Then ($I_P = I_O + mr^2$), (|| Axes Theorem)

$$I_P = 5ml^2 + 3m(8l)^2$$

$$I_P = 197ml^2$$

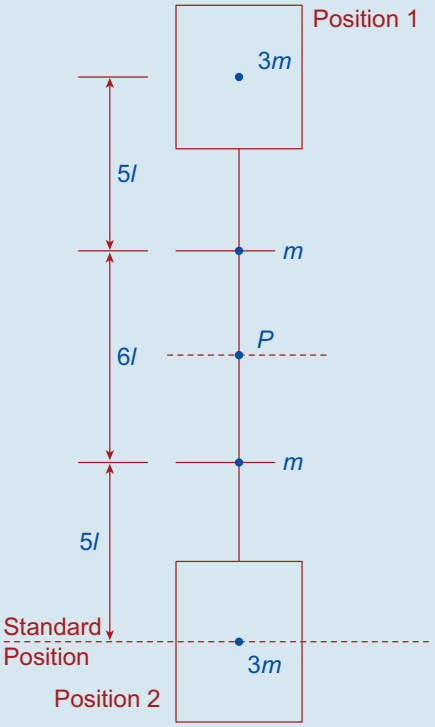
System:

$$I_{\text{Total}} = I_{\text{Rod}} + I_{\text{Lamina}}$$

$$= 12ml^2 + 197ml^2$$

$$= 209ml^2$$

(ii)



Energy Conserved:

P.E.$_{①}$ + K.E.$_{①}$ = P.E.$_{②}$ + K.E.$_{②}$

$mg(11l) + 3mg(16l)$

$= mg(5l) + 3mg(0) + \frac{1}{2}I\omega_{②}^{\ 2}$

$\Rightarrow 54mgl = \frac{1}{2}I\omega_{②}^{\ 2}$

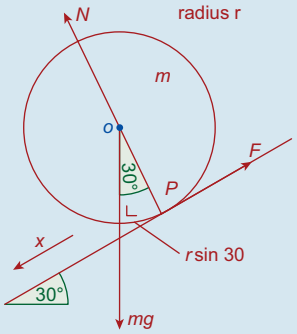
But $I = 209ml^2$

$\therefore \omega_{②}^{\ 2} = \frac{108mgl}{209ml^2}$

$\Rightarrow \omega_{②} = \sqrt{\frac{108g}{209l}}$

Exercise 14C

Q. 1.



(i) Gain in K.E. = Loss in P.E.

$\Rightarrow \frac{1}{2}mv^2 + \frac{1}{2}I\omega^2 = mgh$ …$\omega = \frac{v}{r}$

$\Rightarrow \frac{1}{2}mv^2 + \frac{1}{2}\left(\frac{1}{2}mr^2\right)\left(\frac{v}{r}\right)^2 = mg(120\sin 30°)$

$\Rightarrow \frac{1}{2}v^2 + \frac{1}{4}v^2 = 60g$

$\Rightarrow \frac{3}{4}v^2 = 60g$

$\Rightarrow v^2 = 80g$

$\Rightarrow v = \sqrt{80g}$

$= 28$ m/s

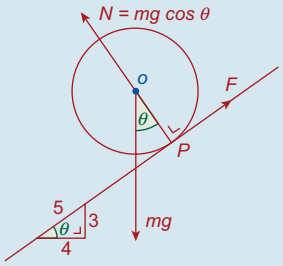
(ii) $v^2 = u^2 + 2as$

$\Rightarrow a = \frac{v^2 - u^2}{2s} = \frac{28^2 - 0^2}{2(120)} = \frac{49}{15}$

$v = u + at$

$\Rightarrow t = \frac{v - u}{a} = \frac{28 - 0}{\left(\frac{49}{15}\right)} = \frac{60}{7}$ s.

Q. 2. (i)



Gain in K.E. = Loss in P.E.

$\Rightarrow \frac{1}{2}mv^2 + \frac{1}{2}I\omega^2 = mgh$

$\Rightarrow \frac{1}{2}mv^2 + \frac{1}{2}\left(\frac{1}{2}mr^2\right)\left(\frac{v^2}{r^2}\right) = mg(s\sin\theta)$

$\Rightarrow \frac{1}{2}v^2 + \frac{1}{4}v^2 = gs\left(\frac{3}{5}\right)$ …multiply by 20