PHYSICS

Alternating Current

Q.1 Hot wire ammeters are used for measuring

(a) Both AC and DC (b) Only AC

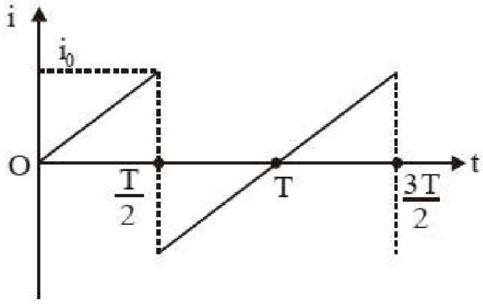
(c) Only DC (d) Neither AC nor DC

Q.2 In alternating current circuits, the a.c. meters measure

(a) r.m.s. value (b) Peak value

(c) Mean value (d) Mean square value

Q.3 The mean value of current for half cycle for a current variation shown by the graph is



(a) $\frac{i_0}{2}$ (b) i_0

(c) $\frac{i_0}{\sqrt{3}}$ (d) $\frac{i_0}{3}$

Q.4 A 110 V d.c. heater is used on an a.c. source, such that the heat produced is same as it produces when connected to 110 V dc in same time-intervals. What would be the r.m.s. value of the alternating voltage?

(a) 110 V (b) 220 V

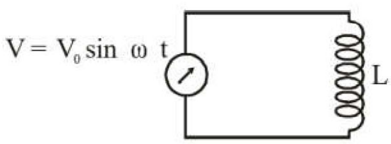
(c) 330 V (d) 440 V

Q.5 A 220 volt input is supplied to a transformer. The output circuit draws a current of 2.0 ampere at 440 volts. If the efficiency of the transformer is 80%, the current drawn by the primary windings of the transformer is

(a) 5.0 ampere (b) 3.6 ampere

(c) 2.8 ampere (d) 2.5 ampere

Q.6 There is no resistance in the inductive circuit. Kirchhoff 's voltage law for the circuit is



(a) $V + L\frac{di}{dt} = 0$

(b) $V = L\frac{di}{dt}$

(c) $V = L^2\frac{di}{dt} = 0$

(d) None of these

Q.7 An inductive circuit contains a resistance of 10 ohms and an inductance of 2 henry. If an alternating voltage of 120 V and frequency 60 Hz is applied to this circuit, the current in the circuit would be nearly

(a) 0.32 A (b) 0.80 A

(c) 0.48 A (d) 0.16 A

Q.8 A transformer having efficiency of 90% is working on 200 V and 3 kW power supply. If the current in the secondary coil is 6A, the voltage across the secondary coil and the current in the primary coil respectively are

(a) 300 V, 15 A (b) 450 V, 15 A

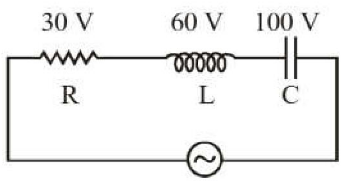
(c) 450 V, 13.5 A (d) 600 V, 15 A

Q.9 In an LCR series circuit R = 10 Ω, X_L = 8 Ω and X_C = 6 Ω. The total impedance of the circuit is

(a) 10.2 Ω (b) 17.2 Ω

(c) 10 Ω (d) None of these

Q.10 In a series RLC circuit, potential differences across R, L and C are 30 V, 60 V and 100 V respectively as shown in figure. The e.m.f. of source (in volts) is



(a) 190 (b) 70

(c) 50 (d) 40

Q.11 Power dissipated in an LCR series circuit connected to an a.c. source of emf ε is

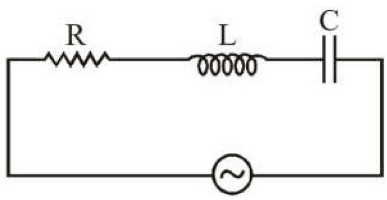
(a) $\dfrac{\varepsilon^2 R}{\sqrt{R^2+\left(L\omega-\dfrac{1}{C\omega}\right)^2}}$

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

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

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

Q.12 In the following circuit the emf of source is E_0 = 200 volt, R = 20 Ω, L = 0.1 henry, C = 10.6 farad and frequency is variable then the current at frequency f = 0 and f = ∞ is



(a) Zero, 10 A (b) 10 A, zero
(c) 10 A, 10 A (d) Zero, zero

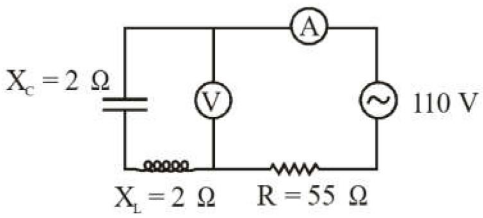
Q.13 With increase in frequency of an a.c. supply, the impedance of an LCR series circuit

(a) Remains constant
(b) Decreases
(c) Increases
(d) Decreases at first, becomes minimum and then increases

Q.14 In an LCR circuit L = 8.0 henry, C = 0.5 μF and R = 100 ohm are in series. The resonance angular frequency is

(a) 500 rad/s (b) 600 rad/s
(c) 800 rad/s (d) 1000 rad/s

Q.15 The reading of ammeter in the circuit is



(a) 2 A (b) 3 A
(c) Zero (d) 1 A

Q.16 In an LCR circuit, the resonating frequency is 500 kHz. If the value of L is doubled and value of C is decreased to $\frac{1}{8}$ times of its initial values, then the new resonating frequency in kHz will be

(a) 250 (b) 500
(c) 1000 (d) 2000

Q.17 In series LCR circuit voltage leads the current when (Given that ω_0 = resonant angular frequency)

(a) $\omega < \omega_0$ (b) $\omega = \omega_0$
(c) $\omega > \omega_0$ (d) None of these

Q.18 Power factor of an ideal choke coil (i.e., R = 0) is

(a) Near about zero
(b) Zero
(c) Near about one
(d) One

Q.19 At resonance, the value of the power factor in an LCR series circuit is

(a) Zero (b) 1
(c) $\frac{1}{2}$ (d) Not defined

Q.20 In an a.c. circuit, the instantaneous values of e.m.f. and current are E = 200 sin 314 t (volt) and i = sin (314 t + π/3) A. The average power consumed in watts is

(a) 100 (b) 200
(c) 50 (d) 25

Q.21 An a.c. of frequency f is flowing in a circuit containing only an ideal choke coil of inductance L. If V_0 and i_0 represent peak values of the voltage and the current respectively, the average power given by the source to the choke coil is equal to

(a) $\frac{1}{2}i_0V_0$ (b) $\frac{1}{2}i_0^2(2\pi fL)$
(c) Zero (d) $\frac{1}{2}V_0(2\pi fL)$

Q.22 When a voltage $V = V_0 \cos \omega t$ is applied across a resistor of resistance R, the average power dissipated per cycle in the resistor is given by

(a) $\frac{V_0}{\sqrt{2}R}$ (b) $\frac{V_0}{\sqrt{2}\omega R}$

(c) $\frac{V_0^2}{2R}$ (d) $\frac{V_0^2}{2\omega R}$

Q.23 **In oscillating LC circuit, the total stored energy is U and maximum charge upon capacitor is Q. When the charge upon the capacitor is $\frac{Q}{2}$, the energy stored in the inductor is**

(a) $\frac{U}{2}$ (b) $\frac{U}{4}$

(c) $\frac{4}{3}U$ (d) $\frac{3U}{4}$

Q.24 **For an AC circuit the potential difference and current are given by $V = 10\sqrt{2}\sin\omega t$ (in V) and $I = 2\sqrt{2}\cos\omega t$ (in A) respectively. The power dissipated in the instrument is**

(a) 20 W (b) 40 W

(c) 40 2 W (d) Zero

Q.25 **In a series L-C circuit, if L = 10^{-3} H and C = 3×10^{-7} F is connected to a 100 V-50 Hz a.c. source, the impedance of the circuit is**

(a) $\frac{10^5}{3\pi} - 10\pi$ (b) $0.1\pi - 3\times10^{-5}\pi$

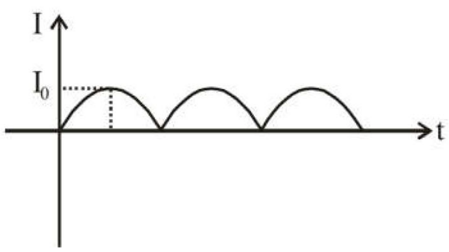
(c) $\frac{10^5}{3\pi} - \frac{\pi}{10}$ (d) None of these

Q.26 **A direct current of 10 A is superimposed on an alternating current I = 40 cos (ωt) A flowing through a wire. The effective value of the resulting current will be**

(a) $10\sqrt{2}$ A (b) $20\sqrt{2}$ A

(c) $20\sqrt{3}$ A (d) 30 A

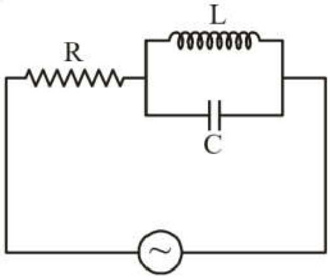
Q.27 **The output current versus time curve for a rectifier is shown in the figure. The average value of output current in this case is**



(a) 0 (b) $\frac{I_0}{2}$

(c) $\frac{2I_0}{\pi}$ (d) I_0

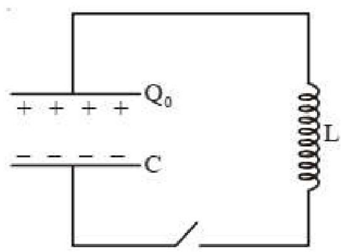
Q.28 **In the given A.C. circuit, the instantaneous current through inductor and capacitor are 0.8 A and 0.4 A respectively. The instantaneous current through resistor is**



(a) 1.2 A (b) 0.6 A

(c) 0.4 A (d) $\sqrt{0.8}$ A

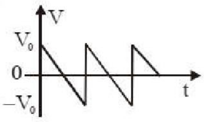
Q.29 **A capacitor of capacitance C has initial charge Q_0 and connected to an inductor of inductance L as shown. At t = 0 switch S is closed. The current through the inductor when energy in the capacitor is three times the energy of inductor is**

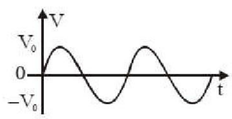


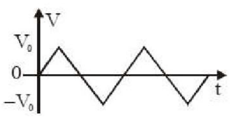
(a) $\frac{Q_0}{2\sqrt{LC}}$ (b) $\frac{Q_0}{\sqrt{LC}}$

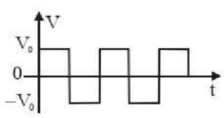
(c) $\frac{2Q_0}{\sqrt{LC}}$ (d) $\frac{4Q_0}{\sqrt{LC}}$

Q.30 **Different alternating voltages are given below. In which case the peak value and rms value are same?**

(i) 

(ii) 

(iii) 

(iv) 

(a) (iii) only (b) (iv) only

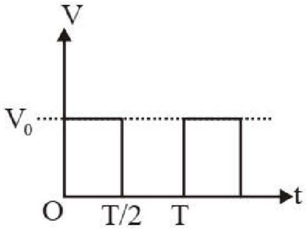
(c) (i), (ii) & (iii) (d) (ii) & (iii)

Q.31 An electric bulb of 100 W – 300 V is connected with an AC supply of 500 V and $\frac{150}{\pi}$ Hz. The required inductance to save the electric bulb is

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

(c) 4 H (d) $\frac{1}{4}$H

Q.32 The r.m.s. value of potential difference V shown in the figure is



(a) $\frac{V_0}{2}$ (b) $\frac{V_0}{\sqrt{3}}$

(c) V_0 (d) $\frac{V_0}{\sqrt{2}}$

Q.33 In an ac circuit an alternating voltage $e = 200\sqrt{2}\sin 100t$ volts is connected to capacitor of capacity 1 μF. The r.m.s. value of the current in the circuit is

(a) 20 mA (b) 10 mA

(c) 100 mA (d) 200 mA

Q.34 In an A.C. circuit, I_{rms} and I_0 are related as

(a) $I_{rms} = \pi I_0$ (b) $I_{rms} = \sqrt{2}\, I_0$

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

Q.35 The electric current in a circuit is given by i = 3 sin ωt + 4 cos ωt. The rms current is

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

(c) $\frac{4}{\sqrt{2}}$ (d) $\frac{3}{\sqrt{2}}$

Q.36 The instantaneous values of alternating current and voltages in a circuit are given as

$i = \frac{1}{\sqrt{2}}\sin(100\pi t)$ ampere

$e = \frac{1}{\sqrt{2}}\sin\left(100\pi t + \frac{\pi}{3}\right)$ volt

The average power in watts consumed in the circuit is

(a) $\frac{1}{4}$ (b) $\frac{\sqrt{3}}{4}$

(c) $\frac{1}{2}$ (d) $\frac{1}{8}$

Q.37 If the power factor in an AC circuit changes from $\frac{1}{3}$ to $\frac{1}{9}$ then by what percent reactance will change (approximately), if resistance remains constant?

(a) Increase by 200% (b) Decrease by 200%

(c) Increase by 100% (d) Decrease by 100%

Q.38 An ac voltage is applied to a resistance R and inductor L in series. If R and the inductive reactance are both equal to 3 Ω, the phase difference between the applied voltage and the current in the circuit is

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

(c) $\frac{\pi}{4}$ (d) $\frac{\pi}{2}$

Q.39 An L-C-R circuit is connected to a source of A.C. current. At resonance, the phase difference between the applied voltage and the current in the circuit, is

(a) π (b) Zero

(c) $\frac{\pi}{4}$ (d) $\frac{\pi}{2}$

Q.40 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

(a) $\frac{1}{\pi f(2\pi f\ L - R)}$ (b) $\frac{1}{2\pi f(2\pi f\ L - R)}$

(c) $\frac{1}{\pi f(2\pi f\ L + R)}$ (d) $\frac{1}{2\pi f(2\pi f\ L + R)}$

Q.41 A coil of inductive reactance 31 Ω has a resistance of 8 Ω. It is placed in series with a condenser of capacitative reactance 25 Ω. The combination is connected to an a.c. source of 110 V. The power factor of the circuit is

(a) 0.33 (b) 0.56

(c) 0.64 (d) 0.80

Q.42 **A capacitor and a bulb are connected in series with a source of alternating emf. If a dielectric slab is inserted between the plates of the capacitor, then**

(a) The brightness of the bulb decreases

(b) The brightness of the bulb increases

(c) The brightness of the bulb remains same

(d) The brightness of the bulb becomes zero

Q.43 **The primary and secondary coils of a transformer have 50 and 1500 turns respectively. If the magnetic flux ϕ linked with the primary coil is given by $\phi = \phi_0 + 4t$ where ϕ is in weber, t is time in second and ϕ_0 is a constant, the output voltage across the secondary coil is**

(a) 120 volt (b) 220 volt

(c) 30 volt (d) 90 volt

Q.44 **A transformer is used to light a 100 W and 110 V lamp from a 220 V mains. If the main current is 0.5 A, then the efficiency of the transformer is approximately**

(a) 50% (b) 90%

(c) 10% (d) 30%

Q.45 **A step-up transformer operates on 220 V line and supplies 2.2 A. The ratio of primary and secondary winding is 11 : 50. The output voltage in the secondary is**

(a) 220 V

(b) 100 V

(c) 1000 V

(d) 0 V

Q.46 **Assertion :** Direct current is more dangerous than Alternating current of same value.

Reason : An electrocuted person sticks to direct current line. while alternating current repels the person from the line.

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

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

(c) Assertion is true but reason is wrong.

(d) Assertion and reason both are wrong.

Q.47 **Assertion :** An inductor and a capacitor are called low pass filter and high pass filter respectively.

Reason : Reactance of an inductor is low for low frequency signals and that of a capacitor is high for high frequency signals.

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

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

(c) Assertion is true but reason is wrong.

(d) Assertion and reason both are wrong.

Q.48 **Assertion :** For a practical choke coil the power factor is very small.

Reason : In a practical choke coil the power dissipation reduces if frequency of the a.c. is increased.

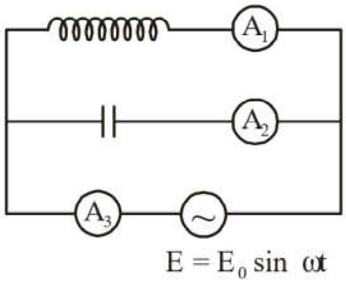
(a) Assertion and reason both are true and the reason is correct explanation of assertion.

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

(c) Assertion is true but reason is wrong.

(d) Assertion and reason both are wrong.

Q.49 **An inductor L and a capacitor C ac connected in the circuit as shown in the figure. The frequency of source is equal to resonance frequency of the circuit. Which ammeter will read zero ampere?**



(a) A_1 (b) A_3

(c) A_2 (d) None of these

Q.50 **The ratio of mean value over half cycle to r.m.s. value of A.C. is**

(a) $2 : \pi$ (b) $2\sqrt{2} : \pi$

(c) $\sqrt{2} : \pi$ (d) $\sqrt{2} : 1$

Solution

1. (a)

The hot wire ammeter is a device used to measure AC and DC current intensity based on the thermal expansion of a wire that is heated due to the flow of the electric current through it, as the heat produced is proportional to the square of DC or rms value of the AC.

2. (a)

Since the actual value of AC is not constant and changes too frequently to measure every time but since the change is only in sign a meter measuring value irrespective of sign would work therefore hot wire ammeters works perfectly they measure rms values, as heat is function of squares of I, V and sign doesn't matter.

3. (a)

$$I_{mean} = \frac{\int_0^{T/2} I dt}{T/2}$$

From 0 to $\frac{T}{2}$ graph is straight line so the function

(I) will be $= \frac{i_0}{(T/2)}.t = \frac{2i_0}{T}t$

So $I_{mean} = \frac{2}{T}\int_0^{T/2}\frac{2i_0}{T}tdt = \frac{2}{T}\left(\frac{2}{T}\right)i_0\left(\frac{t^2}{2}\right)_0^{T/2}$

$$= \frac{4}{T^2}i_0\left(\frac{1}{2}\right)\left(\frac{T^2}{4}-0\right) = \frac{i_0}{2}$$

4. (a)

Given that $H_{AC} = H_{DC}$

$$I_{rms}^2 Rt = I^2 Rt$$

$$\frac{V_{rms}^2}{R} = \frac{V^2}{R}$$

$$V_{rms} = V$$

so, $V_{rms} = 110V$

5. (a)

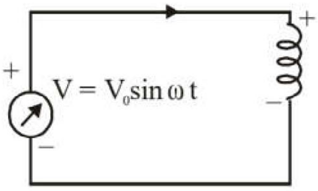
$\frac{P_{out}}{P_{input}} = 0.8$ (given)

$$\frac{V_{out}I_{out}}{V_{input}I_{input}} = 0.8$$

$$\frac{2\times 440}{(220)I} = 0.8$$

$$I = \frac{4}{0.8} = 5.0A$$

6. (b)



Using Kirchhoff's voltage law

$$\frac{-Ldi}{dt} + V = 0$$

$$\Rightarrow V = \frac{Ldi}{dt}$$

7. (d)

R = 10 Ω, L = 10 H, V_{rms} = 120 V, f = 60 Hz

$$I_{rms} = \frac{V_{rms}}{Z}$$

$$Z = \sqrt{R^2+\omega^2L^2} = \sqrt{(10)^2+(2\pi\times 60\times 2)^2}$$

$$\Rightarrow Z = 753.6\Omega$$

$$I_{rms} = \frac{120}{753.6} = 0.16A$$

8. (b)

9. (a)

R = 10 Ω, X_L = 8 Ω and X_C = 6 Ω

$$Z = \sqrt{R^2+(X_L-X_C)^2}$$

$$= \sqrt{(10)^2+2^2}$$

$$= \sqrt{104} \approx 10.2\Omega$$

10. (c)

$$\text{emf} = V_{rms} = \sqrt{V_R^2+(V_L-V_C)^2}$$

$$= \sqrt{(30)^2 + (100-60)^2}$$

$$= \sqrt{(30)^2 + (40)^2} = 50\,V$$

11. (b)

$$P = \left(\frac{V_{rms}^2}{Z}\right)\cos\phi$$

now in problem

$$P = \frac{\varepsilon^2}{Z}\cdot\frac{R}{Z} = \frac{\varepsilon^2 R}{Z^2} = \frac{\varepsilon^2 R}{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}$$

12. (d)

$E_0 = 200$ volt, $R = 20\,\Omega$, $L = 0.1$ henry, $C = 10.6$ F

When $f = 0$, $X_L = \omega L = 2\pi f L = 0$

$X_C = \propto$

When $f = \infty$, $X_L = \infty$, $X_C = 0$

In both case at least one component has infinite value of reactance. So in both cases current will be zero as they are connected in series.

13. (d)

$$X_L = 2\pi f L,\ X_c = \frac{1}{2\pi f C}$$

When f is increased, X_L will increase

X_C will decrease

$$Z = \sqrt{R^2 + (X_C - X_L)^2}$$

initially, if $X_C > X_L \Rightarrow Z$ will decrease

at resonance frequency,

$X_C = X_L \Rightarrow Z$ will be minimum

further $X_C < X_L \Rightarrow Z$ will increase.

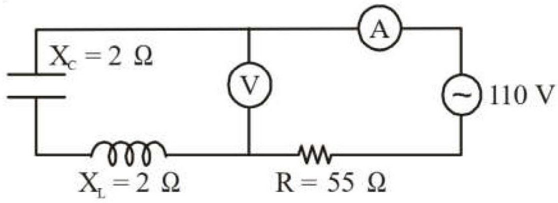
14. (a)

$L = 8.0$ henry, $C = 0.5\,\mu F$ and $R = 100\,\Omega$ in series

$$\omega = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{8\times(0.5)\times10^{-6}}}$$

$$= \frac{1}{\sqrt{4\times10^{-6}}} = \frac{10^3}{2} = 500\,rad/s$$

15. (a)



$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

$$= \sqrt{(55)^2} = 55\Omega$$

$V = IZ$

$$\frac{110}{55} = I \Rightarrow I = 2A$$

16. (c)

$f_1 = 500\times10^3$ Hz

$$L' \to 2L,\ C' \to \frac{1}{8}C$$

$$f = \frac{1}{2\pi\sqrt{LC}} \Rightarrow f \propto \frac{1}{\sqrt{CL}}$$

$$\frac{f_1}{f_2} = \frac{\sqrt{L_2C_2}}{\sqrt{L_1C_1}} = \sqrt{\frac{(2L)\left(\frac{1}{8}C\right)}{LC}}$$

$$\frac{f_1}{f_2} = \frac{1}{2} \Rightarrow f_2 = 1000\,kHz$$

17. (c)

$$X_L = \omega L,\qquad X_C = \frac{1}{\omega C}$$

If voltage leads $\Rightarrow X_L > X_C$, for this condition

$\omega > \omega_0$

So it will be an inductive circuit

18. (b)

$$\cos\phi = \frac{R}{Z} = 0$$

19. (b)

At resonance, $Z = R$

$$\cos\phi = \frac{R}{Z} = 1 = \text{Power factor.}$$

20. (c)

$$P = E_{rms} I_{rms} \cos\phi$$

$$= \frac{E}{\sqrt{2}} \frac{I}{\sqrt{2}} \left(\frac{1}{2}\right) \quad \left(\because \cos\phi = \frac{\pi}{3} \text{here}\right)$$

$$= 200 \times 1 \times \frac{1}{2} \times \frac{1}{2}$$

$$= \frac{100}{2} W$$

$$= 50 \text{ W}$$

21. (c)

For an ideal choke coil $\cos\phi = 0$

so, $P = E_{rms} I_{rms} \cos\phi = 0$

22. (c)

$$P = E_{rms} I_{rms} \cos\phi$$

$$\cos\phi = \frac{R}{Z}$$

$\cos\phi = 1$ for resistor

$$V_{rms} = \frac{V_0}{\sqrt{2}}$$

$$P = \frac{V_0}{\sqrt{2}}, \frac{V_0}{R\sqrt{2}}(1) \quad \left(\because I_{rms} = \frac{V_{rms}}{R} = \frac{V_0}{R\sqrt{2}}\right)$$

$$P = \frac{V_0^2}{2R}$$

23. (d)

$$\text{Initial energy} = \text{total energy} = \frac{Q^2}{2C} = U$$

$$U' = \frac{Q'^2}{2C}$$

$$U' = \frac{Q^2}{4(2C)} \left(\text{as } Q' = \frac{Q}{2}\right)$$

$$= \frac{Q^2}{8C}$$

$$U_{inductor} = U_{total} - U_{capacitor}$$

$$= \frac{Q^2}{2C} - \frac{Q^2}{8C}$$

$$= \frac{3Q^2}{8C} = \frac{3}{4} U$$

24. (d)

Here phase difference $\phi = \frac{\pi}{2}$

So, $P = V_{rms} I_{rms} \cos\frac{\pi}{2} = 0$

25. (c)

$L = 10^{-3}$ H and $C = 3 \times 10^{-7}$ F

$f = 50$ Hz, $V = 100$ V

$$Z = \sqrt{(X_L - X_C)^2}$$

$$= (X_L - X_C) = \omega L - \frac{1}{\omega C}$$

Putting ω, L & C

$$Z = \left(\frac{10^5}{3\pi} - \frac{\pi}{10}\right)$$

26. (d)

$$I_{net} = \sqrt{(10)^2 + \left(\frac{40}{\sqrt{2}}\right)^2}$$

$$I_{net} = \sqrt{100 + 800}$$

$$= \sqrt{900} = 30 \text{ A}$$

27. (c)

$$I_{avg} = \frac{\int idt}{\int dt}$$

So $I_{avg} = \frac{2I_0}{\pi}$

28. (c)

$$I_R = I_L - I_C$$

$$I_R = 0.4 \text{ A}$$

29. (a)

$$E_{total} = E_L + E_c = \frac{Q_0^2}{2C}$$

$$E_L + 3E_L = \frac{Q_0^2}{2C}$$

$$4E_L = \frac{Q_0^2}{2C}$$

$$E_L = \frac{Q_0^2}{8C} = \frac{1}{2}Li^2$$

$$i^2 = \frac{Q_0^2}{4LC}$$

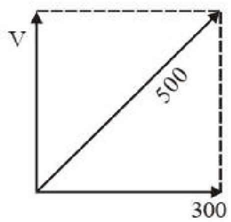
$$i = \frac{Q_0}{2\sqrt{LC}}$$

30. (b)

For square pulse

$V_{rms} = V_{peak}$

31. (c)



$$V^2 + (300)^2 = (500)^2$$

$$V^2 = (400)^2$$

$$V = 400$$

and $I = \frac{100}{300} = \frac{1}{3}A$

$$V = IX_L$$

$$400 = \left(\frac{1}{3}\right)X_L$$

$$X_L = 1200\ \Omega$$

$$(2\pi f)L = 1200\ \Omega$$

So $L = 4$ H

32. (d)

$$I_{rms} = \sqrt{\frac{\int I^2 dt}{\int dt}}$$

$$V_{rms} = \sqrt{\frac{\int V^2 dt}{\int dt}}$$

from $0 \to \frac{T}{2}$, $V = V_0$ and $\frac{T}{2} \to T$, $V = 0$

So $V_{rms} = \sqrt{\frac{V_0^2 T/2}{T}} = \frac{V_0}{\sqrt{2}}$

33. (a)

$$X_C = \frac{10^6}{100 \times 1} = 10^4$$

$$I_{rms} = \frac{V_{rms}}{X_C}$$

$$I_{rms} = \frac{200}{10^4} = 0.02\,A = 20\,mA$$

34. (d)

$$I_{rms} = \frac{I_0}{\sqrt{2}}$$

35. (a)

$$I = 3\sin\omega t + 4\cos\omega t$$

$$= 3\sin\omega t + 4\sin\left(\omega t + \frac{\pi}{2}\right)$$

$$I_0 = \sqrt{I_1^2 + I_2^2 + 2I_1 I_2 \cos\frac{\pi}{2}}$$

I_1 is max of $I_1 = 3$ and $I_2 = 4$

$$I_0 = \sqrt{(3)^2 + (4)^2 + 2(3)(4)\cos\frac{\pi}{2}} = 5$$

$$I_{rms} = \frac{I_0}{\sqrt{2}} = \frac{5}{\sqrt{2}}$$

36. (d)

$$P = V_{rms} I_{rms} \cos\phi$$

$$I_{rms} = \frac{I_0}{\sqrt{2}} = \frac{1}{(\sqrt{2})(\sqrt{2})} = \frac{1}{2}$$

$$V_{rms} = \frac{V_0}{\sqrt{2}} = \frac{1}{(\sqrt{2})(\sqrt{2})} = \frac{1}{2}$$

So, $P = \left(\frac{1}{2}\right)\left(\frac{1}{2}\right)\cos\frac{\pi}{3} = \left(\frac{1}{4}\right)\left(\frac{1}{2}\right) = \frac{1}{8}W$

37. (a)

Power factor $\cos\phi = \frac{R}{Z}$

$$\frac{R}{\sqrt{R^2 + X^2}} = \frac{1}{3} \qquad \text{...(i)}$$

$$\frac{R}{\sqrt{R^2+(X')^2}}=\frac{1}{9} \quad ...(ii)$$

Using (i) and (ii)

$X = R\sqrt{8}$

$X' = R\sqrt{80}$

$\frac{X'}{X}=\sqrt{10}$

$\frac{X'-X}{X}=(\sqrt{10}-1)$

so percentage change $=(\sqrt{10}-1)\times 100$

$\cong 200\%$

38. (c)

$$\cos\phi=\frac{R}{\sqrt{R^2+X_L^2}}\Rightarrow \cos\phi=\frac{3}{3\sqrt{2}},$$

So $\phi = 45^o$

39. (b)

At resonance $X_C = X_L$ hence

$Z = R$

$\Rightarrow \phi = 0$ at resonance as current and voltge are in phase

40. (d)

$$\cos 45° = \frac{R}{\sqrt{R^2+\left(\omega L-\frac{1}{\omega C}\right)^2}}$$

$$R^2+\left(\omega L-\frac{1}{\omega C}\right)=2R^2$$

$$\omega L-\frac{1}{\omega C}=R$$

$$\omega C=\frac{1}{\omega L-R}$$

$$C=\frac{1}{\omega(\omega L-R)}=\frac{1}{2\pi f(2\pi fL-R)}$$

41. (d)

$$\cos\phi=\frac{R}{Z}$$

$$Z=\sqrt{R^2+(X_L-X_C)^2}$$

$X_L = 31\,\Omega$, $X_C = 25\,\Omega$

So $Z=\sqrt{8^2+(31-25)^2}=10$

So $\cos\phi=\frac{8}{10}=\frac{4}{5}=0.8$

42. (b)

$$i=\frac{E}{\sqrt{R^2+\left(\frac{1}{\omega C}\right)^2}}$$

$\frac{1}{\omega C}$ will decrease, so i will increase. Hence the brightness of the bulb increases.

43. (a)

$$\varepsilon=\frac{d\phi}{dt}=4$$

$$\frac{N_P}{N_S}=\frac{V_P}{V_S} \quad ; \quad \frac{50}{1500}=\frac{4}{V_S}$$

$$\frac{50}{4}=\frac{1500}{V}\Rightarrow V=120\,V$$

44. (b)

$P_{in} = P_{main} = 220\times 0.5$

$= 110$ w

$P_{out} = 100$w

efficiency, $\eta=\left(\frac{P_{out}}{P_{in}}\right)\times 100$

$=\left(\frac{100}{110}\right)\times 100 = 90.9\%$

45. (c)

$$\frac{N_P}{N_S}=\frac{V_P}{V_S}$$

$$V_S=\frac{N_S V_P}{N_P}$$

$$=\frac{50}{11}(220)=1000\,V$$

46. (d)

The effect of AC on the body depends largely on the frequency. Low-frequency currents of 50-60 H_Z, which are commonly used, are usually more dangerous than high frequency currents and are 3-5 times more dangereous than DC of the same voltage and current. The usual frequency of 50-60 H_Z is extremely dangerous as it directly affects our heart as the frequency of AC current interferes with the frequency of the electric pulses of the heart.

47. (d)

Both inductor and capacitor can act as a low pass and high pass filter. when an inductor is used as a low pass filter it provides low reactance to low frequency and high reactance to high frequency. Similarly the capacitor provides lower reactance at higher frequency and let them pass smoothly.

48. (b)

$Z = \sqrt{X_L^2 + R^2}$

$X_L = \omega L$

as ω = increases

Z increases

Current reduces, also loss decreses

49. (b)

Given that $\omega L = \frac{1}{\omega C}$

So net current $I_L - I_C = 0 \quad (\because I_L = I_C)$

So A_3 reads zero ampere.

50. (b)

We know that $I_{rms} = I_0/\sqrt{2}$ and $I_m = 2I_0/\pi$

$\therefore \frac{I_m}{I_{rms}} = \frac{2\sqrt{2}}{\pi}$