DPP
DAILY PRACTICE PROBLEMS

Class : XIIth
Date :

Solutions

Subject : PHYSICS
DPP No. : 3

Topic :-Alternating current

1 **(b)**

$Z = \sqrt{R^2 + X_L^2}, X_L = \omega L$ and $\omega = 2\pi f$

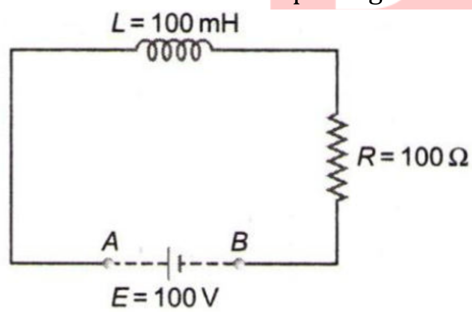
$\therefore Z = \sqrt{R^2 + 4\pi^2 f^2 L^2}$

3 **(b)**

$V_{rms} = \frac{V_0}{\sqrt{2}} = \frac{120}{1.414} = 84.8\ V$

4 **(a)**

This is a combined example of growth and decay of current in an $L - R$ circuit.



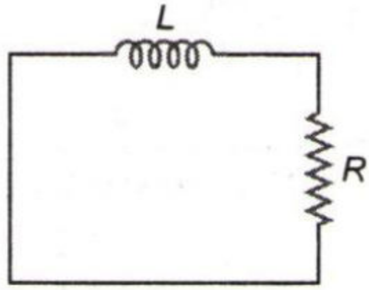
The current through circuit just before shorting the battery,

$I_0 = \frac{E}{R} = 1$ A

(as inductor would be shorted in steady state)

After this decay of current starts in the circuit according to the equation $I = I_0 e^{-t/\tau}$

Where $\tau = L/R$.



$I = 1 \times e^{-(1\times 1\ 0^{-3})/(1\ 00\times 1\ 0^{-3}/1\ 00)} = (1/e)$ A

5 **(d)**

$\frac{R}{L} = \frac{e/i}{edt/di} = \frac{1}{dt} =$ frequency.

6 **(a)**

Phase difference relative to the current

$\phi = \left(314t - \frac{\pi}{6}\right) - (314\ t) = -\frac{\pi}{6}$

7 **(b)**

At $t = 0$, phase of the voltage is zero, while phase of the current is $-\frac{\pi}{2}$, *i.e.*, voltage leads by $\frac{\pi}{2}$

8 **(d)**

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

$= (30)^2 + \left(2\pi \times 50 \times \frac{0.4}{\pi}\right)^2$

$= (900 + 1600) = 2500$

or $Z = 50\ \Omega$

Also, $I = \frac{V}{Z} = \frac{200}{50} = 4$ A

10 **(b)**

We know that Q- factor of series resonant circuit is given as

$Q = \frac{\omega_r L}{R}$

Here, $L = 8.1$ mH, $C = 12.5\ \mu$F, $R = 10\Omega$, $f = 500$ Hz

$\therefore \quad Q = \frac{\omega_r L}{R} = \frac{2\pi f L}{R}$

$= \frac{2 \times \pi \times 500 \times 8.1 \times 10^{-3}}{10} = \frac{8.1\pi}{10} = 2.5434$

11 **(b)**

For capacitive circuits $X_C = \frac{1}{\omega C}$

$\therefore i = \frac{V}{X_C} = V\omega C \Rightarrow i \propto \omega$

12 **(b)**

$V_0 = \sqrt{2}\, V_{rms} = 10\sqrt{2}$

13 **(a)**

In L-R circuit, the growing current at time t is given y $i = i_0\left[1 - e^{-\frac{t}{\tau}}\right]$ where $i_0 = \frac{E}{R}$ $\quad and\ \tau = \frac{L}{R}$

$\therefore$ Charge passed through the battery in one time constant is

$q = \int_0^\tau i dt = \int_0^\tau i_0(1 - e^{-t/r})dt$

$q = i_0\tau - \left[\frac{i_0 e^{-t}}{-2/\tau}\right]_0^t = i_0\tau + i_0\tau[e^{-1} - 1]$

$= i_0\tau - i_0\tau + \frac{i_0\tau}{e}$

$q = \frac{i_0\tau}{e} = \frac{(E/R)(L/R)}{e} = \frac{el}{eR^2}$

14 **(b)**

$P_i = 240 \times 0.7 = 168$ W, $P_0 = 140$ W

$$\eta = \frac{P_0}{P_i} \times 100 = \frac{140}{168} \times 100 \approx 80\%$$

15 **(c)**

Energy stored in a inductor L carrying

Current i is $U = \frac{1}{2} L\, i^2$

Rate at which energy is stored

$$= \frac{dU}{dt} = \frac{1}{2} L\, 2i \left(\frac{di}{dt}\right) = Li \left(\frac{di}{dt}\right)$$

At $t = 0, i = 0,\quad \therefore \frac{dU}{dt} = 0$

At $t = \infty, i = i_0$ (constant), $\therefore \frac{di}{dt} = 0$

16 **(d)**

Required time $t = T/4 = \frac{1}{4 \times 50} = 5 \times 10^{-3} sec$

17 **(a)**

Maximum voltage is AC circuit

$V_0 = 282\, V$

$$V = \frac{V_0}{\sqrt{2}} = \frac{282}{\sqrt{2}}$$

$$V = \frac{282}{1.41} = \frac{28200}{141}$$

$V = 200\, V$

18 **(b)**

$$X_C = \frac{1}{2\pi v\, C} = \frac{1}{0} = \infty$$

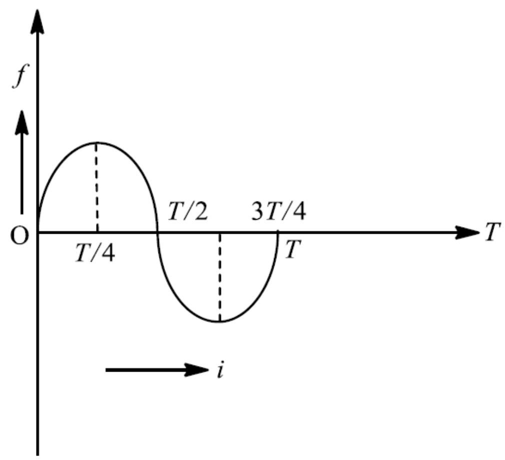
19 **(b)**

$$Z = \sqrt{R^2 + X_L^2} = \sqrt{10^2 + (2\pi \times 60 \times 2)^2} = 753.7$$

$$\therefore i = \frac{120}{753.7} = 0.159\, A$$

20 **(b)**

An alternating current is one whose magnitude changes continuously with time between zero and a maximum value and whose direction reverses periodically. The relation between frequency (f) and time (T) is.



$T = \frac{1}{f} = \frac{1}{50} = 0.02\ s$

As is clear from the figure time taken to reach the maximum value is

$\frac{T}{4} = \frac{0.02}{4} = 0.005$ s

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