PHYSICS

21. (1)

Inside the sphere field varies linearly i.e., $E \propto r$ with distance and outside varies according to $E \propto \frac{1}{r^2}$. Hence, the variation is shown by curve (1).

22. (4)

Because of the Lenz's law of conservation of energy.

23. (4)

$$M = \frac{\mu_0 N_1 N_2 A}{l}$$

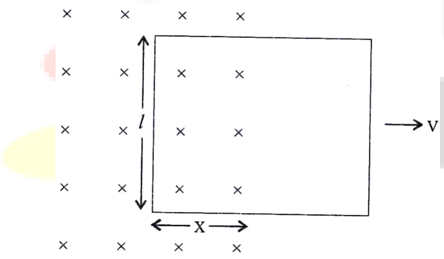
$$= \frac{4\times10^{-7}\times300\times400\times100\times10^{-4}}{0.2}$$

$$M = \frac{\mu_0 N_1 N_2 A}{l} = 2.4\pi\times10^{-4}\ \text{H}$$

24. (4)

The induced emf is

$$e = \frac{-d\phi}{dt} = -\frac{d(\vec{B}\cdot\vec{A})}{dt} = \frac{-d(BA\cos 0°)}{dt}$$



$$\therefore e = -B\frac{dA}{dt} = -B\frac{d(l\times x)}{dt}$$

$$\therefore e = -Bl\frac{dx}{dt} = -Blv$$

25. (3)

We know that power consumed in a.c circuit is given by, $P = E_{rms}.\ I_{rms} \cos\phi$

Here, $E = E_0 \sin\omega t$

$$I = I_0 \sin\left(\omega t - \frac{\pi}{2}\right) \qquad \left(\because \cos\frac{\pi}{2} = 0\right)$$

Which implies that the phase difference, $\phi = \frac{\pi}{2}$

$$\therefore\ P = E_{rms}\cdot I_{rms}\cdot \cos\frac{\pi}{2} = 0$$

26. (4)

Impedance (Z) of the series LCR circuit is

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

At resonance, $X_L = X_C$

Therefore, $Z_{minimum} = R$

27. (3)

$$\text{Frequency, } f = \frac{1}{2\pi\sqrt{LC}}$$

$$= \frac{1}{2\times3.4\sqrt{24\times2\times10^{-6}}} = 23\,\text{Hz}$$

28. (3)

Voltage E of the ac source

$E = V_C - V_L = 400\ V - 300\ V = 100\ V$

29. (1)

Energy stored in magnetic field $= \frac{1}{2}Li^2$

Energy stored in electric field $= \frac{1}{2}\frac{q^2}{C}$

$$\therefore \frac{1}{2}Li^2 = \frac{1}{2}\frac{q^2}{C}$$

Also, $q = q_0 \cos\omega t$ and $\omega = \frac{1}{\sqrt{LC}}$

On solving $t = \frac{\pi}{4}\sqrt{LC}$

30. (4)

$$e = -\frac{d\phi}{dt} = -\frac{d(N\vec{B}\cdot\vec{A})}{dt}$$

$$= -N\frac{d}{dt}(BA\cos\omega t)$$

$$= NBA\omega\sin\omega t = NBA\omega$$