S22. Ans. (a)

Hint: External torque is zero Angular momentum conserved

$I_1\omega_1 = I_2\omega_2$

$\frac{ML^2}{12}\omega = \left[\frac{ML^2}{12} + \frac{M}{3}\left[\frac{L}{2}\right]^2 + \frac{M}{3}\left[\frac{L}{2}\right]^2\right]\omega^2$

$\omega_2 = \frac{\omega}{3}$

S23. Ans. (b)

Hint: $mgh = \frac{1}{2}\left[\frac{7}{5}mR^2\right]\omega^2$.....(1)

$KE_{rot} = \frac{1}{2}\left[\frac{2}{5}mR^2\right]\omega^2$.....(2)

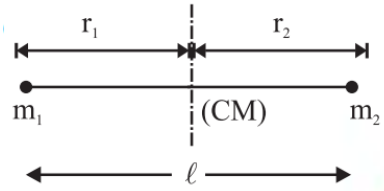
by Eqs. (1) and (2)

$KE_{rot} = \frac{2}{7}mgh$

$= \frac{2}{7} \times 3 \times 10 \times 7 = 60\ J$

S24. Ans. (c)

Hint:



$r_1 = \frac{m_2\ell}{m_1+m_2}, r = \frac{m_1\ell}{m_1+m_2}$

$I_{cm} = m_1r_1^2 + m_2r_2^2 = \frac{m_1m_2}{m_1+m_2}\ell^2$

S25. Ans. (d)

Hint: $K.E_{rotation} = \frac{1}{2}I\omega^2$

$E_{sphere} = \frac{1}{2}I_s\omega^2 = \frac{1}{2} \times \frac{2}{5}Mr^2 \times \omega^2$

$E_{cylinder} = \frac{1}{2}I_c(2\omega)^2 = \frac{1}{2} \times \frac{MR^2}{2} \times 4\omega^2$

$\frac{E_{sphere}}{E_{cylinder}} = \frac{1}{5}$

S26. Ans. (a)

Hint: $K_A = K_B \Rightarrow \frac{L_A^2}{2I_A} = \frac{L_B^2}{2I_B}$

As $I_B > I_A$ So, $L_A^2 < L_B^2 \Rightarrow L_A < L_B \Rightarrow L_B > L_A$

S27. Ans. (c)

Hint: Impulse $= \left|\overrightarrow{\Delta P}\right| = \left|\overrightarrow{m\Delta V}\right|$

$= m(2V\cos 60°) = mV$

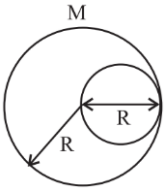
S28. Ans. (a)

Hint: Centripetal acceleration $= \frac{v^2}{R} =$ $a\cos 30°$

$\Rightarrow v = \sqrt{aR\cos 30°} = \sqrt{15 \times 2.5 \times \frac{\sqrt{3}}{2}} = 5.7\ m/s$

S29. Ans. (b)

Hint:



$I_{total\ disc} = \frac{MR^2}{2}$

$M_{Removed} = \frac{M}{4}$ (Mass $\propto$ area)

$I_{Removed}$ (about same Perpendicular axis)

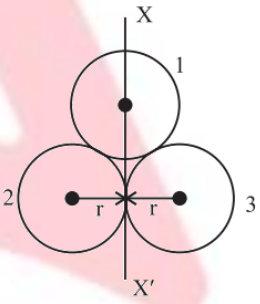
$= \frac{M}{4}\frac{\left(\frac{R}{2}\right)^2}{2} + \frac{M}{4}\left(\frac{R}{2}\right)^2 = \frac{3MR^2}{31}$

$I_{Remaing\ disc} = I_{disc} - I_{Removed}$

$= \frac{MR^2}{2} - \frac{3}{32}MR^2 = \frac{13}{32}MR^2$

S30. Ans. (c)

Hint:



$I_{x_x}' = I_1 + I_2 + I_3$

$\frac{2}{3}mr^2 + \left(\frac{2}{3}mr^2 + mr^2\right) + \left(\frac{2}{3}mr^2 + mr^2\right)$

(Using parallel axis theorem)

$\Rightarrow I_{xx}' = 2m^2 + 2mt^2 = 4mr^2$

S31. Ans. (c)

Hint: By torque balancing about B

$N_A(d) = W(d - x)$

$\Rightarrow N_A = \frac{W(d-x)}{d}$