DPP

DAILY PRACTICE PROBLEMS

CLASS : XITH
DATE :

Solutions

SUBJECT : PHYSICS
DPP NO. : 1

Topic :- SYSTEM OF PARTICLES AND ROTATIONAL MOTION

1 **(b)**

When two identical balls collide head on elastically, they exchange their velocities. Hence when A collides with B, A transfers its whole velocity to B. When B collides with C, B transfers its whole velocity to C. Hence finally A and B will be at rest and only C will be moving forward with speed v

2 **(d)**

$I = M\left(\frac{L^2}{12} + \frac{r^2}{4}\right) = M\left(\frac{L^2}{12} + \frac{D^2}{16}\right)$

3 **(b)**

Rotational kinetic energy $= \frac{1}{2}I\omega^2 = 1500$

$$\Rightarrow \frac{1}{2} \times 1.2 \times \omega^2 = 1500$$

$$\Rightarrow \omega^2 = \frac{3000}{1.2} \Rightarrow \omega = 50\ rad/s$$

Initially the body was at rest and after $t\ sec$ its angular velocity becomes 50 rad/s

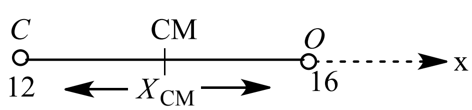
$$\omega = \omega_0 + \alpha t \Rightarrow 50 = 0 + 25 \times t \Rightarrow t = 2s$$

4 **(b)**

By doing so the distribution of mass can be made away from the axis of rotation

5 **(c)**

$X_{CM} = \frac{m_1 x_1 + m_2 x_2}{m_1 + m_2}$



$\therefore \quad X_{CM} = \frac{(12 \times 0) + (16 \times 1.13)}{12 + 16} = 0.6457Å$

6 **(a)**

As initially both the particles were at rest therefore velocity of centre of mass was zero and there is no external force on the system so speed of centre of mass remains constant *i.e.* it should be equal to zero

7 **(c)**

$$\frac{K_R}{K_N} = \frac{K^2/R^2}{1+K^2/R^2} = \frac{2/5}{1+2/5} = 2/7$$

8 **(d)**

Moment of inertia of cylinder about an axis through the centre and perpendicular to its axis is

$$I_c = M\left(\frac{R^2}{4} + \frac{L^2}{12}\right)$$

Using theorem of parallel axes, moment of inertia of the cylinder about an axis through its edge would be

$$I = I_c + M\left(\frac{L}{2}\right)^2 = M\left(\frac{R^2}{4} + \frac{L^2}{12} + \frac{L^2}{4}\right)$$

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

When $L = 6\,R, I_{\mathrm{h}} = \frac{49}{4}MR^2$

9 **(a)**

$$I = \frac{ML^2}{12} = \frac{0.12 \times 1^2}{12} = 0.01 kg\text{ - }m^2$$

10 **(c)**

The moment of inertia is maximum about axis 3, because rms distance of mass is maximum for this axis

11 **(d)**

$$v = \sqrt{\frac{2g_{\mathrm{h}}}{1 + \frac{k^2}{R^2}}}$$

Where k is the radius of gyration

For ring, $\frac{k^2}{R^2} = 1$

$$\therefore v = \sqrt{\frac{2g_{\mathrm{h}}}{1+1}} = \sqrt{g\mathrm{h}}$$

13 **(b)**

Moment of inertia of the system about the centre of plane is given by

$$I = \left[\frac{2}{5} \times 1 \times (0.1)^2 + 1 \times (1)^2\right] + \left[\frac{2}{5} \times 2 \times (0.1)^2 + 2 \times (1)^2\right]$$
$$+ \left[\frac{2}{5} \times 3 \times (0.1)^2 + 3 \times (1)^2\right] + \left[\frac{2}{5} \times 4 \times (0.1)^2 + 4 \times (1)^2\right]$$
$$= 1.004 + 2.008 + 3.012 + 4.016$$
$$= 10.04\ \mathrm{kg - m^2}$$

14 **(d)**

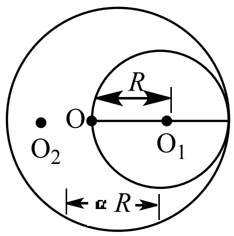
$\omega = \omega_0 + \alpha t \Rightarrow \omega = 0 + \left(\frac{\tau}{I}\right)t$ [As $\tau = I\alpha$]

$$\omega = 0 + \frac{1000}{200} \times 3 = 15 rad/s$$

15 **(a)**

In this question distance of centre of mass of new disc from the centre of mass of remaining disc is αR.

Mass of remaining disc



$= M - \frac{M}{4} = \frac{3M}{4}$

$\therefore \quad -\frac{3M}{4}\alpha R + \frac{M}{4}R = 0$

$\therefore \quad \alpha = \frac{1}{3}$

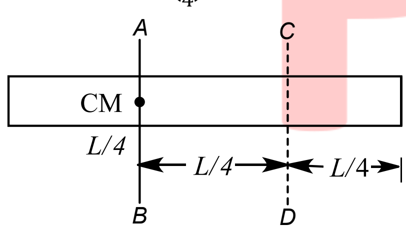
16 **(a)**

$$\frac{I_{\text{Sphere}}}{I_{\text{Cylinder}}} = \frac{\frac{2}{5}M_1R^2}{\frac{1}{2}M_2R^2} = \frac{\frac{2}{5}\left(\frac{4}{3}\pi R^3\rho\right)R^2}{\frac{1}{2}(\pi R^2 L\rho)R^2} = \frac{16}{15}$$

$\therefore I_{\text{Sphere}} > I_{\text{Cylinder}}$

17 **(d)**

$I_{\text{CD}} = I_{\text{CM}} + M\left(\frac{L}{4}\right)^2$



$= \frac{ML^2}{12} + \frac{ML^2}{16} = \frac{7ML^2}{48}$

18 **(c)**

Kinetic energy $E = \frac{L^2}{2I}$

If angular momenta are equal then $E \propto \frac{1}{I}$

Kinetic energy $E = K$ [Given in the problem]

If $I_A > I_B$ then $K_A < K_B$

20 **(d)**

$$\mathbf{L} = \mathbf{r} \times \mathbf{P} = \begin{vmatrix} \hat{\mathbf{i}} & \hat{\mathbf{j}} & \hat{\mathbf{k}} \\ 1 & 2 & -1 \\ 3 & 4 & -2 \end{vmatrix}$$

$\mathbf{L} = \hat{\mathbf{i}}(-4+4) - \hat{\mathbf{j}}(-2+3) + \hat{\mathbf{k}}(4-6) = -\hat{\mathbf{j}} - 2\hat{\mathbf{k}}$

$\mathbf{L}$ has components along $-y$ axis and $-z$ axis.

The angular momentum is in y - z plane *ie.*, perpendicular to x-axis.

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