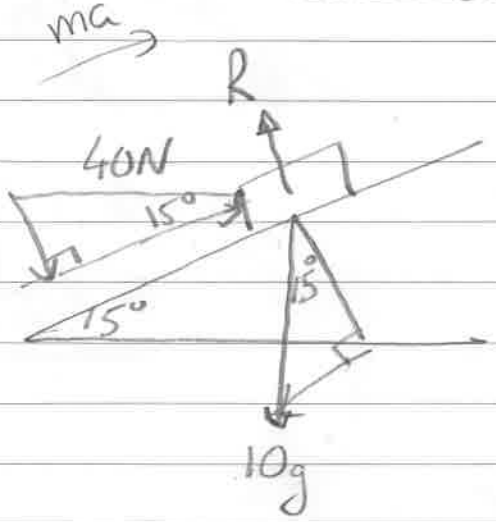
Homework 6 solutions

/28.

1)



$ma = 40\cos 15° - 10g\sin 15°$ ✓

$a = 1.327 ms^{-2}$ ✓

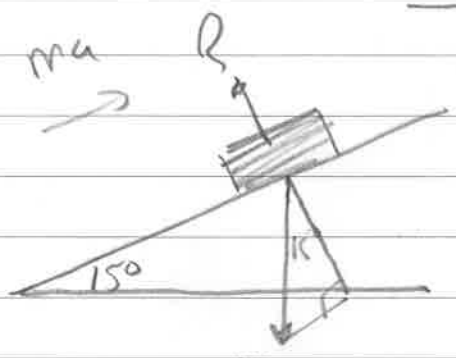
$u = 0$
$v = 3$

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

$3^2 = 0^2 + 2 \times 1.327$

$2.654s = 9$

$s = 3.39m$ ✓



$ma = -10g\sin 15°$

$a = -2.54 ms^{-2}$ ✓

$u = 3$
$v = 0$

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

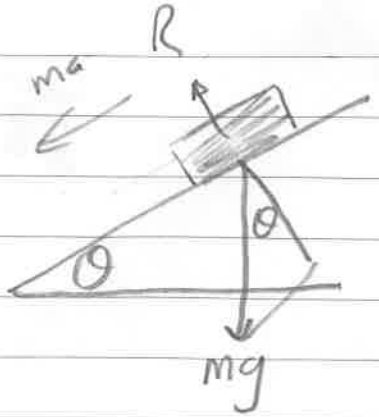
$0 = 3^2 - 2 \times 2.54s$

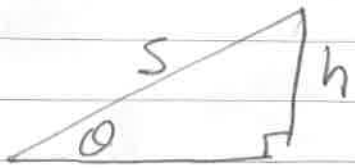
$s = 1.77m$

Total distance $= 3.39 + 1.77$

$= 5.16m$ ✓

2)





$$\sin\theta = \frac{h}{s}$$

$$s = \frac{h}{\sin\theta} \checkmark$$

$$ma = mg\sin\theta$$

$$a = g\sin\theta \checkmark$$

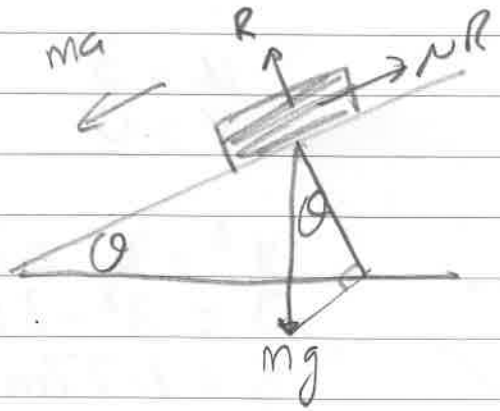
$$s = ut + \frac{1}{2}at^2 \qquad u = 0$$

$$\frac{h}{\sin\theta} = \frac{1}{2}g\sin\theta t^2 \checkmark$$

$$t^2 = \frac{2h}{g\sin^2\theta} \checkmark$$

$$t = \sqrt{\frac{2h}{g\sin^2\theta}}$$

3)



$$ma = mg\sin\theta - \mu R \checkmark \qquad R = mg\cos\theta \checkmark$$

$$a = g\sin\theta - \mu g\cos\theta \checkmark$$

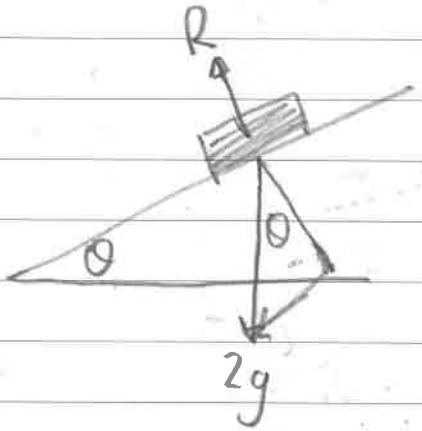
$u = 0$

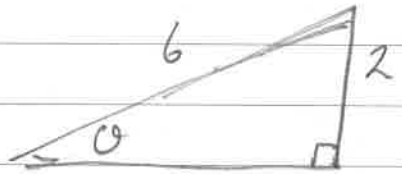
$$v^2 = u^2 + 2as$$

$$v^2 = 2(g\sin\theta - \mu g\cos\theta)s \checkmark$$

$$s = \frac{v^2}{2(g\sin\theta - \mu g\cos\theta)}$$

4) a)





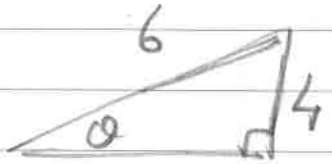
$\sin\theta = 2/6$

$\theta = 19.5° \checkmark$

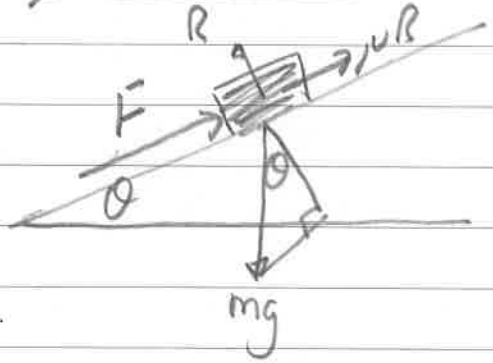
$\mu = \tan\theta$

$\Rightarrow \mu = \tan 19.5$

$\mu = 0.354 \checkmark$



b)

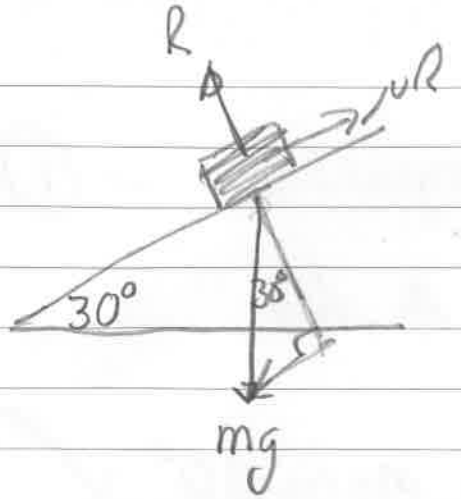


$F + \mu R = mg\sin\theta \qquad R = mg\cos\theta$

$F = mg\sin\theta - \mu mg\cos\theta$

$F = 7.90N$

5)



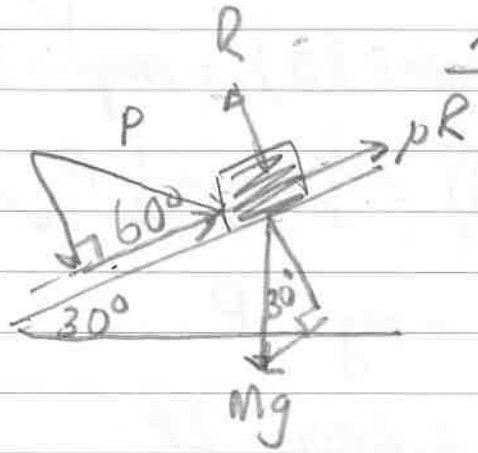
To stay in place $\mu R \geq mg\sin 30°$ ✓

$\mu mg\cos 30° \geq mg\sin 30°$ ✓

$\mu \geq \tan 30$ ✓

$\mu \geq \frac{1}{\sqrt{3}}$

b)



$\mu = 0.5$

$R = P\sin 60° + mg\cos 30°$ ✓

$R = \frac{\sqrt{3}}{2}P + \frac{\sqrt{3}}{2}mg$ ✓

$R = \frac{\sqrt{3}}{2}(P + mg)$

$$R = P\sin 60 + mg\cos 30 \quad -(1)$$

resolve in the direction of the slope

$$P\cos 60 + \mu R = mg\sin 30^\circ \checkmark$$

$$\mu R = mg\sin 30^\circ - P\cos 60^\circ \quad -(2)$$

sub (1) into (2) $\Rightarrow$

$$\mu\left(P\sin 60 + mg\cos 30\right) = mg\sin 30 - P\cos 60 \checkmark$$

$$\frac{1}{2}\left(\frac{\sqrt{3}}{2}\left(mg + P\right)\right) = \frac{1}{2}mg - \frac{1}{2}P \checkmark$$

$$\frac{\sqrt{3}}{2}\left(mg + P\right) = mg - P$$

$$\sqrt{3}\left(mg + P\right) = 2mg - 2P$$

$$\sqrt{3}mg + \sqrt{3}P = 2mg - 2P \checkmark$$

$$\sqrt{3}P + 2P = 2mg - \sqrt{3}mg$$

$$P\left(\sqrt{3} + 2\right) = mg\left(2 - \sqrt{3}\right) \checkmark$$

$$P = \frac{\left(2 - \sqrt{3}\right)mg}{2 + \sqrt{3}}$$