JEE MAIN-2012

PHYSICS

1. Sol. (A)

In each rotation relative speed becomes zero twice and becomes maximum twice.

2. Sol. (B)

Magnetic moment, $\vec{M} = I\vec{A} = I\left(\frac{\pi}{2}+1\right)a^2 K$

3. Sol. (D)

Inside the cavity, $B = 0$

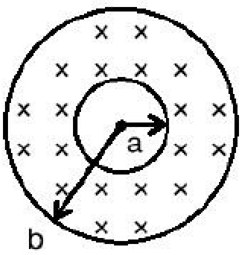
Outside the cylinder, $B = \frac{\mu_0 I}{2\pi r}$

In the shaded region

$$B = \frac{\mu_0 I}{2\pi r\left(b^2 - a^2\right)}\left(r - \frac{a^2}{r}\right)$$

at $r = a, B = 0$

at $r = b, B = \frac{\mu_0 I}{2\pi b}$



4. Sol. (A)

$$\frac{V_m + V_a + V_w}{2}\rho_w g = V_m \rho_c \rho_w g + V_w \rho_w g$$
$$V_m = V_m\left(1 - 2\rho_C\right) + V_a$$

if $\rho_C > \frac{1}{2} \Rightarrow V_w < V_a$

if $\rho_C < \frac{1}{2} \Rightarrow V_w > V_a$,

where, V_w = volume occupied by water in the shell

V_a = volume occupied by air in the shell

V_m = volume of the material in the shell

5. Sol. (C)

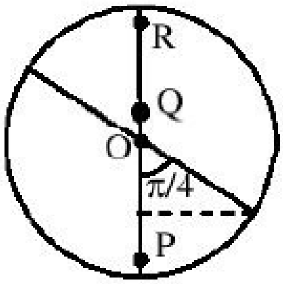
Let 'q' be the final charge on $3\mu F$ capacitor then

$$\frac{80 - q}{23} = \frac{q}{3} \Rightarrow 48\mu C$$

6. Sol. (D)

$$\Delta Q = nC_p \Delta T \qquad (\text{Isobaric process})$$
$$= 2 \times \frac{5}{2} R \times (35 - 30)$$
$$= 208\,\text{J}$$

7. Sol. (C)



At $t = \frac{1}{8} \times \frac{2\pi}{\omega} = \frac{\pi}{4\omega}$

$x-\text{coordinate of } P = \omega R\left(\frac{\pi}{4\omega}\right)$

$= \frac{\pi R}{4} > R\cos 45°$

$\therefore$ Both particles P and Q land in unshaded region.

8. Sol. (B)

$L + e = \frac{\lambda}{4}$

$\Rightarrow L = \frac{\lambda}{4} - e$

$= 16.4 - 1.2 = 15.2\,\text{cm}$

9. Sol. (A)

10. Sol. (D)

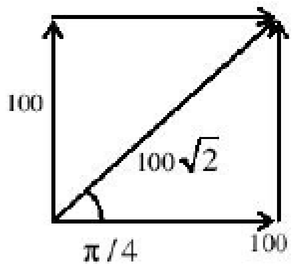
11. Sol. (D)

12. Sol. (C)

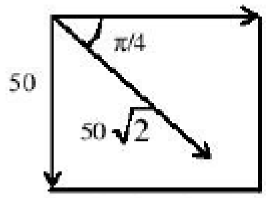
13. Sol. (C)

14. Sol. (B)

15. Sol. (A, C)



Capacitive circuit



Inductive circuit

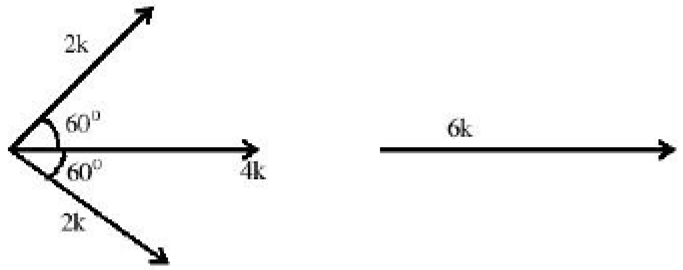
$$I_{\text{upper}} = \frac{20}{100\sqrt{2}}; +\frac{\pi}{4} \text{ ahead of voltage}$$

$$I_{\text{lower}} = \frac{20}{50\sqrt{2}}; -\frac{\pi}{4} \text{ behind voltage}$$

$$I\sqrt{I_1^2 + I_2^2} = \sqrt{\frac{1}{10}} \approx 0.3\text{A}$$

$$\text{V}_{100\Omega} = \frac{20}{100\sqrt{2}} \times 100 = 10\sqrt{2}.$$

16. Sol. (A,B,C)



Line PR is perpendicular bisector of all the dipoles.

At point O : $\frac{1}{4\pi\varepsilon_0}\sum\frac{Q_i}{r_i}=0$

17. Sol. (B,D)

By calculation, if Mass of $P=m$

and Radius of $P=R$

Then Mass of $Q=8M$

and radius of $Q=2R$

and Mass of $R=9M$

and radius of $R=9^{1/3}R$

$$V_p\sqrt{\frac{2GM}{R}}$$

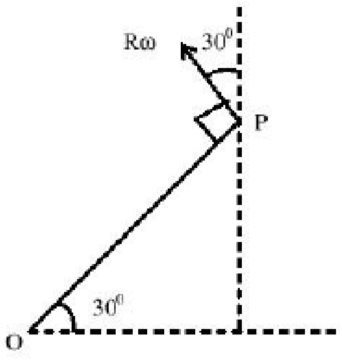
$$V_Q=\sqrt{\frac{2G8M}{2R}}=2V_p$$

$$V_R=\sqrt{\frac{2G8M}{9^{1/3}R}}=9^{1/3}V_p$$

$$\therefore V_R>V_Q=V_P$$

$$\frac{V_0}{V_P}=2$$

18. Sol. (A,B)



$\vec{v_0}(3R)\omega\hat{i} = 0$

$\therefore \vec{v_0} = 3R\omega\hat{i}$

$\vec{v}_{P.O} = \frac{-R\omega}{4}\hat{i} + \frac{R\omega\sqrt{3}}{4}j$

$\therefore \vec{v}_P = \vec{v}_{P.O} + \vec{v_O}$

$= \frac{11}{4}R\omega\hat{i} + R\omega\frac{\sqrt{3}}{4}j$

19. Sol. (D)

$$a = \frac{Mg\sin\theta}{M + \frac{I}{R^2}}$$

$$a_P = \frac{Mg\sin\theta}{M + \frac{MR^2}{R^2}} \approx \frac{g}{2}$$

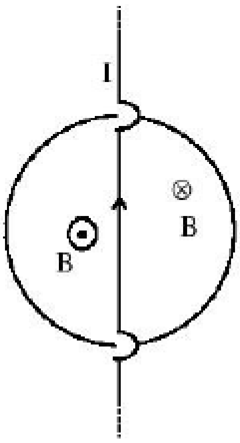
$$a_Q = g\sin\theta \text{ as } I_Q \sim 0$$

$$\therefore \omega_p = \frac{\sqrt{2.\frac{g}{2}.\ell}}{R}$$

$$\omega_Q = \frac{\sqrt{2.g.\ell}}{R}$$

$$\therefore \omega_Q > \omega_P$$

20. Sol. (A, C)



$\phi =$ zero

$\therefore \frac{d\phi}{dt} =$ zero

$\therefore A, C$ are correct.