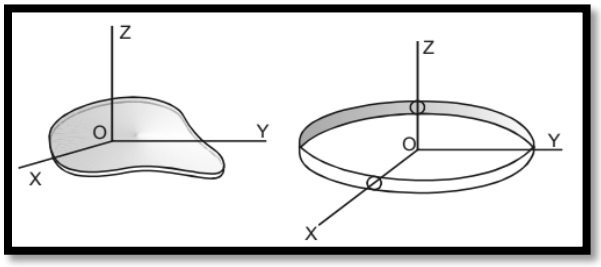
SYSTEM OF PARTICLES AND ROTATIONAL MOTION

THEOREMS OF PERPENDICULAR AND PARALLEL AXES

Theorems of moment of inertia

1. Theorem of perpendicular axis -

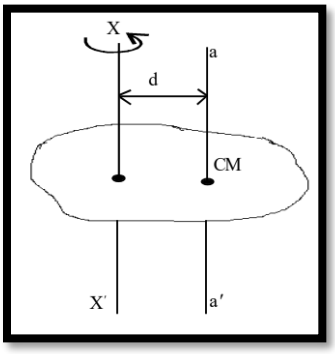


According to this theorem the moment of inertia of a lamina about an axis passing through its axis and perpendicular to its plane is equal to the sum of moment of inertia about the two mutually perpendicular axis in the plane of lamina. The normal axis OZ must pass through the point intersection of two mutually perpendicular axes OX and OY

$\Rightarrow I_{zz} = I_{xx} + I_{yy}$

Note%& This theorem is used only for plane lamina.

2. Theorem of parallel axes



According to this theorem, the moment of inertia of a body about any axis is equal to the sum of moment of inertia about an axis passing through its centre of gravity and parallel to given axis and product of its mass and square of distance between the center of gravity and the axis of rotation.

$I_{Xx} = I_{C\cdot G} + Md^2$

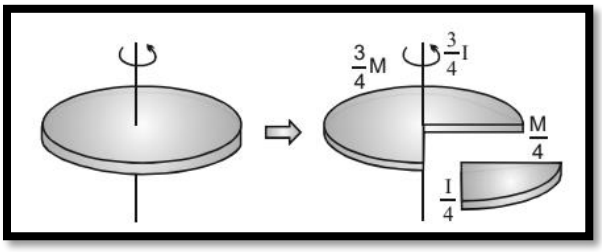
3. Symmetrical separation

M = Mass of disc

R = Radius of disc

If $\frac{M}{4}$ part is separated

Remaining Mass $= \frac{3}{4}M = M'$

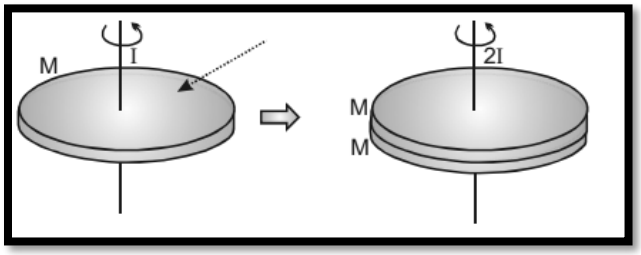


M.I. of remaining part $I' = \frac{3}{4}I$

Radius of gyration of remaining part

$K' = \sqrt{\frac{\frac{3I}{4}}{\frac{3M}{4}}} = \sqrt{\frac{I}{M}} = K \Rightarrow$K remains unchanged

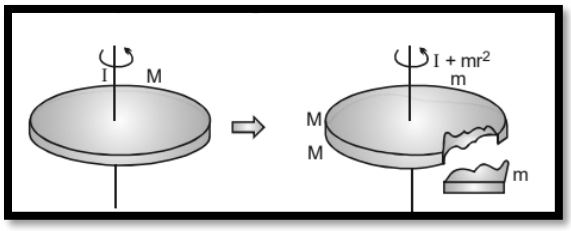
4. Symmetrical Attachment:



$$K = \sqrt{\frac{I}{M}}$$

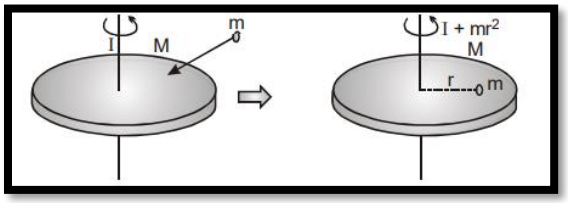
$$K' = \sqrt{\frac{2I}{2M}} = K$$

5. Unsymmetrical separation:



$$K = \sqrt{\frac{I - m^2}{M - m}}$$

6. Unsymmetrical attachment:



$$K = \sqrt{\frac{I + m^2}{M + m}}$$