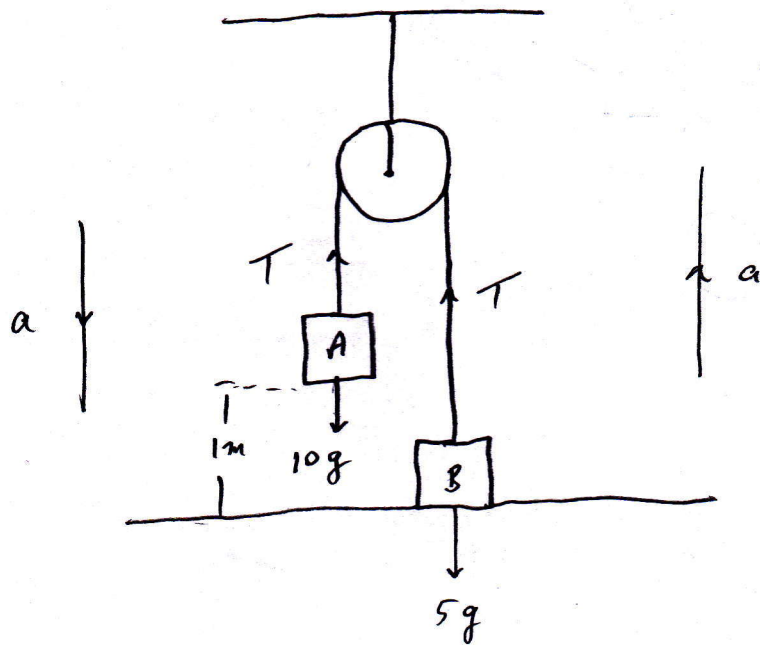


2009 Q4.

(a)



$$(i) F = ma \Rightarrow 10g - T = 10a$$

$$\text{and } T - 5g = 5a$$

$$\Rightarrow 5g = 15a$$

$$\Rightarrow a = \frac{g}{3} \text{ ms}^{-2}$$

$$V^2 = u^2 + 2as$$

$$\Rightarrow V^2 = 0^2 + 2\left(\frac{g}{3}\right)(1)$$

$$\Rightarrow V = \sqrt{\frac{2g}{3}} \text{ ms}^{-1} \text{ or } 2.556 \text{ ms}^{-1}$$

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

$$\Rightarrow 0^2 = \frac{2g}{3} + 2gs$$

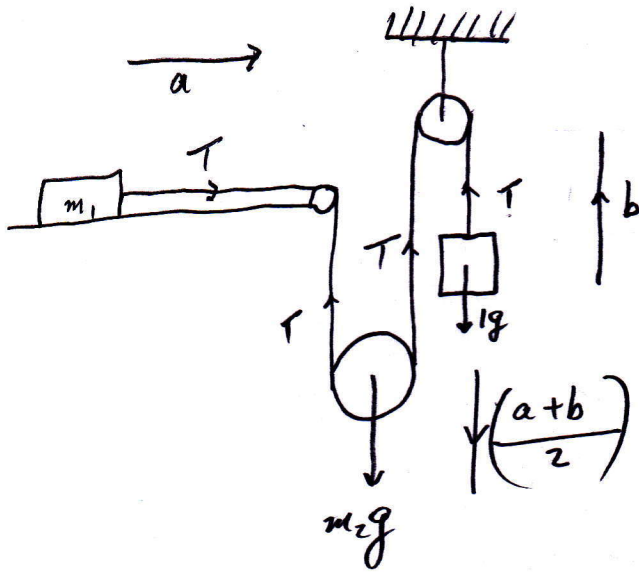
$$\Rightarrow \frac{-2g}{3} = -2gs$$

$$\Rightarrow \frac{1}{3} m = s$$

\Rightarrow Height B rises above horizontal ground is

$$1 + \frac{1}{3} = \frac{4}{3} \text{ m}$$

(b)



$$\underline{\underline{m_1}} \quad F = ma \Rightarrow T = m_1 a \Rightarrow a = \frac{T}{m_1} \quad (1)$$

$$\underline{\underline{1b}} \quad \Rightarrow T - mg = 1b \quad (2)$$

$$\underline{\underline{m_2}} \quad \Rightarrow m_2 g - 2T = m_2 \left(\frac{a+b}{2} \right) \quad (3)$$

Substituting (1) + (2) into (3)

$$\Rightarrow m_2 g - 2T = m_2 \left(\frac{\frac{T}{m_1} + T - g}{2} \right)$$

$$\Rightarrow m_2 g - 2T = \frac{m_2 T}{2m_1} + \frac{m_2 T}{2} - \frac{m_2 g}{2}$$

$$\Rightarrow m_2 g + \frac{1}{2} m_2 g = T \left(\frac{m_2}{2m_1} + \frac{m_2}{2} \right) + 2T$$

$$\Rightarrow \frac{3}{2} m_2 g = T \left(\frac{m_2 + m_1 m_2}{2m_1} + \frac{2}{1} \right)$$

$$\Rightarrow \frac{3}{2} \cdot 2 m_1 m_2 g = T (m_2 + m_1 m_2 + 4m_1)$$

$$\Rightarrow \frac{3 m_1 m_2 g}{m_2 + m_1 m_2 + 4m_1}$$

$$(ii) \quad \frac{2}{m_2} - \frac{1}{m_1} = k$$

C will not move if $m_2 g - 2T = 0$ or $\frac{a+b}{2} = 0$

$$m_2 g - 2T = 0$$

$$\Rightarrow m_2 g = 2T$$

$$\Rightarrow m_2 g = 2 \left(\frac{3 m_1 m_2 g}{4 m_1 + m_2 + m_1 m_2} \right)$$

$$\Rightarrow 4 m_1 m_2 g + m_2 m_2 g + m_1 m_2 m_2 g = 6 m_1 m_2 g$$

$$\Rightarrow 4 m_1 + m_2 + m_1 m_2 = 6 m_1$$

$$\Rightarrow m_2 + m_1 m_2 = 2 m_1$$

$$\Rightarrow m_1 m_2 = 2 m_1 - m_2$$

$$\Rightarrow 1 = \frac{2 m_1 - m_2}{m_1 m_2}$$

$$\Rightarrow 1 = \frac{2}{m_2} - \frac{1}{m_1}$$

$$\Rightarrow k = 1$$