The point mass: $I_p = mr^2$

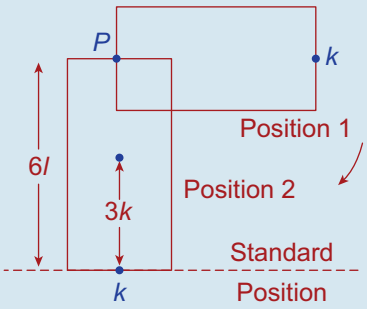
$= m(6l)^2$

$= 36ml^2$

The system $I_p = \frac{51}{4}ml^2 + 36ml^2$

$= \frac{195}{4}ml^2$

$\underbrace{mgh}_{\text{Lamina}} + \underbrace{mgh}_{\text{Point mass}} + \underbrace{\frac{1}{2}I\omega^2}_{\text{System}} = \underbrace{mgh}_{\text{Lamina}} + \underbrace{mgh}_{\text{Point mass}} + \underbrace{\frac{1}{2}I\omega^2}_{\text{System}}$



$mg\,(6l) + mg\,(6l) + \frac{1}{2}l(0)^2 = mg(3l) + mg(0) + \frac{1}{2}I\omega^2$

$\Rightarrow I\omega^2 = 18mgl$

$\Rightarrow \frac{195}{4}ml^2\omega^2 = 18mgl$

$\Rightarrow \omega = \sqrt{\frac{72g}{195l}} = \sqrt{\frac{24g}{65l}}$

Speed of $k = \omega r = 6l\sqrt{\frac{24g}{65l}}$

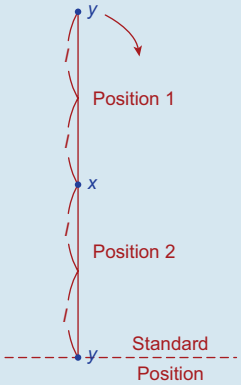
Q.9.

The rod: $I_x = \frac{4}{3}(3m)l^2 = 4ml^2$

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

The system: $I_x = 8ml^2$

$\underbrace{mgh}_{\text{Rod}} + \underbrace{mgh}_{\text{Point mass}} + \underbrace{\frac{1}{2}I\omega^2}_{\text{System}} = \underbrace{mgh}_{\text{Rod}} + \underbrace{mgh}_{\text{Point mass}} + \underbrace{\frac{1}{2}I\omega^2}_{\text{System}}$



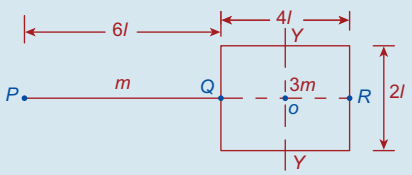
$(3m)g(3l) + mg(4l) + \frac{1}{2}I\left(\frac{g}{l}\right) = (3m)gl + mg(0) + \frac{1}{2}I\omega^2$

$\Rightarrow 9mgl + 4mgl + \frac{1}{2}(8ml^2)\left(\frac{g}{l}\right) = 3mgl + \frac{1}{2}(8ml^2)\omega^2$

$\Rightarrow 4ml^2\omega^2 = 14mgl$

$\Rightarrow \omega = \sqrt{\frac{7g}{2l}}$

Q. 10. (i)



Rod:

$I_P = \frac{4}{3}m(3l)^2$

$= 12ml^2$

Lamina:

$I_{QR} = \frac{3m(2l)^2}{3} = 4ml^2$

$I_{yy} = \frac{3ml^2}{3} = ml^2$

⊥ Axes: $I_O = I_{YY} + I_{QR}$

$= 5ml^2$