DPP

DAILY PRACTICE PROBLEMS

Class : XIIth
Date :

Solutions

Subject : PHYSICS
DPP No. : 4

Topic :-Alternating current

1 **(b)**

From $e = LdI/dt \Rightarrow dI = \frac{e}{L} = \frac{1}{1} = 1\text{ As}^{-1}$

2 **(a)**

After time t, thickness of liquid will remain $\left(\frac{d}{3} - vt\right)$.

Now, time constant as function of time

$\tau_c = CR$

$$= \frac{\varepsilon_0(1).R}{\left(d - \frac{d}{3} + vt\right) + \frac{d/3 - vt}{2}} \left(\text{Applying } C = \frac{\varepsilon_0 A}{d - t + \frac{t}{k}}\right)$$

$$= \frac{6\varepsilon_0 R}{5d + 3vt}$$

3 **(d)**

When wire is thick, its resistance reduces. Therefore, Joules' heating loss is reduced.

4 **(c)**

Peak value $= 220\sqrt{2} = 311\ V$

5 **(c)**

I_L lags behind I_R by a phase of $\frac{\pi}{2}$, while I_C leads by a phase of $\frac{\pi}{2}$

6 **(b)**

Time constant of $R - C$ circuit is $\tau = RC$

Here effective resistance of the circuit

$$= \frac{2R \times 3R}{2R + 3R} = \frac{6R}{5}$$

$$\therefore \quad \tau = \frac{6R}{5} \times C = \frac{6RC}{5}$$

7 **(b)**

$$e = \frac{Mdi}{dt} = \left(\frac{\mu_0 N_1 N_2 A}{l}\right)\frac{di}{dt}$$

$$= \frac{4\pi \times 10^{-7} \times 2000 \times 300 \times 1.2 \times 10^{-3}(4)}{0.3 \times 0.25}$$

$$= 4.8 \times 10^{-2}\ \text{V}$$

8 **(a)**

$V = 5\cos\omega t = 5\sin\left(\omega t + \frac{\pi}{2}\right)$ and $i = 2\sin\omega t$

Power $= V_{r.m.s.} \times i_{r.m.s.} \times \cos\phi = 0$

[Since $\phi = \frac{\pi}{2}$, therefore $\cos\phi = \cos\frac{\pi}{2} = 0$]

9 **(d)**

$$i = \frac{V}{Z} = \frac{4}{\sqrt{4^2 + (1000 \times 3 \times 10^{-3})^2}} = 0.8\ A$$

10 **(a)**

$X_L = 31\Omega, X_C = 25\Omega, R = 8\Omega$

Impedance of series LCR is

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

$$= \sqrt{(8)^2 + (31-25)^2} = \sqrt{64+36} = 10\Omega$$

Power factor, $\cos\phi = \frac{R}{Z} = \frac{8}{10} = 0.8$

11 **(d)**

$$B = \frac{\phi}{A} = \frac{\mu_0 N_1 A i}{LA} = \frac{\mu_0 N^2 i}{L}$$

12 **(c)**

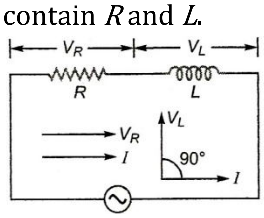
$$P = E_{rms} i_{rms} \cos\phi = \frac{E_0}{\sqrt{2}} \times \frac{i_0}{\sqrt{2}} \times \frac{R}{Z}$$

$$\Rightarrow \frac{E_0}{\sqrt{2}} \times \frac{E_0}{Z\sqrt{2}} \times \frac{R}{Z} \Rightarrow P = \frac{E_0^2 R}{2Z^2}$$

Given $X_L = R$ so, $Z = \sqrt{2}R \Rightarrow P = \frac{E_0^2}{4R}$

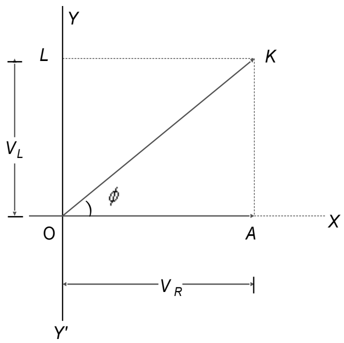
13 **(a)**

Since, current lags behind the voltage in phase by a constant angle, then circuit must contain R and L.



We find that in $R - L$ circuit, voltage leads the current by a phase angle ϕ, where

$$\tan\phi = \frac{AK}{OA} = \frac{OL}{OA}$$
$$= \frac{V_L}{V_R} = \frac{I_0 X_L}{I_0 R}$$
$$\therefore \quad \tan\phi = \frac{X_L}{R}$$



14 **(d)**

Current will be max at first time when

$100\pi t + \pi/3 = \pi/2 \Rightarrow 100\,\pi t = \pi/6 \Rightarrow t = 1/600\ s$

15 **(d)**

The current will lag behind the voltage when reactance of inductance is more than the reactance of condenser.

Thus, $\omega L > \frac{1}{\omega C}$ or $\omega > \frac{1}{\sqrt{LC}}$

or $n > \frac{1}{2\pi\sqrt{LC}}$ or $n > n_r$ where n_r = resonant frequency

16 **(b)**

$e = L\frac{dI}{dt}\ L = \frac{edt}{dI} = \frac{8(0.05)}{(4-2)} =$ 0.2 H

17 **(c)**

In $L-R$ circuit, current at any time t is given by

$$i = \frac{E}{R}\left(1 - e^{-\frac{R}{L}t}\right) = \frac{E}{R} - \frac{E}{R}e^{-\frac{R}{L}t}$$
$$\frac{di}{dt} = \frac{E}{R}e^{-\frac{R}{L}t}\left(\frac{R}{L}\right) = \frac{E}{L}e^{-\frac{R}{L}t}$$

Induced emf $= L\frac{di}{dt} = Ee^{-\frac{R}{L}t}$

From Eq. (i), $iR = E - Ee^{-\frac{R}{L}t}$

Using Eq. (ii), $iR = E - e \quad or \quad e = E - iR$

Therefore, graph between e and i is a straight line with negative slope and positive intercept. The choice (c) is correct.

18 **(c)**

$U = \frac{1}{2}\frac{q^2}{C} = \frac{1}{2C}\left(q_0 e^{-t/\tau}\right)^2 = \frac{q_0^2}{2C}e^{-2t/\tau}$ (where $\tau = CR$)

$$U = U_{i}e^{-2t/\tau}$$

$$\frac{1}{2}U_i = U_{i}e^{-2t_1/\tau}$$

$$\frac{1}{2} = e^{-2t_1/\tau}$$

$\Rightarrow$ $$t_1 = \frac{\tau}{2}\ln 2$$

Now $$q = q_{0}e^{-t/\tau}$$

$$\frac{1}{2}q_0 = q_{0}e^{-t_2/\tau}$$

$$t_2 = \tau \ln 4 = 2\tau \ln 2$$

$\therefore$ $$\frac{t_1}{t_2} = \frac{1}{4}$$

19 **(a)**

At resonance LCR series circuit behaves as pure resistive circuit. For resistive circuit

$$\phi = 0°$$

20 **(b)**

$Z = \sqrt{R^2 + X^2} = \sqrt{4^2 + 3^2} = 5$

$\therefore \cos\phi = \frac{R}{Z} = \frac{3}{5} = 0.6$

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