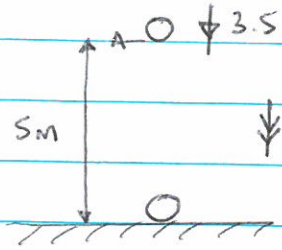
M1 Year 12 Mock 2015

1.



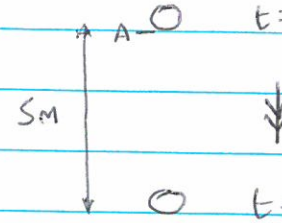
(i) suvat ↓ +ve

$s = 5,\ u = 3.5,\ v = ?,\ a = 9.8,\ t = x$

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

$v^2 = 3.5^2 + 2 \times 9.8 \times 5 = 110.25$

$v = \sqrt{110.25} = 10.5\ ms^{-1}$



(ii) suvat ↑ +ve

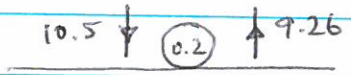
$s = 5,\ u = ?,\ v = x,\ a = -9.8,\ t = 0.87$

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

$5 = 0.87u - 4.9 \times 0.87^2$

$u = \dfrac{5 + 4.9 \times 0.87^2}{0.87} = 10.0\ ms^{-1}$

(iii)



+ve

change in momentum = $MV - Mu$ ↓

$= 0.2 \times 10.5 - 0.2 \times -10.0$

$= 4.10\ Ns$

4. (i)

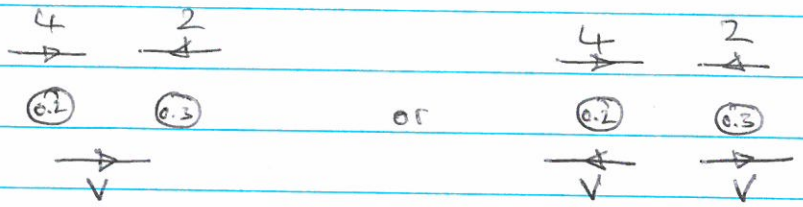
Total initial momentum $4 \times 0.2 - 2 \times 0.3 = 0.2$ Ns

Total initial momentum is positive in direction of P

∴ Total final momentum must be positive in the direction of P (conservation of momentum)

∴ Q must change direction.

(ii)



Note: P and Q have same speed not necessarily the same velocity

Cons of mom

$0.2 = 0.5V$

$V = \frac{2}{5} = 0.4 \text{ ms}^{-1}$

Cons of mom

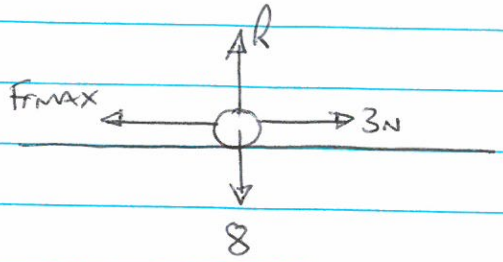
$0.2 = -0.2V + 0.3V$

$0.2 = 0.1V$

$V = 2 \text{ ms}^{-1}$

$V = 0.4 \text{ ms}^{-1}$ or 2 ms^{-1}

6 i)



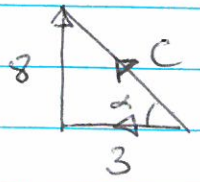
$R(\updownarrow)\quad R = 8N$

$R(\leftrightarrow)\quad F_{MAX} = 3N$

$F_{MAX} = \mu R$

$3 = 8\mu \quad \therefore \mu = \frac{3}{8} = 0.375$

ii) Contact force has a vertical component which is the normal reaction force and a horizontal component which is friction



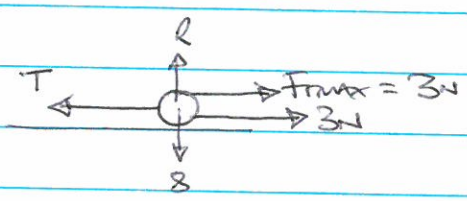
$C^2 = 8^2 + 3^2$

$C = \sqrt{73} = 8.54N$

$\tan\alpha = \frac{8}{3}, \quad \alpha = \tan^{-1}\frac{8}{3} = 69.4°$

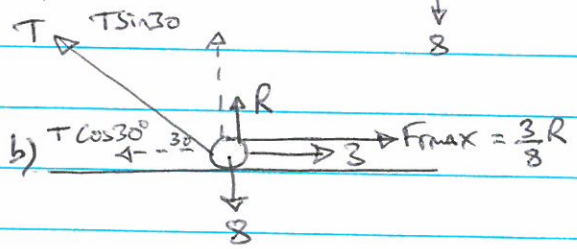
∴ Contact force has magnitude of 8.54N and acts at an angle of 69.4° to the horizontal.

iii) a) if $\theta = 0$



$R(\leftrightarrow)\quad T = 6N$

b)



$R(\updownarrow)\quad R + T\sin 30 = 8$

$R = 8 - \frac{T}{2}$ ①

$R(\leftrightarrow)\quad T\cos 30 = 3 + \frac{3}{8}R$ ②

$\therefore \frac{\sqrt{3}}{2}T = 3 + \frac{3}{8}\left(8 - \frac{T}{2}\right)$

$\frac{\sqrt{3}}{2}T = 6 - \frac{3T}{16}$

$T\left(\frac{\sqrt{3}}{2} + \frac{3}{16}\right) = 6$

$T = \frac{6}{\frac{\sqrt{3}}{2} + \frac{3}{16}} = 5.70N$

7 (i) $s = ?, u = 0.6, v = x, a = 0.9, t = 2$ ↙ +ve

$s = ut + \frac{1}{2}at^2$ $\quad s = 0.6 \times 2 + \frac{1}{2} \times 0.9 \times 2^2 = 3m = MB$

$\therefore AB = 2 \times 3 = 6m$

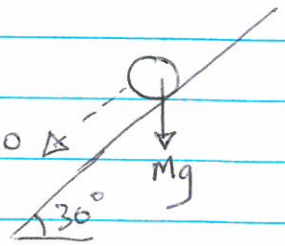
(ii) from M to B, P will move due to it's weight only since there can be no tension if Q is at rest.

To find P's speed at M suvat ↙ +ve

$s = 3, u = 0.6, v = ?, a = 0.9, t = 2$

$v = u + at$ $\quad v = 0.6 + 0.9 \times 2 = 2.4 ms^{-1}$

To find P's acceleration from M to B



↙ +ve

$F = ma$ $\quad \cancel{m}g \sin 30 = \cancel{m}a$

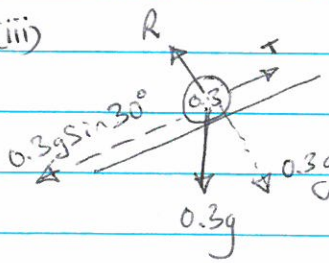
$a = 4.9 ms^{-2}$

To find P's speed at B suvat ↙ +ve

$s = 3, u = 2.4, v = ?, a = 4.9, t = x$

$v^2 = u^2 + 2as$, $\quad v^2 = 2.4^2 + 2 \times 4.9 \times 3$, $\quad v = 5.93 ms^{-1}$

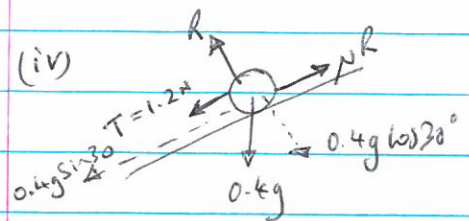
(iii) JUST Q



$F = ma$ ↙ +ve $\quad 0.3g \sin 30 - T = 0.3 \times 0.9$

$T = 0.3g \sin 30 - 0.3 \times 0.9 = 1.2 N$

(iv)



$F = ma$ ↙ +ve

$1.2 + 0.4g \sin 30 - \mu 0.4g \cos 30 = 0.4 \times 0.9$

$\mu = \dfrac{1.2 + 0.4g \sin 30 - 0.4 \times 0.9}{0.4g \cos 30}$

$\mu = 0.825$ 3sf