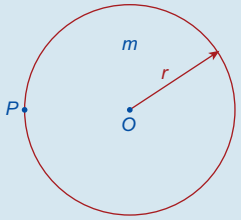
Q. 2. **Disc:**



$$I_O = \frac{mr^2}{2}$$

$$I_P = \frac{mr^2}{2} + mr^2$$

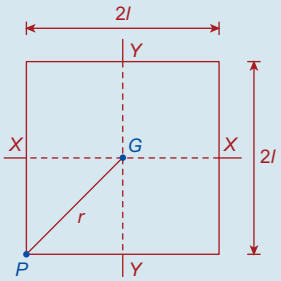
$$\Rightarrow I_P = \frac{3mr^2}{2}$$

$$T = 2\pi\sqrt{\frac{I}{mgh}}$$

$$= 2\pi\sqrt{\frac{3mr^2}{2mgr}}$$

$$= 2\pi\sqrt{\frac{3r}{2g}}$$

Q. 3.



mass: m

$I_{XX} = I_{YY}$ (Square Lamina)

$I_{XX} = \frac{ml^2}{3}$ (Standard Formula)

Perpendicular Axes:

$$I_G = I_{xx} + I_{yy}$$

$$\Rightarrow I_G = 2I_{xx}$$

$$\Rightarrow I_G = \frac{2ml^2}{3}$$

Parallel Axes:

$$I_P = I_G + mr^2$$

Here $r = \sqrt{2}l$

So $I_P = \frac{2ml^2}{3} + m(\sqrt{2}l)^2$

$$\Rightarrow I_P = \frac{8ml^2}{3}$$

$$T = 2\pi\sqrt{\frac{I}{mgh}}$$

$$= 2\pi\sqrt{\frac{8ml^2}{3mg\sqrt{2}l}}$$

$$= 2\pi\sqrt{\frac{8l}{3\sqrt{2}g}}$$

Q. 4. **The rod:**

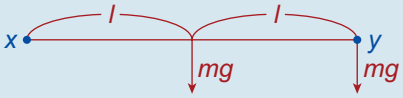
$$I_x = \frac{4}{3}ml^2$$

The system:

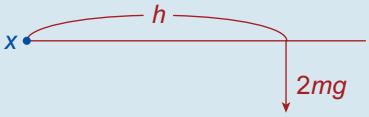
$$I_x = \frac{16}{3}ml^2$$

The point mass: $I_x = m(2l)^2 = 4ml^2$

Forces:



Resultant:



Taking moments about *x*:

$mg(l) + mg(2l) = 2mgh$

$$\Rightarrow h = \frac{3}{2}l$$

The mass of the system is $2m$.

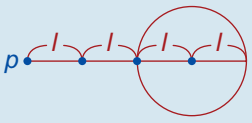
$$T = 2\pi\sqrt{\frac{I}{mgh}}$$

$$= 2\pi\sqrt{\frac{\frac{16ml^2}{3}}{(2m)g\left(\frac{3l}{2}\right)}}$$

$$= 2\pi\sqrt{\frac{16l}{9g}}$$

$$= \frac{8}{3}\pi\sqrt{\frac{l}{g}}$$

Q. 5.



The rod:

$$I_P = \frac{4}{3}ml^2$$

The disc:

$$I_P = I_C + md^2$$

$$= \frac{1}{3}(2m)l^2 + (2m)(3l)^2$$

$$= 19ml^2$$

The system:

$$I_P = \frac{4}{3}ml^2 + 19ml^2 = \frac{61}{3}ml^2$$