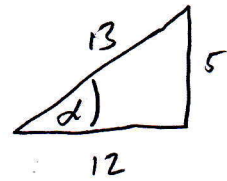
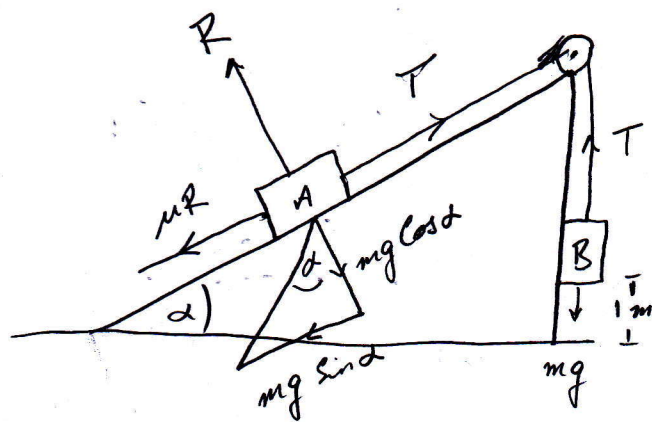


2012 Q4.

(a) (i)



$$\tan \alpha = \frac{5}{12}$$

$$\sin \alpha = \frac{5}{13}$$

$$\cos \alpha = \frac{12}{13}$$

$$R = mg \cos \alpha$$

$$\Rightarrow F_r = \frac{1}{2} mg \cos \alpha$$

$$F = ma$$

$$\Rightarrow mg - T = ma \quad (\text{Particle B})$$

$$\text{and } T - mg \sin \alpha - \frac{1}{2} mg \cos \alpha = ma \quad (\text{Particle A})$$

$$mg - mg \sin \alpha - \frac{1}{2} mg \cos \alpha = 2ma$$

$$\Rightarrow mg - mg \frac{5}{13} - mg \frac{12}{26} = 2ma$$

$$\Rightarrow g - \frac{5g}{13} - \frac{6g}{13} = 2a$$

$$\Rightarrow \frac{2g}{13} = 2a \Rightarrow a = \frac{g}{13}$$

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

$$\Rightarrow v^2 = 0^2 + 2 \frac{g}{13} (1)$$

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

$$(ii) \quad v^2 = u^2 + 2fs$$

$$0 = \frac{2g}{13} + 2fs$$

Note:
($a \neq f$)

$$F = mf$$

$$\Rightarrow 0 = \frac{2g}{13} + 2\left(\frac{11}{13}g\right)s$$

$$\Rightarrow mf = mg \sin \alpha + \frac{1}{2}mg \cos \alpha$$

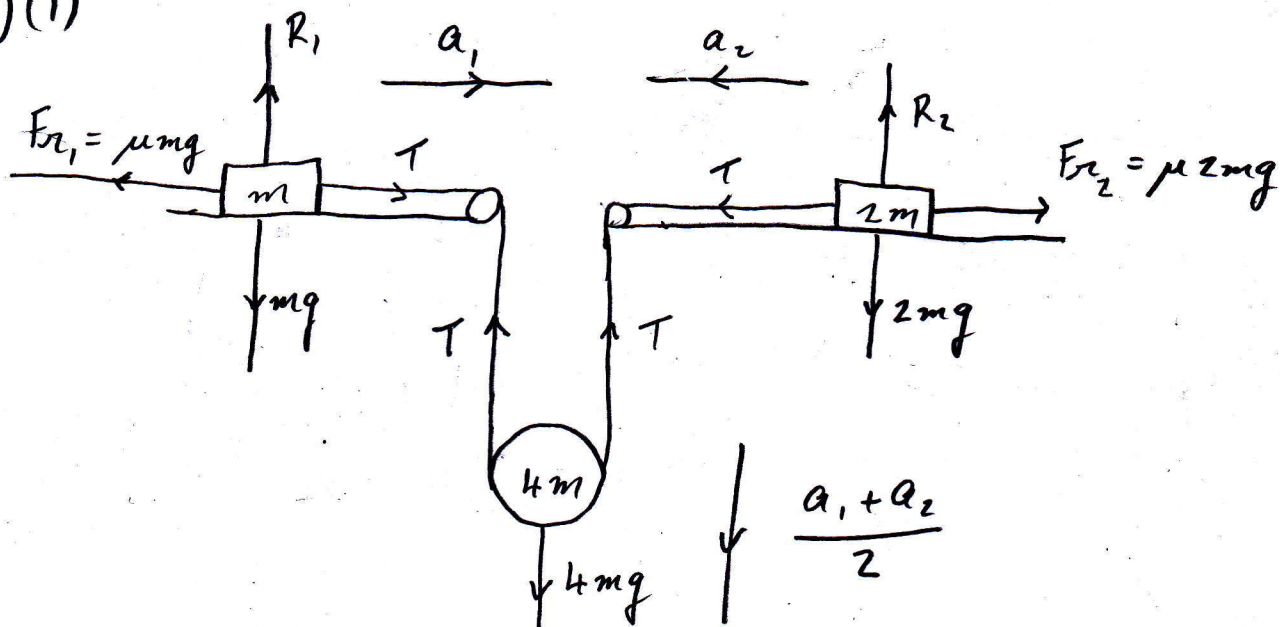
$$\Rightarrow \frac{-2g}{13} = -\frac{22}{13}gs$$

$$\Rightarrow f = g \frac{5}{13} + g \frac{6}{13}$$

$$\Rightarrow s = \frac{1}{11}m$$

$$\Rightarrow f = \frac{11}{13}g \text{ m s}^{-2}$$

(b)(i)



$$T - \mu mg = ma_1 \quad (1) \quad T - \mu 2mg = 2ma_2 \quad (2)$$

$$\text{and } 4mg - 2T = 4m \left(\frac{a_1 + a_2}{2} \right)$$

$$\Rightarrow 4mg - 2T = 2ma_1 + 2ma_2 \quad (3)$$

We want to get rid of a_1 and a_2 so substitute (1) and (2) into (3)

$$\Rightarrow 4mg - 2T = 2(T - \mu mg) + (T - \mu 2mg)$$

$$\Rightarrow 4mg - 2T = 2T - 2\mu mg + T - \mu 2mg$$

$$\Rightarrow 4mg + 2\mu mg + \mu 2mg = 5T$$

$$\Rightarrow \frac{4mg + 4\mu mg}{5} = T$$

$$\Rightarrow \frac{4mg(1 + \mu)}{5} = T$$

$$(ii) \text{ Note: } a_1 = f \Rightarrow T - \mu mg = mf \quad (1)$$

$$\Rightarrow \frac{4mg(1 + \mu)}{5} - \mu mg = mf$$

$$\Rightarrow \frac{4mg(1 + \mu) - 5\mu mg}{5} = mf$$

$$\Rightarrow \frac{4mg - \mu mg}{5} = mf$$

$$\Rightarrow \frac{4g - \mu g}{5} = f$$

$$T - \mu 2mg = 2ma_2 \quad (2)$$

$$\frac{4mg(1+\mu)}{5} - \frac{2\mu mg}{1} = 2ma_2$$

$$\Rightarrow \frac{4mg(1+\mu) - 10\mu mg}{5} = 2ma_2$$

$$\Rightarrow \frac{4g - 6\mu g}{5} = 2a_2$$

$$\Rightarrow \frac{2g - 3\mu g}{5} = a_2 \quad \text{and} \quad f = \frac{4g - \mu g}{5}$$

$$\Rightarrow \frac{2g}{5} - \frac{3\mu g}{5} = a_2$$

$$\Rightarrow f = \frac{4g}{5} - \frac{\mu g}{5}$$

$$\Rightarrow \frac{2g}{5} - \frac{3\mu g}{5} + \frac{3f}{1} = a_2$$

$$\Rightarrow f - \frac{4g}{5} = -\frac{\mu g}{5}$$

$$\Rightarrow \frac{-10g}{5} + 3f = a_2$$

$$\Rightarrow \frac{12g}{5} - 3f = \frac{3\mu g}{5}$$

$$\Rightarrow 3f - 2g = a_2$$