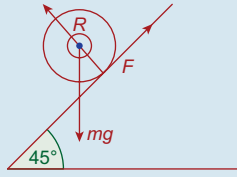
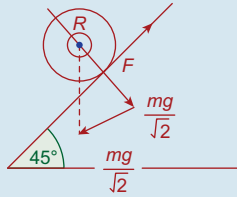


Forces:



Resolved:



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

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

$$\Rightarrow \frac{1}{2}mv^2 + \frac{1}{2}\left(\frac{5}{2}m\right)\left(\frac{v^2}{r^2}\right) = mg(s \sin 45^\circ)$$

$$\Rightarrow \frac{1}{2}mv^2 + \frac{1}{2}\left(\frac{5}{2}m\right)\left(\frac{v^2}{4}\right) = mg\left(\frac{s}{\sqrt{2}}\right)$$

...multiply by  $\frac{16\sqrt{2}}{m}$

$$\Rightarrow 8v^2\sqrt{2} + 5v^2\sqrt{2} = 16gs$$

$$\Rightarrow 13v^2\sqrt{2} = 16gs$$

$$\Rightarrow v^2 = \frac{16gs}{13\sqrt{2}}$$

$$v^2 = u^2 + 2as$$

$$\Rightarrow a = \frac{v^2 - u^2}{2s} = \frac{\frac{16gs}{13\sqrt{2}} - 0}{2s}$$

$$= \frac{8g}{13\sqrt{2}} \text{ m/s}^2$$

(ii)  $F = ma$  (assume annulus is on the point of slipping)

$$\Rightarrow \frac{mg}{\sqrt{2}} - \mu\left(\frac{mg}{\sqrt{2}}\right) = m\left(\frac{8g}{13\sqrt{2}}\right)$$

...multiply by  $\frac{13\sqrt{2}}{mg}$

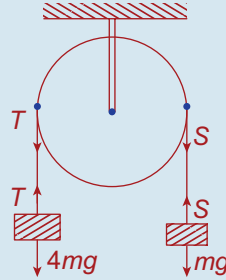
$$\Rightarrow 13 - 13\mu = 8$$

$$\Rightarrow 13\mu = 5$$

$$\Rightarrow \mu = \frac{5}{13}$$

This is the least value of  $\mu$  that will prevent slipping  $\therefore \mu \geq \frac{5}{13}$

Q. 6. Forces:



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

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

m mass      4m mass      disc      4m mass      m mass

$$\Rightarrow \frac{1}{2}mv^2 + \frac{1}{2}(4m)v^2 + \frac{1}{2}\left(\frac{1}{2}mr^2\right)\left(\frac{v^2}{r^2}\right)$$

$$= 4mgh - mgh \quad \dots \text{multiply by } \frac{4}{m}$$

$$\Rightarrow 2v^2 + 8v^2 + v^2 = 12gh$$

$$\Rightarrow 11v^2 = 12gh$$

$$\Rightarrow v^2 = \frac{12}{11}gh$$

$$v^2 = u^2 + 2as$$

$$\Rightarrow a = \frac{v^2 - u^2}{2s} = \frac{\frac{12}{11}gh - 0}{2h} = \frac{6}{11}g$$

(ii) 4m mass:

$$F = ma$$

$$\Rightarrow 4mg - T = 4m\left(\frac{6}{11}g\right)$$

$$\Rightarrow 44mg - 11T = 24mg$$

$$\Rightarrow 11T = 20mg$$

$$\Rightarrow T = \frac{20}{11}mg$$

m mass:

$$F = ma$$

$$\Rightarrow S - mg = m\left(\frac{6}{11}g\right)$$

$$\Rightarrow 11S - 11mg = 6mg$$

$$\Rightarrow 11S = 17mg$$

$$\Rightarrow S = \frac{17}{11}mg$$

Q. 7.

