DPP
DAILY PRACTICE PROBLEMS

Class : XIIth
Date :

Solutions

Subject : PHYSICS
DPP No. : 1

Topic :-Alternating current

1 **(b)**

$e = 300\sqrt{2} \sin \omega t$

$$I_0 = \frac{e_0}{Z} = \frac{300\sqrt{2}}{\sqrt{(30)^2 + (10-10)^2}}$$

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

$$= \frac{300\sqrt{2}}{30} = 10\sqrt{2} \text{ A}$$

$\therefore$ Current $I = \frac{I_0}{\sqrt{2}} = 10$ A

2 **(a)**

Natural frequency is nothing but resonant frequency.

In this case $X_L = X_C$

$$\Rightarrow \quad \omega_0 L = \frac{1}{\omega_0 C}$$

$$\Rightarrow \quad \omega_0^2 = \frac{1}{LC}$$

$$\Rightarrow \quad \omega_0 = \frac{1}{\sqrt{LC}}$$

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

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

3 **(a)**

At angular frequency ω, the current in RC circuit is given by

$$i_{rms} = \frac{V_{rms}}{\sqrt{R^2 + \left(\frac{1}{\omega C}\right)^2}} \qquad \text{...(i)}$$

Also $\frac{i_{rms}}{2} = \frac{V_{rms}}{\sqrt{R^2 + \left(\frac{1}{\frac{\omega}{3}} C\right)^2}} = \frac{V_{rms}}{\sqrt{R^2 + \frac{9}{\omega^2 C^2}}}$ ...(ii)

From equation (i) and (ii), we get

$$3R^2 = \frac{5}{\omega^2 C^2} \Rightarrow \frac{\frac{1}{\omega C}}{R} = \sqrt{\frac{3}{5}} \Rightarrow \frac{X_C}{R} = \sqrt{\frac{3}{5}}$$

4 **(d)**

Resistance of coil$(R) = \frac{200}{1} = 200\ \Omega$

Current, $I = \frac{200}{\sqrt{R^2 + X_L^2}}$

or $0.5 = \frac{200}{\sqrt{R^2 + X_L^2}}$

or $R^2 + (2\pi f L)^2 = (400)^2$

or $\left(2\pi f \times \frac{2\sqrt{3}}{\pi}\right)^2 = (400)^2 - (200)^2$

$= 120000$

or $4f\sqrt{3} = 200\sqrt{3}$

or $f = 50\ Hz$

5 **(a)**

$\cos\phi = \frac{R}{Z}$. In choke coil $\phi = 90°$ so $\cos\phi \approx 0$

6 **(b)**

$Q-$ factor $= \frac{1}{R}\sqrt{\frac{L}{C}} = \frac{1}{6}\sqrt{\frac{1}{17.36 \times 10^{-6}}} = 40$

7 **(a)**

$$P = E_{rms}\, i_{rms} \cos\phi = \frac{E^2 R}{Z^2} = \frac{E^2 R}{\left[R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2\right]}$$

8 **(b)**

$$R = \frac{P}{i_{rms}^2} = \frac{240}{16} = 15\Omega; Z = \frac{V}{i} = \frac{100}{4} = 25\Omega$$

Now $X_L = \sqrt{Z^2 - R^2} = \sqrt{(25)^2 - (15)^2} = 20\Omega$

$$\therefore 2\pi\nu L = 20 \Rightarrow L = \frac{20}{2\pi \times 50} = \frac{1}{5\pi} Hz$$

9 **(b)**

$$P = \frac{1}{2} V_0 i_0 \cos\phi \Rightarrow P = P_{Peak}.\cos\phi$$

$$\Rightarrow \frac{1}{2}(P_{peak}) = P_{peak}\cos\phi \Rightarrow \cos\phi\, \frac{1}{2} \Rightarrow \phi = \frac{\pi}{3}$$

10 **(d)**

When a ring moves in a magnetic field in a direction perpendicular to its plane, we replace the ring by a diameter (2r) perpendicular to the direction of motion. The emf is induced across this diameter. Current flow in the ring will be through the two semicircular portions in parallel.

Induced emf $= B\ (2\ r)v$.

Resistance of each half of ring = R /2

As the two halves are in parallel, therefore, equivalent resistance = R /4

$\therefore$ Current in the section $= \frac{B(2r)v}{R/4}$

$I = \frac{8Brv}{R}$

13 **(c)**

$$Z = \sqrt{R^2 + \left(2\pi f L - \frac{1}{2\pi f C}\right)^2}$$

From above equation at $f = 0, z = \infty$

When $f = \frac{1}{2\pi\sqrt{LC}}$ (resonant frequency) $\Rightarrow Z = R$

For $f > \frac{1}{2\pi\sqrt{LC}} \Rightarrow Z$ starts increasing

$i.e.$, for frequency $0 - f_r$, Z decreases and for f_r to ∞, Z increases

This is justified by graph c

14 **(a)**

$$X_C = \frac{1}{2\pi v C} \Rightarrow \frac{1}{1000} = \frac{1}{2\pi \times v \times 5 \times 10^{-6}}$$

$$\Rightarrow v = \frac{100}{\pi} MHz$$

15 **(a)**

$$i_{rms} = \frac{i_0}{\sqrt{2}} = \frac{5}{\sqrt{2}} = 3.536 \text{ A}$$

16 **(a)**

$X_L = \ \omega L.$

or $\quad L = \frac{X_L}{\omega} = \frac{10}{20} = 0.5$ H

17 **(b)**

When a circuit contains inductance only, then the current lags behind the voltage by the phase difference of $\frac{\pi}{2}$ or 90°.

While in a purely capacitive circuit, the current leads the voltage by a phase angle of $\frac{\pi}{2}$ or 90°.

In a purely resistive circuit current is in phase with the applied voltage.

18 **(b)**

At $t = 0$, inductor behaves like an infinite resistance. So at

$$t = 0, i = \frac{V}{R_2}$$

And at $t = \infty$, inductor behaves like a conducting wire,

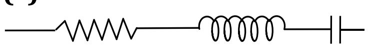
$$i = \frac{V}{R_{\text{eq}}} = \frac{V(R_1 + R_2)}{R_1 R_2}$$

19 **(c)**

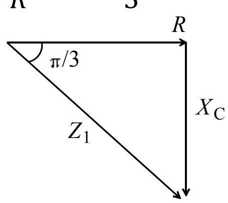
Hot wire ammeter reads rms value of current. Hence its peak value $= i_{rms} \times \sqrt{2}$

$= 14.14\ amp$

20 **(c)**

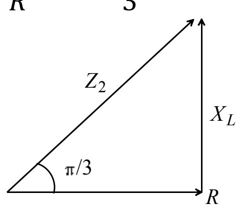


$$\frac{X_C}{R} = \tan\frac{\pi}{3}$$



$X_C = R\tan\frac{\pi}{3}$ ...(i)

$$\frac{X_L}{R} = \tan\frac{\pi}{3}$$



$X_L = R\tan\frac{\pi}{3}$ ...(ii)

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

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

ANSWER-KEY										
Q.	1	2	3	4	5	6	7	8	9	10
A.	B	A	A	D	A	B	A	B	B	D
Q.	11	12	13	14	15	16	17	18	19	20
A.	C	D	C	A	A	A	B	B	C	C