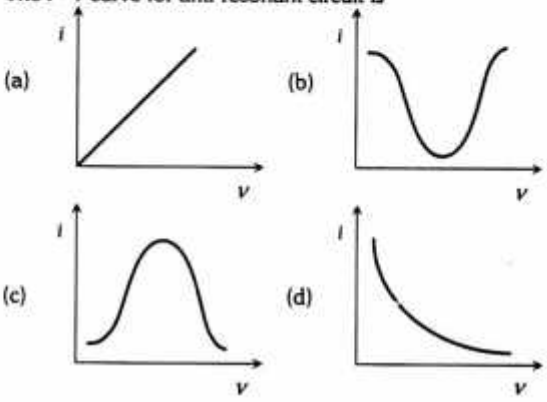
15. The resonance point in $X_L - f$ and $X_C - f$ curves is



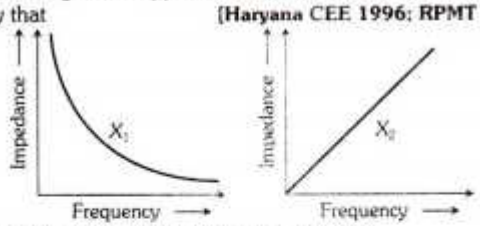
(a) P (b) Q

(c) R (d) S

16. The i - v curve for anti-resonant circuit is



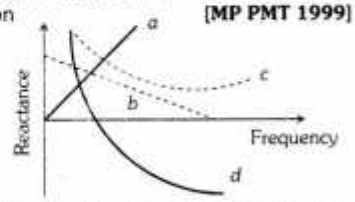
17. The graphs given below depict the dependence of two reactive impedances X_1 and X_2 on the frequency of the alternating e.m.f. applied individually to them. We can then say that **[Haryana CEE 1996; RPMT 2004]**



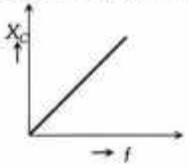
(a) X_1 is an inductor and X_2 is a capacitor
(b) X_1 is a resistor and X_2 is a capacitor
(c) X_1 is a capacitor and X_2 is an inductor
(d) X_1 is an inductor and X_2 is a resistor

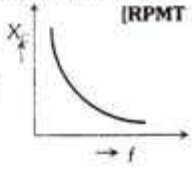
18. Which of the following plots may represent the reactance of a series LC combination **[MP PMT 1999]**

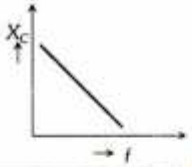
(a) a
(b) b
(c) c
(d) d

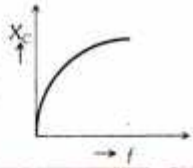


19. Which of the following curves correctly represents the variation of capacitive reactance X_C with frequency f **[RPMT 1996]**

(a) 

(b) 

(c) 

(d) 

JEE Section

More than one correct answers

1. An alternating e.m.f. of frequency $\nu\left(=\frac{1}{2\pi\sqrt{LC}}\right)$ is applied to a series LCR circuit. For this frequency of the applied e.m.f. **[Roorkee 1999]**

(a) The circuit is at resonance and its impedance is made up only of a reactive part
(b) The current in the circuit is in phase with the applied e.m.f. and the voltage across R equals the applied emf
(c) The sum of the p.d.'s across the inductance and capacitance equals the applied e.m.f. which is 180° ahead of phase of the current in the circuit
(d) The quality factor of the circuit is $\omega L/R$ or $1/\omega CR$ and this is a measure of the voltage magnification (produced by the circuit at resonance) as well as the sharpness of resonance of the circuit

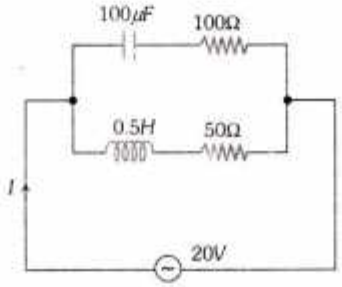
2. In an ac circuit, the power factor **[Roorkee 2000]**

(a) Is zero when the circuit contains an ideal resistance only
(b) Is unity when the circuit contains an ideal resistance only
(c) Is zero when the circuit contains an ideal inductance only
(d) Is unity when the circuit contains an ideal inductance only

3. A series R-C circuit is connected to AC voltage source. Consider two cases; (A) when C is without a dielectric medium and (B) when C is filled with dielectric of constant 4. The current I_R through the resistor and voltage V_c across the capacitor are compared in the two cases. Which of the following is/are true **[IIT-JEE 2011]**

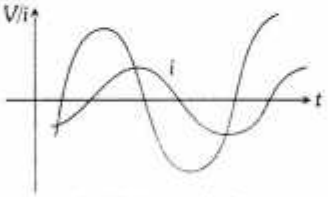
(a) $I_R^A > I_R^B$ (b) $I_R^A < I_R^B$
(c) $V_C^A > V_C^B$ (d) $V_C^A < V_C^B$

4. In the given circuit, the AC source has $\omega = 100\,rad/s$, considering the inductor and capacitor to be ideal, the correct choice (s) is (are) **[IIT-JEE 2012]**



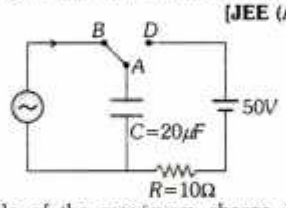
(a) The current through the circuit, I is $0.3A$
(b) The current through the circuit, I is $0.3\sqrt{2}A$
(c) The voltage across 100Ω resistor $= 10\sqrt{2}V$
(d) The voltage across 50Ω resistor $= 10V$

5. Graph shows variation of source emf V and current i in a series RLC circuit, with time



(a) The current leads the emf in the circuit
(b) The circuit is more inductive than capacitive
(c) To increase the rate at which energy is transferred to the resistive load, L should be decreased
(d) To increase the rate at which energy is transferred to the resistive load, C should be increased

6. At time $t=0$, terminal A in the circuit shown in the figure is connected to B by a key and alternating current $I(t)=I_0\cos(\omega t)$, with $I_0=1A$ and $\omega=500\,rad\,s^{-1}$ starts flowing in it with the initial direction shown in the figure. At $t=\frac{7\pi}{6\omega}$, the key is switched from B to D. Now onwards only A and D are connected. A total charge Q flows from the battery to charge the capacitor fully. If $C=20\mu$, $R=10\Omega$ and the battery is deal with emf of 50 V, identify the correct statement(s) **[JEE (Advanced) 2014]**



(a) Magnitude of the maximum charge on the capacitor before $t=\frac{7\pi}{6\omega}$ is $1\times10^{-3}C$

(b) The current in the left part of the circuit just before $t=\frac{7\pi}{6\omega}$ is clockwise

(c) Immediately after A is connected to D. the current in R is 10A

(d) $Q=2\times10^{-3}C$

Reasoning type questions

Read the following statements carefully to mark the correct option out of the options given below

(a) Statement 1 is true, statement 2 is true ; statement 2 is a correct explanation for statement 1

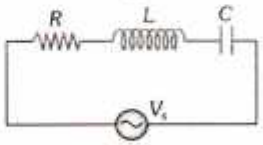
(b) Statement 1 is true, statement 2 is true ; statement 2 is not a correct explanation for statement 1

(c) Statement 1 is true, statement 2 is false

(d) Statement 1 is false, statement 2 is true

7. **Statement-1** : In a series R, L, C circuit if V_R, V_L and V_C denote rms voltage across R, L and C respectively and V_S is the rms voltage across the source, then $V_S=V_R+V_L+V_C$.

Statement-2 : In AC circuits, kirchoff voltage law is correct at every instant of time.



8. **Statement-1** : An inductor is connected to an ac source. When the magnitude of current decreases in the circuit, energy is absorbed by the ac source.

Statement-2 : When current through an inductor decreases, the energy stored in inductor decreases.

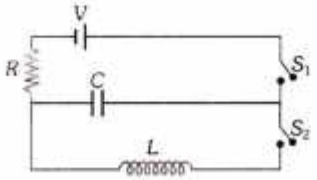
9. **Statement-1** : The electrostatic energy stored in capacitor plus magnetic energy stored in inductor will always be zero in a series LCR circuit driven by ac voltage source under condition of resonance.

Statement-2 : The complete voltage of ac source appears across the resistor in a series LCR circuit driven by ac voltage source under condition of resonance.

Comprehension type questions

Passage-I

In the given circuit the capacitor (C) may be charged through resistance R by battery V by closing switch S_1. Also when S_1 is opened and S_2 is closed the capacitor is connected in series with inductor (L)



10. Given that the total charge stored in the LC circuit is Q_0 for $t\geq0$. the charge on the capacitor is **[IIT-JEE 2006]**

(a) $Q=Q_0\cos\left(\frac{\pi}{2}+\frac{t}{\sqrt{LC}}\right)$

(b) $Q=Q_0\cos\left(\frac{\pi}{2}-\frac{t}{\sqrt{LC}}\right)$

(c) $Q=-LC\frac{d^2Q}{dt^2}$

(d) $Q=-\frac{1}{\sqrt{LC}}\frac{d^2Q}{dt^2}$

11. When the capacitor gets charged completely, S_1 is opened and S_2 is closed. Then **[IIT-JEE 2006]**

(a) At $t=0$, energy stored in the circuit is purely in the form of magnetic energy

(b) At any time $t>0$, current in the circuit is in the same direction

(c) At $t>0$, there is no exchange of energy between the inductor and capacitor

(d) At any time $t>0$, instantaneous current in the circuit may be $V\sqrt{\frac{C}{L}}$

12. At the start, the capacitor was uncharged. When switch S_1 is closed and S_2 is kept open, the time constant of this circuit is τ. Which of the following is correct

[IIT-JEE 2006; JEE (Mains) 2013]

(a) After time interval τ, charge on the capacitor is $\frac{CV}{2}$

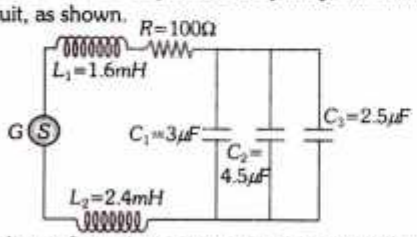
(b) After time interval 2τ, charge on the capacitor of $CV(1-e^{-2})$

(c) The work done by the voltage source will be half of the heat dissipated when the capacitor is fully charge

(d) After time interval $2t$, charge on the capacitor is $CV(1-e^{-1})$

Passage-II

An *ac* generator G with an adjustable frequency of oscillation is used in the circuit, as shown.



13. Current drawn from the *ac* source will be maximum of its angular frequency is

(a) $10^5 rad/s$ (b) $10^4 rad/s$

(c) $5000 rad/s$ (d) $500 rad/s$

14. To increase resonant frequency of the circuit, some of the changes in the circuit are carried out. Which change(s) would certainly result in the increase in resonant frequency

(a) R is increased

(b) L_1 is increased and C_1 is decreased

(c) L_2 is decreased and C_2 is increased

(d) C_3 is removed from the circuit

15. If the *ac* source G is of 100 V rating at resonant frequency of the circuit, then average power supplied by the source is

(a) 50 W (b) 100 W

(c) 500 W (d) 1000 W

16. Average energy stored by the inductor L_2 (source is at resonance frequency) is equal to

(a) Zero (b) 1.2 mJ

(c) 2.4 mJ (d) 4 mJ

17. Thermal energy produced by the resistance R in time duration $1\,\mu s$, using the source at resonant condition, is

(a) $0\,J$

(b) $1\,\mu J$

(c) $100\,\mu J$

(d) Not possible to calculate from the given information

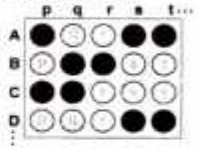
Integer type questions

This section contains some integer type questions. The answers to each of the questions is a **single-digit integer**, ranging from **0 to 9**.

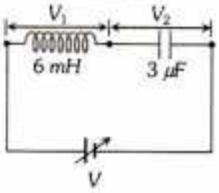
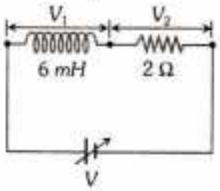
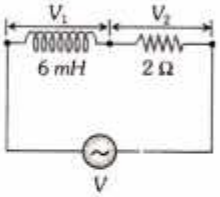
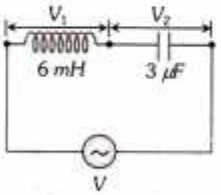
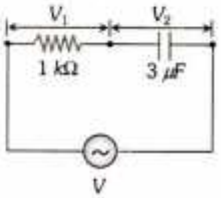
18. A series R-C combination is connected to an AC voltage of angular frequency $\omega = 500$ radian/s. If the impedance of the R-C circuit is $R\sqrt{1.25}$, the time constant (in millisecond) of the circuit is **[IIT-JEE 2011]**

Matrix Match type questions

In this section each question has some statements (A, B, C, D,...) given in **Column-I** and some statements (p, q, r, s, t,...) in **Column-II**. Any given statement in **Column-I** can have correct matching with **ONE OR MORE** statement(s) in **Column-II**. For example, if for a given question, statement B matches with the statements given in q and r, then for that particular question against statement B, darken the bubbles corresponding to q and r in the ORS. i.e. answer will be q and r.



19. You are given many resistances, capacitors and inductors. These are connected to a variable DC voltage source (the first two circuits) or an AC voltage source of 50 Hz frequency (the next three circuits) in different ways as shown in Column-II. When a current I (steady state for DC or *rms* for AC) flows through the circuit, the corresponding voltage V_1 and V_2 (indicated in circuits) are related as shown in Column-I. Match the two **[IIT-JEE 2010]**

Column-I		Column-II
(A)	$I \neq 0, V_1$ is proportional to I	(p) 
(B)	$I \neq 0, V_2 > V_1$	(q) 
(C)	$V_1 = 0, V_2 = V$	(r) 
(D)	$I \neq 0, V_2$ is proportional to I	(s) 
		(t) 

Assertion & Reason

Read the assertion and reason carefully to mark the correct option out of the options given below:

(a) *If both assertion and reason are true and the reason is the correct explanation of the assertion.*

(b) *If both assertion and reason are true but reason is not the correct explanation of the assertion.*

(c) *If assertion is true but reason is false.*

(d) *If the assertion and reason both are false.*

(e) *If assertion is false but reason is true.*

1. Assertion : In series *LCR* circuit resonance can take place.

Reason : Resonance takes place if inductance and capacitive reactances are equal and opposite.

[AIIMS 1998]

2. Assertion : The alternating current lags behind the e.m.f. by a phase angle of $\pi/2$, when ac flows through an inductor.

Reason : The inductive reactance increases as the frequency of ac source decreases.

3. Assertion : Capacitor serves as a block for dc and offers an easy path to ac.

Reason : Capacitive reactance is inversely proportional to frequency.

4. Assertion : When capacitive reactance is smaller than the inductive reactance in *LCR* circuit, e.m.f. leads the current .

Reason : The phase angle is the angle between the alternating e.m.f. and alternating current of the circuit.

5. Assertion : A capacitor of suitable capacitance can be used in an ac circuit in place of the choke coil.

Reason : A capacitor blocks dc and allows ac only.

6. Assertion : If the frequency of alternating current in an ac circuit consisting of an inductance coil is increased then current gets decreased.

Reason : The current is inversely proportional to frequency of alternating current.

7. Assertion : An inductance and a resistance are connected in series with an ac circuit. In this circuit the current and the potential difference across the resistance lags behind potential difference across the inductance by an angle $\pi/2$.

Reason : In *LR* circuit voltage leads the current by phase angle which depends on the value of inductance and resistance both.

8. Assertion : An alternating current does not show any magnetic effect.

Reason : Alternating current varies with time.

9. Assertion : The dc and ac both can be measured by a hot wire instrument.

Reason : The hot wire instrument is based on the principle of magnetic effect of current.

10. Assertion : ac is more dangerous than dc

Reason : Frequency of ac is dangerous for human body.

11. Assertion : Average value of ac over a complete cycle is always zero.

Reason : Average value of ac is always defined over half cycle.

12. Assertion : The divisions are equally marked on the scale of ac ammeter.

Reason : Heat produced is directly proportional to the current.

13. Assertion : For an electric lamp connected in series with a variable capacitor and ac source, its brightness increases with increase in capacitance.

Reason : Capacitive reactance decreases with increase in capacitance of capacitor. **[AIIMS 2010]**

Answers

Alternating Current, Voltage and Power

1	c	2	a	3	c	4	b	5	c
6	b	7	c	8	a	9	c	10	c
11	d	12	c	13	a	14	a	15	b
16	d	17	b	18	b	19	d	20	b
21	c	22	a	23	c	24	d	25	c
26	c	27	d	28	e	29	c	30	d
31	d	32	d	33	b	34	b	35	d
36	c	37	a	38	b	39	a	40	c
41	a	42	d	43	b	44	b	45	c
46	b								

ac Circuits

1	b	2	a	3	d	4	a	5	a
6	a	7	b	8	d	9	d	10	b
11	d	12	b	13	b	14	b	15	a
16	a	17	b	18	b	19	a	20	b
21	b	22	d	23	b	24	b	25	a
26	d	27	c	28	b	29	c	30	a
31	a	32	b	33	d	34	a	35	c
36	a	37	a	38	b	39	c	40	d
41	a	42	b	43	d	44	a	45	d
46	c	47	a	48	a	49	c	50	c
51	b	52	c	53	b	54	c	55	c
56	a	57	a	58	b	59	a	60	d
61	c	62	c	63	b	64	a	65	a
66	d	67	a	68	a	69	a	70	b
71	a	72	d	73	d	74	c	75	b
76	b	77	b	78	c	79	c	80	a
81	b	82	d	83	c	84	c	85	b
86	a	87	c	88	a	89	a	90	c
91	d	92	b	93	d	94	c	95	b
96	a	97	d	98	b	99	b	100	d
101	a	102	b	103	b	104	a	105	c
106	a	107	a	108	a	109	a	110	d
111	d	112	c	113	a	114	c	115	b
116	b	117	c	118	c	119	c	120	d
121	c	122	a	123	b	124	a	125	c
126	d	127	a	128	c	129	a		

Critical Thinking Questions

1	a	2	c	3	a	4	b	5	e
6	d	7	d	8	b	9	b	10	d
11	d	12	d	13	a	14	c	15	d
16	c	17	a	18	a	19	b	20	b
21	d	22	c	23	c				

Graphical Questions

1	c	2	b	3	c	4	c	5	d
6	a	7	b	8	d	9	b	10	a
11	b	12	d	13	c	14	a	15	c
16	b	17	c	18	d	19	b		

JEE Section

1	bd	2	bc	3	bc	4	ac	5	bcd
6	cd	7	d	8	a	9	d	10	c
11	d	12	b	13	c	14	d	15	b
16	b	17	d	18	4				
19	A→r, s, t; B→q, r, s, t; C→p, q; D→q, r, s, t								

Assertion and Reason

1	a	2	c	3	a	4	b	5	b
6	a	7	b	8	b	9	c	10	a
11	b	12	d	13	a				