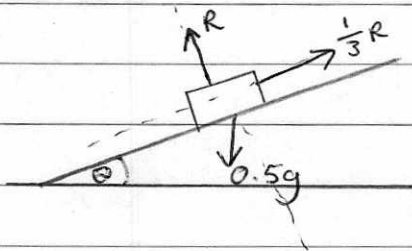


# M1 DYNAMICS - PLANES

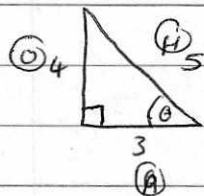
1)



$$\tan \theta = \frac{4}{3}$$

$$\cos \theta = \frac{3}{5}$$

$$\sin \theta = \frac{4}{5}$$



Resolving  $\uparrow$ :

$$R = 0.5g \cos \theta$$

$$= \frac{3}{10}g$$

$$F = ma$$

$$0.5g \sin \theta - \frac{1}{3}R = 0.5a$$

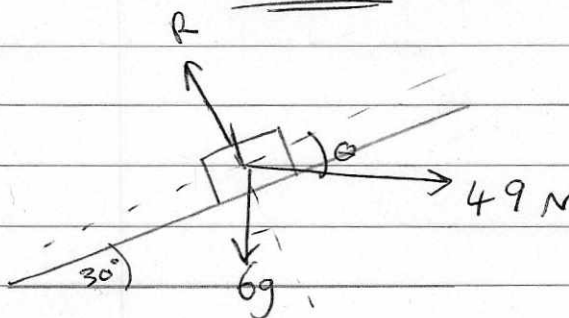
$$0.5g \left(\frac{4}{5}\right) - \frac{1}{3}\left(\frac{3}{10}g\right) = 0.5a$$

$$\frac{2}{5}g - \frac{1}{10}g = 0.5a$$

$$\frac{3}{10}g = 0.5a$$

$$\underline{\underline{\frac{3}{5}g = a}}$$

2a)



resolving  $\rightarrow$

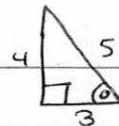
$$49 \cos \theta = 6g \sin 30$$

$$\cos \theta = \frac{30}{49}$$

$$= \underline{\underline{\frac{3}{5}}}$$

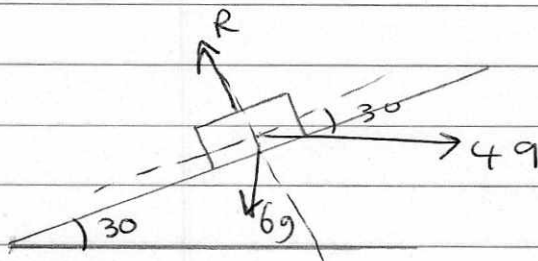
Resolving  $\uparrow$

b/  $R = 49 \sin \theta + 6g \cos 30$   
 $R = 49 \left(\frac{4}{5}\right) + 6g \cos 30$   
 $= \underline{\underline{90.1 \text{ N}}} \quad (3 \text{ sf})$



$$\sin \theta = \frac{4}{5}$$

c/

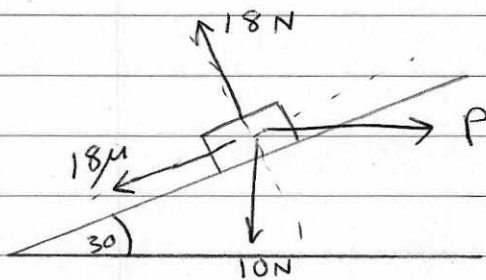


$$F = ma$$

$$49 \cos 30 - 6g \sin 30 = 6a$$

$$a = \underline{\underline{2.17 \text{ ms}^{-2}}} \quad (3 \text{ sf})$$

3a/



Resolving  $\uparrow$

$$18 = 10 \cos 30 + P \sin 30$$

$$\frac{18 - 10 \cos 30}{\sin 30} = P$$

$$P = \underline{\underline{18.7 \text{ N}}} \quad (3 \text{ sf})$$

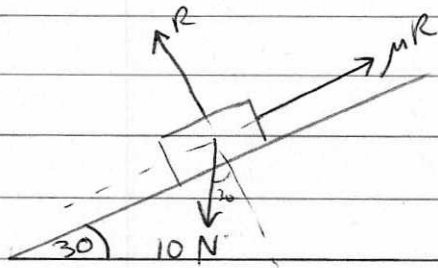
b/ Resolving  $\rightarrow$

$$"18.7" \cos 30 = 10 \sin 30 + 18\mu$$

$$\frac{18.7 \cos 30 - 10 \sin 30}{18} = \mu$$

$$\mu = 0.621 \quad (3 \text{ sf})$$

c)



Resolving  $\uparrow$ :

$$R = 10 \cos 30$$

$$= 5\sqrt{3}$$

The parcel moves if  $10 \sin 30 > \mu R$

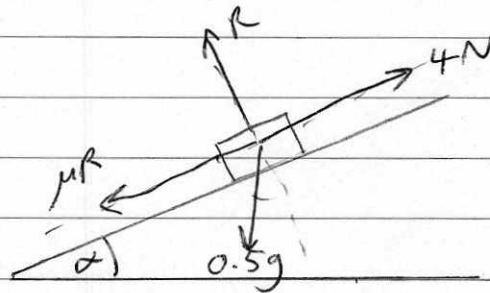
$$10 \sin 30 > 0.621 (5\sqrt{3})$$

$$5 > 5.4$$

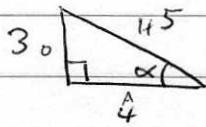
$$5 < 5.4$$

$\therefore$  The parcel ~~moves~~ will not move  $\rightarrow 0.621$

4



$$\tan \alpha = \frac{3}{4}$$



$$\cos \alpha = \frac{4}{5}$$

$$\sin \alpha = \frac{3}{5}$$

Resolving  $\uparrow$

$$R = 0.5g \cos \alpha$$

$$= \frac{2}{5}g$$

Resolving  $\rightarrow$

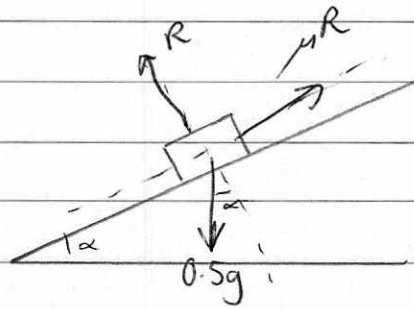
$$4 = 0.5g \sin \alpha + \mu R$$

$$4 = \frac{3}{10}g + \frac{2}{5}g \mu$$

$$\frac{4 - \frac{3}{10}g}{\frac{2}{5}g} = \mu$$

$$\mu = 0.270 \quad (3sf)$$

b)



$$F = ma$$

$$0.5g \sin \alpha - \mu R = 0.5a$$

$$0.5g \left(\frac{3}{5}\right) - 0.270 \left(\frac{2}{5}g\right) = 0.5a$$

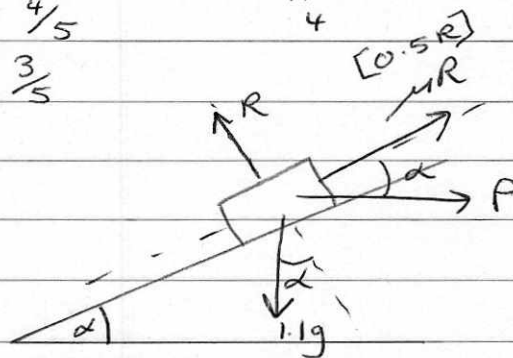
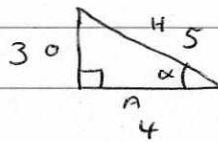
$$a = \underline{\underline{3.76 \text{ ms}^{-2} \text{ (3sf)}}}$$

5a)

$$\tan \alpha = \frac{3}{4}$$

$$\cos \alpha = \frac{4}{5}$$

$$\sin \alpha = \frac{3}{5}$$

Resolving  $\uparrow$ 

$$R = 1.1g \cos \alpha + P \sin \alpha$$

$$R = \frac{22}{25}g + \frac{3}{5}P$$

Resolving  $\rightarrow$ 

$$0.5R + P \cos \alpha = 1.1g \sin \alpha$$

$$0.5 \left( \frac{22}{25}g + \frac{3}{5}P \right) + \frac{4}{5}P = \frac{33}{50}g$$

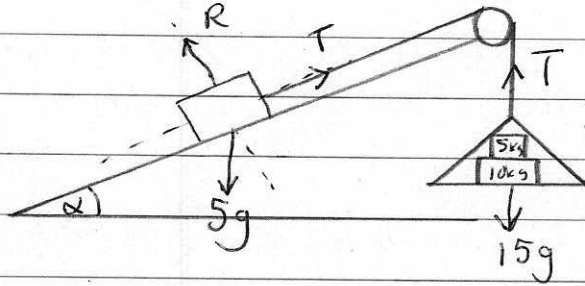
$$\frac{11}{25}g + \frac{3}{10}P + \frac{4}{5}P = \frac{33}{50}g$$

$$\frac{11}{10}P = \frac{11}{50}g$$

$$P = \underline{\underline{\frac{1}{5}g}}$$

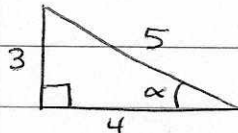
$$R = \underline{\underline{g}}$$

6



$$\sin \alpha = \frac{3}{5}$$

$$\cos \alpha = \frac{4}{5}$$



scale per.

block

$$a) \quad F = m a$$

$$F = m a$$

$$15g - T = 15 a$$

$$T - 5g \sin \alpha = 5 a$$

$$T = 15g - 15a$$

$$T = 5a + 5g \left( \frac{3}{5} \right)$$

$$15g - 15a = 5a + 3g$$

$$12g = 20a$$

$$\underline{\underline{\frac{3}{5}g = a}}$$

$$T = 15g - 15 \left( \frac{3}{5}g \right)$$

$$= \underline{\underline{6g}}$$

$$b) \quad F = m a$$

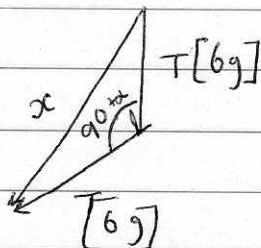
$$5g - R = 5a$$

$$5g - 5a = R$$

$$5g - 5 \left( \frac{3}{5}g \right) = R$$

$$R = \underline{\underline{2g}}$$

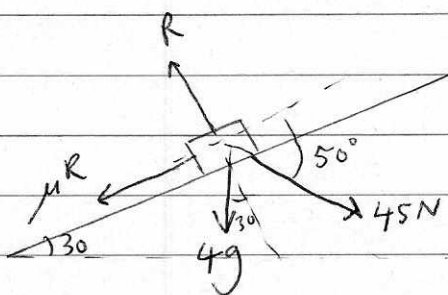
c/



$$\alpha^2 = (6g)^2 + (6g)^2 - 2(6g)(6g) \cos(90 + \alpha)$$

$$\alpha = 105 \text{ N (3sf)}$$

7

Resolving  $\uparrow$  :

$$R = 4g \cos 30 + 45 \sin 50$$

$$= \underline{68.4 \text{ N (3sf)}}$$

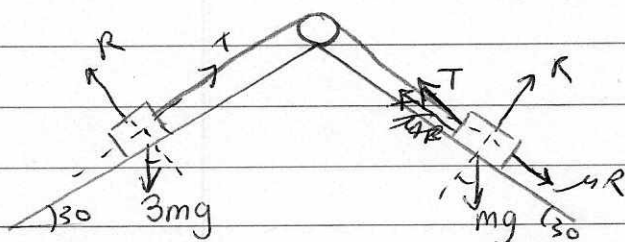
Resolving  $\rightarrow$ 

$$45 \cos 50 = 4g \sin 30 + \mu (68.4)$$

$$\mu = \frac{45 \cos 50 - 4g \sin 30}{68.4}$$

$$\mu = 0.136 \text{ (3sf)}$$

8



A

$$F = ma$$

$$3mg \sin 30 - T = 3ma$$

$$\frac{3}{2}mg - T = 3ma$$

$$T = \frac{3}{2}mg - 3ma$$

$$= \frac{3}{2}mg - \frac{3}{10}mg$$

$$= \underline{\underline{\frac{6}{5}mg}}$$

$$b) \text{ B: Resolving } \uparrow : R = mg \cos 30$$

$$= \frac{\sqrt{3}}{2}mg$$

$$F = ma$$

$$\frac{6}{5}mg + \frac{\sqrt{3}}{2}mg(\mu) - \frac{1}{2}mg = m(\frac{1}{10}g) + \frac{\sqrt{3}}{2}mg(\mu)$$

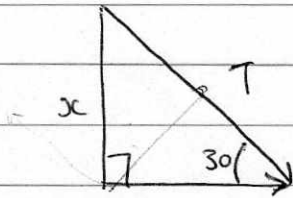
$$\frac{6}{5} + \frac{\sqrt{3}}{2}\mu - \frac{1}{2} = \frac{1}{10} + \frac{\sqrt{3}}{2}\mu$$



$$\frac{\sqrt{3}}{2} \mu = \frac{3}{5}$$

$$\mu = 0.693 \quad (3 \text{ s.f.})$$

c/

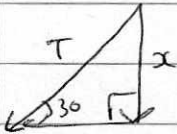


$$\sin 30 = \frac{x}{T}$$

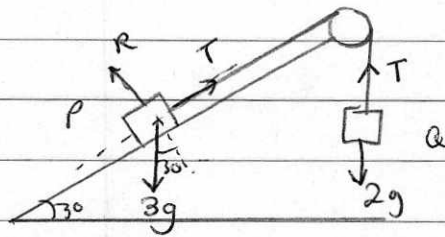
$$x = \frac{1}{2}T$$

$$2x = T$$

$$= \underline{\underline{\frac{6}{5}mg}}$$



9



a) P:  $F = ma$   
 $T - 3g \sin 30 = 3a$

Q:  $2g - T = 2a$

b)  $T = 3a + 3g \sin 30$   
 $T = 2g - 2a$

$$2g - 2a = 3a + 3g \sin 30$$

$$2g - 3g \sin 30 = 5a$$

$$\frac{1}{2}g = 5a$$

$$a = \frac{1}{10}g = \underline{\underline{0.98 \text{ ms}^{-2}}}$$

c)  $T = 2(9.8) - 2(0.98)$   
 $= 17.64 \text{ N}$   
 $[17.6] \text{ N}$

d) The acceleration is the same for P and Q.

e)  $s = 0.8$        $v^2 = u^2 + 2as$   
 $u = 0$        $v^2 = 2\left(\frac{1}{10}g\right)(0.8)$   
 $v = ?$        $v = 1.25 \text{ ms}^{-1} \quad 3 \text{ sf}$   
 $a = \frac{1}{10}g$   
 $t = x$

d)  $s = 0$        $F = ma$   
 $u = 1.25$        $-3g \sin 30 = 3a$   
 $v =$        $a = -4.9$   
 $a = -4.9$   
 $t = ?$



$$s = ut + \frac{1}{2}at^2$$

$$0 = 1.25t - 2.45t^2$$

$$0 = t(1.25 - 2.45t)$$

$$t = \underline{\underline{0.510}} \text{ seconds (3sf)}$$

$$[0.511]$$