

6. NTA Ans. (4)

Sol. $i = i_0 (1 - e^{-Rt/L}) = i_0 (1 - e^{-t/T_C})$

$$q = \int_0^{T_C} i dt \Rightarrow \int_0^{T_C} \frac{\epsilon}{R} (1 - e^{-t/T_C}) dt$$

$$= \frac{\epsilon}{R} \left(t - \frac{e^{-t/T_C}}{-1/T_C} \right) \Big|_0^{T_C}$$

$$= \frac{\epsilon}{R} (T_C - T_C e^{-1}) - \frac{\epsilon}{R} (0 + T_C) \Rightarrow q = \frac{\epsilon}{R} \times T_C e^{-1}$$

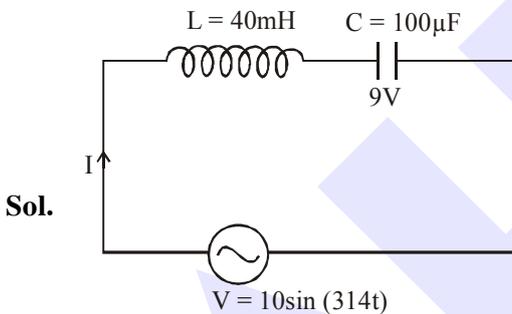
$$= \frac{\epsilon}{R} \times \frac{L}{R} \frac{1}{e} \Rightarrow = \frac{\epsilon L}{e R^2}$$

7. NTA Ans. (10.00)

Sol. $V = \left| L \frac{di}{dt} \right|$

$$\Rightarrow L = \frac{V}{\left| \frac{di}{dt} \right|} = \frac{100}{\frac{0.25}{0.025 \times 10^{-3}}} = 10 \text{mH}$$

8. NTA Ans. (1)

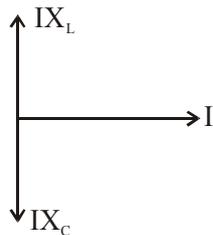


$$X_L = \omega L = 314 \times 40 \times 10^{-3} = 12.56 \Omega$$

$$X_C = \frac{1}{\omega C} = \frac{1}{314 \times 100 \times 10^{-6}}$$

$$= \frac{10^4}{314} = 31.84 \Omega$$

Phasor



$$V_m = I_m (X_C - X_L)$$

$$10 = I_m (31.84 - 12.56)$$

$$I_m = \frac{10}{19.28} = 0.52 \text{A}$$

$$I = 0.52 \sin \left(314t + \frac{\pi}{2} \right)$$

∴ Correct answer (1)

9. Official Ans. by NTA (15)

Sol. $r = 0.1 \text{ m} \quad \frac{T}{2} = 0.2 \text{ sec}$

$$B = 3 \times 10^{-5} \text{ m} \quad T = 0.4 \text{ sec}$$

At any time flux $\phi = BA \cos \omega t$

$$\text{emf} = \left| \frac{d\phi}{dt} \right| = |BA\omega \sin \omega t|$$

$$(\text{emf})_{\text{max}} = BA\omega = BA \frac{2\pi}{T}$$

$$= \frac{3 \times 10^{-5} \times \pi \times (0.1)^2 \times 2\pi}{0.4}$$

$$= \frac{6\pi^2}{4} \times 10^{-6} \quad (\pi^2 \approx 10 \text{ take})$$

$$= 15 \times 10^{-6}$$

$$= 15 \mu\text{V}$$

10. Official Ans. by NTA (1)

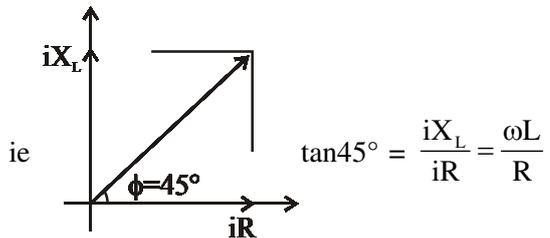


♦ Reactance of inductance coil

$$= \sqrt{R^2 + X_L^2} = 100 \quad \dots(i)$$

♦ $f = 1000 \text{ Hz}$ of applied AC signal

♦ Voltage leads current by 45°



$$ie R = X_L = \omega L$$

Putting in eqn (i) : $\sqrt{X_L^2 + X_L^2} = 100$

$$\sqrt{2} X_L = 100 \Rightarrow X_L = 50\sqrt{2}$$

$$ie \omega L = 50\sqrt{2}$$

$$L = \frac{50\sqrt{2}}{\omega} = \frac{50\sqrt{2}}{2\pi f} = \frac{25\sqrt{2}}{\pi \times 1000} \text{ H}$$

$$= 1.125 \times 10^{-2} \text{ H}$$

11. Official Ans. by NTA (3)

Sol. $f = 750 \text{ Hz}$, $V_{\text{rms}} = 20\text{V}$,
 $R = 100 \Omega$, $L = 0.1803 \text{ H}$,
 $C = 10 \mu\text{F}$, $S = 2 \text{ J}^\circ\text{C}$

$$Z = \sqrt{R^2 + (X_L - X_C)^2} = \sqrt{R^2 + (\omega L - 1/\omega C)^2}$$

$$= \sqrt{R^2 + \left(2\pi fL - \frac{1}{2\pi fC}\right)^2}$$

Putting values

$$|Z| = 834\Omega$$

In AC power $P = V_{\text{rms}} i_{\text{rms}} \cos\phi$

$$\cos\phi = \frac{R}{|Z|} \quad i_{\text{rms}} = \frac{V_{\text{rms}}}{|Z|}$$

$$= \frac{V_{\text{rms}}^2 R}{(|Z|)^2}$$

$$= \left(\frac{20}{834}\right)^2 \times 100 = 0.0575 \text{ J/s}$$

$$H = Pt = S\Delta\theta$$

$$t = \frac{2(10)}{0.0575} = 348 \text{ sec}$$

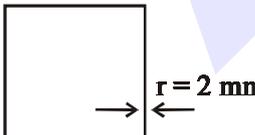
12. Official Ans. by NTA (1)

Sol. $\epsilon = NAB\omega\cos\omega t$ $N = 1$

$$P_{\text{avg}} = \left\langle \frac{\epsilon^2}{R} \right\rangle = \left\langle \frac{(AB\omega\cos\omega t)^2}{R} \right\rangle$$

$$= \frac{A^2 B^2 \omega^2}{R} \frac{1}{2} = \frac{\pi^2 a^2 b^2 B^2 \omega^2}{2R}$$

13. Official Ans. by NTA (1)

Sol. 
 $a = 7.5 \text{ cm}$
 $r = 2 \text{ mm}$

$$q_i = \frac{d(Ba^2)}{dt} = a^2 \frac{dB}{dt}$$

$$i = \frac{q}{R} = \frac{a^2 dB/dt}{\frac{\rho(40)}{\pi r^2}}$$

14. Official Ans. by NTA (3)

Sol. When bar magnet is entering with constant speed, flux will change and an e.m.f. is induced, so galvanometer will deflect in positive direction.

When magnet is completely inside, flux will not change, so reading of galvanometer will be zero.

When bar magnet is making on exit, again flux will change and on e.m.f. is induced in opposite direction to not of (a), so galvanometer will deflect in negative direction.

Looking at options, option (3) is correct.

15. Official Ans. by NTA (3)

Sol. $U_{\text{max}} = \frac{1}{2} L I_{\text{max}}^2$

$$i = I_{\text{max}} (1 - e^{-Rt/L})$$

For U to be $\frac{U_{\text{max}}}{n}$; i has to be $\frac{I_{\text{max}}}{\sqrt{n}}$

$$\frac{I_{\text{max}}}{\sqrt{n}} = I_{\text{max}} (1 - e^{-Rt/L})$$

$$e^{-Rt/L} = 1 - \frac{1}{\sqrt{n}} = \frac{\sqrt{n}-1}{\sqrt{n}}$$

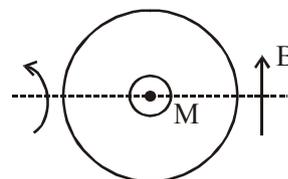
$$-\frac{Rt}{L} = \ln\left(\frac{\sqrt{n}-1}{\sqrt{n}}\right)$$

$$t = \frac{L}{R} \ln\left(\frac{\sqrt{n}}{\sqrt{n}-1}\right)$$

16. Official Ans. by NTA (1)

Official Ans. by ALLEN (BONUS)

Sol. $I_{\text{dia}} = 0.8 \text{ kg/m}^2$
 $M = 20 \text{ Am}^2$



$$U_i + K_i = U_f + K_f$$

$$0 + 0 = -MB \cos 30^\circ + \frac{1}{2} I \omega^2$$

$$20 \times 4 \times \frac{\sqrt{3}}{2} = \frac{1}{2} (0.8) \omega^2$$

$$\omega = \sqrt{100\sqrt{3}} = 10(3)^{1/4}$$

17. Official Ans. by NTA (5.00)



$$B = \frac{\mu_0 NI}{2R}$$

$$\phi = \frac{\mu_0 NN'I}{2R} \pi r^2$$

$$\epsilon = \frac{d\phi}{dt} = \frac{2\pi \times 10^{-7} \times 10^5 \times \pi \times 10^{-4}}{0.2}$$

$$= 8 \times 10^{-4} = 0.8 \text{ mV}$$

18. Official Ans. by NTA (2)

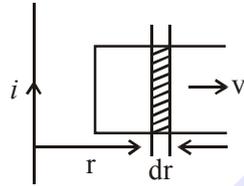
Sol. $B = \frac{\mu_0 i}{2\pi r}$

$$\phi = \frac{\mu_0 i}{2\pi r} \ell dr$$

$$\Rightarrow \frac{d\phi}{dt} = \frac{\mu_0 i \ell}{2\pi r} \frac{dr}{dt}$$

$$\Rightarrow e = \frac{\mu_0}{2\pi} \cdot \frac{iv\ell}{r}$$

$$i = \frac{e}{R} = \frac{\mu_0}{2\pi} \cdot \frac{iv\ell}{Rr}$$



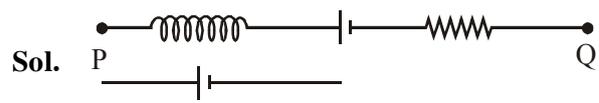
19. Official Ans. by NTA (2)

Sol. $Q = \frac{1}{R} \sqrt{\frac{L}{C}} = \frac{1}{100} \sqrt{\frac{80 \times 10^{-3}}{2 \times 10^{-6}}}$

$$= \frac{1}{100} \sqrt{40 \times 10^3}$$

$$= \frac{200}{100} = 2$$

20. Official Ans. by NTA (33.00)



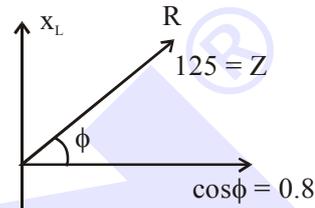
$$\frac{L di}{dt} = 5$$

$$V_P - 5 - 30 + 2 \times 1 = V_Q$$

$$V_P - V_Q = 33 \text{ volt}$$

Ans. 33.00

21. Official Ans. by NTA (400.00)



Sol.

$$P = \frac{E_{rms}^2}{Z} \cos \phi$$

$$400 = \frac{(250)^2 \times 0.8}{Z}$$

$$Z = 25 \times 5 = 125$$

$$X_L = 125 \sin \phi = 125 \times 0.6 = 75$$