

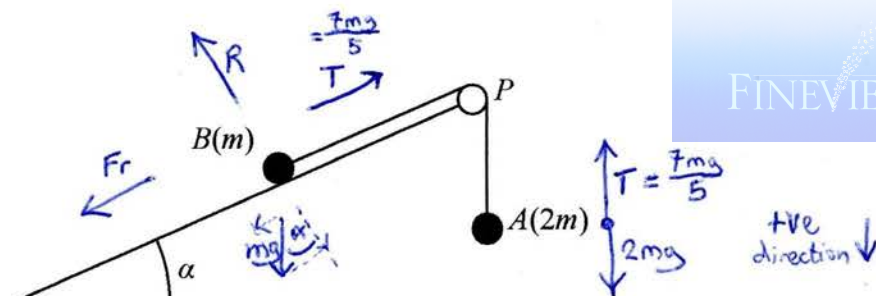
$$\tan \alpha = \frac{4}{3} = \frac{\text{opp.}}{\text{adj.}}$$

$$\Rightarrow \cos X = \frac{\text{adj.}}{\text{hyp.}}$$

$$= \frac{3}{\sqrt{3^2 + 4^2}} = \frac{3}{5}$$

$$\sin x = \frac{\text{opp.}}{\text{hyp}} = \frac{4}{5} \quad \text{Figure 1}$$

### Figure 1



A small smooth light pulley  $P$  is fixed at the top of the plane.

A particle  $A$  of mass  $2m$  and a particle  $B$  of mass  $m$  are connected by a rope.

The rope passes over the pulley  $P$

The part of the rope from  $B$  to  $P$  is parallel to a line of greatest slope of the plane.

Particle  $B$  is held at rest on the rough plane and  $A$  hangs freely with the rope taut, as shown in Figure 1.

Particle  $B$  is released from rest and begins to move up the plane.

(a) Find, in terms of  $mg$ , the magnitude of the normal reaction that the plane exerts on  $B$ . (a) Resolving perpendicular to the plane for equilibrium

Resolving perpendicular to the plane, for equilibrium,  
 $R(\perp): R = mg \cos \alpha$  (1 mark)  $= \frac{3}{5} mg$  (1 mark) (2)

The rope is modelled as being light and inextensible.

As  $B$  moves up the plane, the tension in the rope has magnitude  $\frac{7mg}{5}$

The coefficient of friction between  $B$  and the plane is  $\mu$ . (b)(i)  $F = ma$

Using the model,

(b)(i)  $F = ma$   
 $2mg - \frac{7mg}{5} = (2m)a$  (2 marks)

(b) (i) write down an equation of motion for  $A$ ,

$$(ii) \quad 10m_g - 7m_g = 10m_a \Rightarrow a = \frac{3g}{10} \text{ (1 mark)}$$

(ii) hence, find in terms of  $g$ , the magnitude of the acceleration of  $A$ .

(c) For B,  $R(\angle)$ :  $T - F_r - mg \sin \alpha = ma$  (3)

(c) find the value of  $\mu$ .

given  $\frac{7mg}{5} = \mu R$   
 $= \mu \frac{3mg}{5}$   
 component of weight of B  
 Same as A  $A = \frac{3g}{10}$  (5) (3marks)

In reality, the rope would not be light.

(d) State how this would affect the tension in the rope.

(1)

(c) cobd so,  $\frac{7mg}{5} - \frac{34mg}{5} - \frac{4mg}{5} = \frac{3mg}{10} \Rightarrow 14mg - 68mg - 8mg = 3mg$

$$\Rightarrow -6\mu = 3 - 14 + 8 \Rightarrow \mu = \frac{1}{2} \text{ (2marks)}$$

(d) tension in rope,  $T$ , would not be constant, but would change as more of rope hangs on right hand side (1mark)