

MI JAN 11

1) max height = 40m

a)  $a \uparrow = -9.8$

$S = 40\text{m}$

$v \uparrow = 0$  (at max height)

$$v^2 = u^2 + 2as \Rightarrow 0 = u^2 - 19.6 \times 40 \Rightarrow u^2 = 784$$
$$\Rightarrow u = \underline{28\text{ms}^{-1}}$$

b)  $u \uparrow = 28$

$a \uparrow = -9.8$

$S \uparrow = 33.6$

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

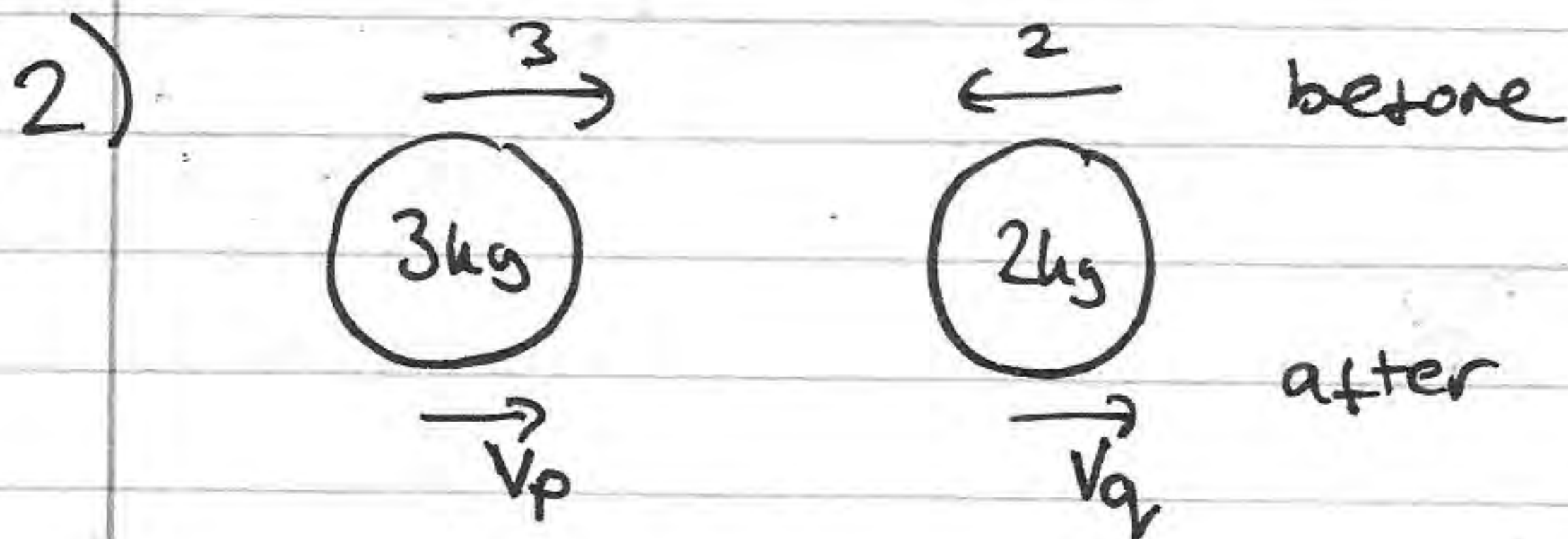
$33.6 = 28t - 4.9t^2$

$\Rightarrow 4.9t^2 - 28t + 33.6 = 0$

$$t = \frac{28 \pm \sqrt{28^2 - 4(4.9)(33.6)}}{9.8}$$

$t_1 = \underline{4}$     $t_2 = \underline{\frac{12}{7}}$

(Total time above =  $4 - \frac{12}{7} = \underline{\frac{16}{7} \text{ sec}}$ )



$v_q = v_p + 1$

CLM  $\Rightarrow 3(3) + 2(-2) = 3(v_p) + 2(v_p + 1)$

$\Rightarrow 5 = 5v_p + 2$

$\Rightarrow 5v_p = 3 \Rightarrow v_p = \frac{3}{5} \Rightarrow v_q = \frac{8}{5}$

Speed of P =  $\frac{3}{5} \text{ms}^{-1}$

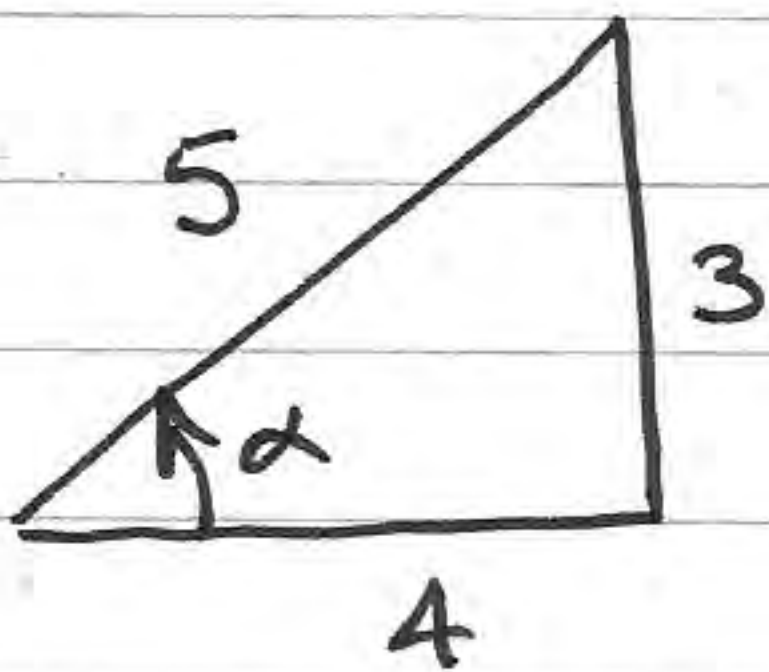
Speed of Q is  $\frac{8}{5} \text{ms}^{-1}$

b) Mom P before =  $3(3) = 9 \text{ N s}$   
 Mom P after =  $3\left(\frac{3}{5}\right) = \frac{9}{5} \text{ N s}$

Impulse = change in Mom =  $9 - \frac{9}{5} = \underline{\underline{\frac{36}{5} \text{ N s}}}$

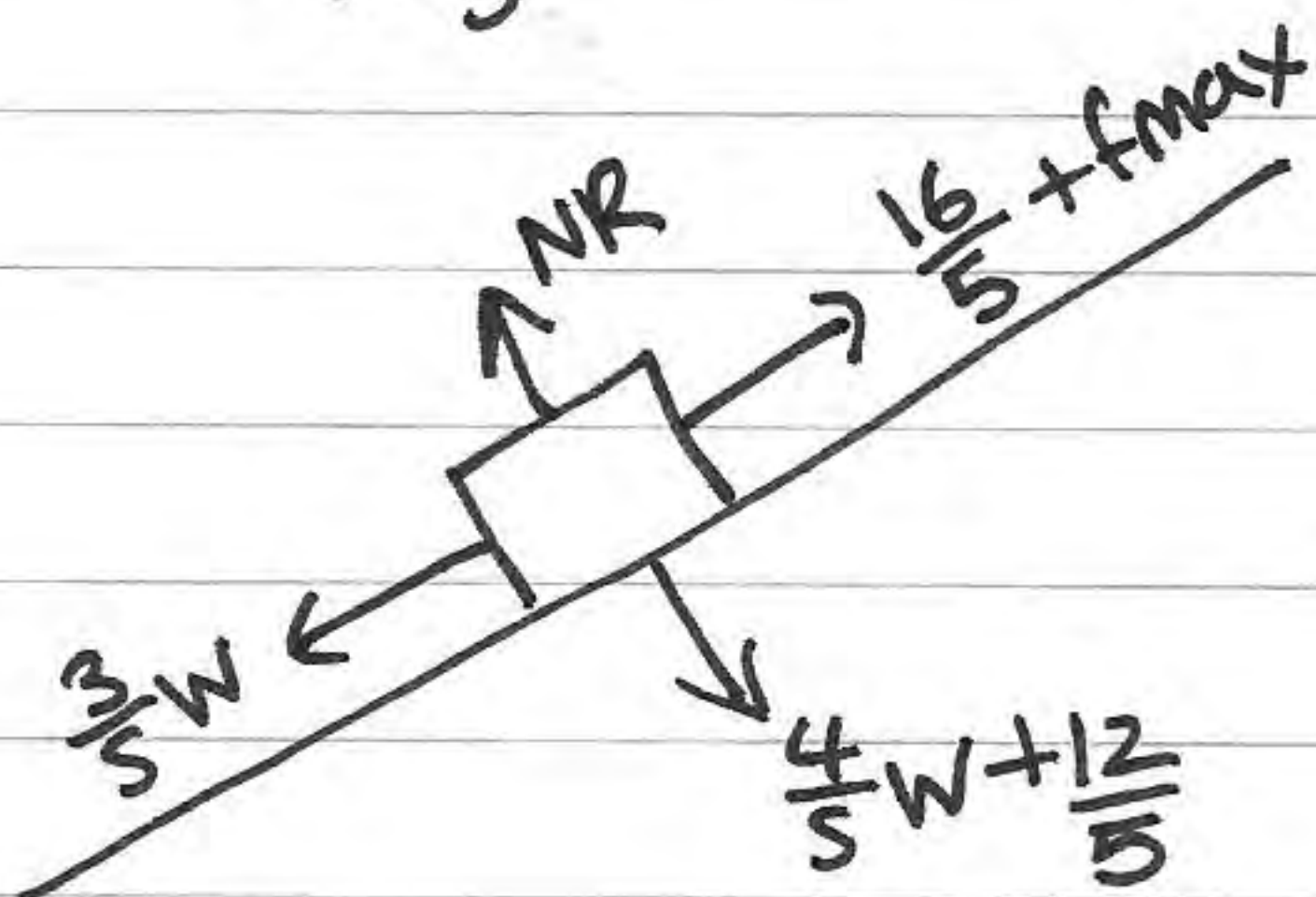
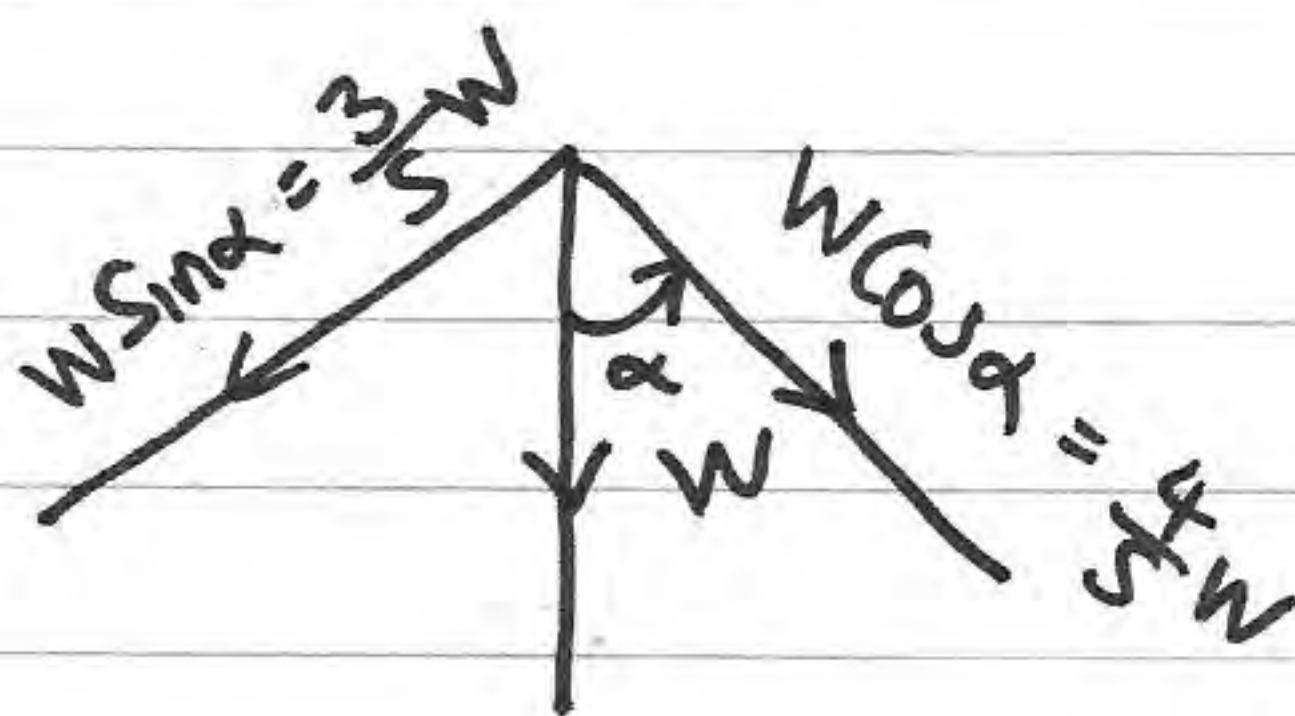
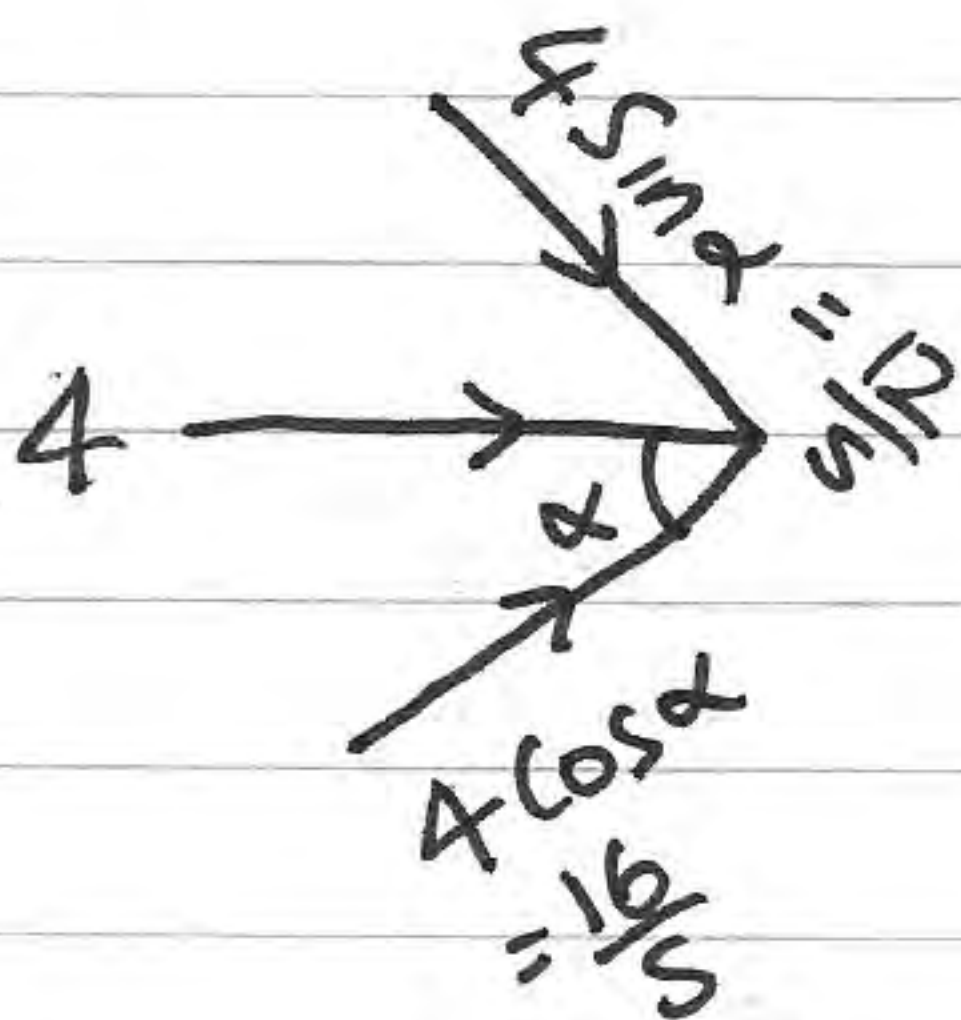
3)

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



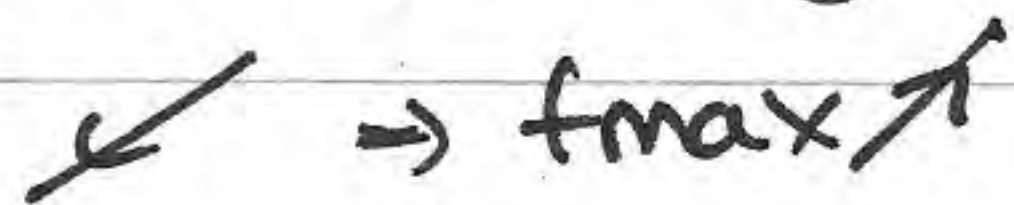
$\sin \alpha = \frac{3}{5}$

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



$\mu = \frac{1}{2}$

point of sliding down



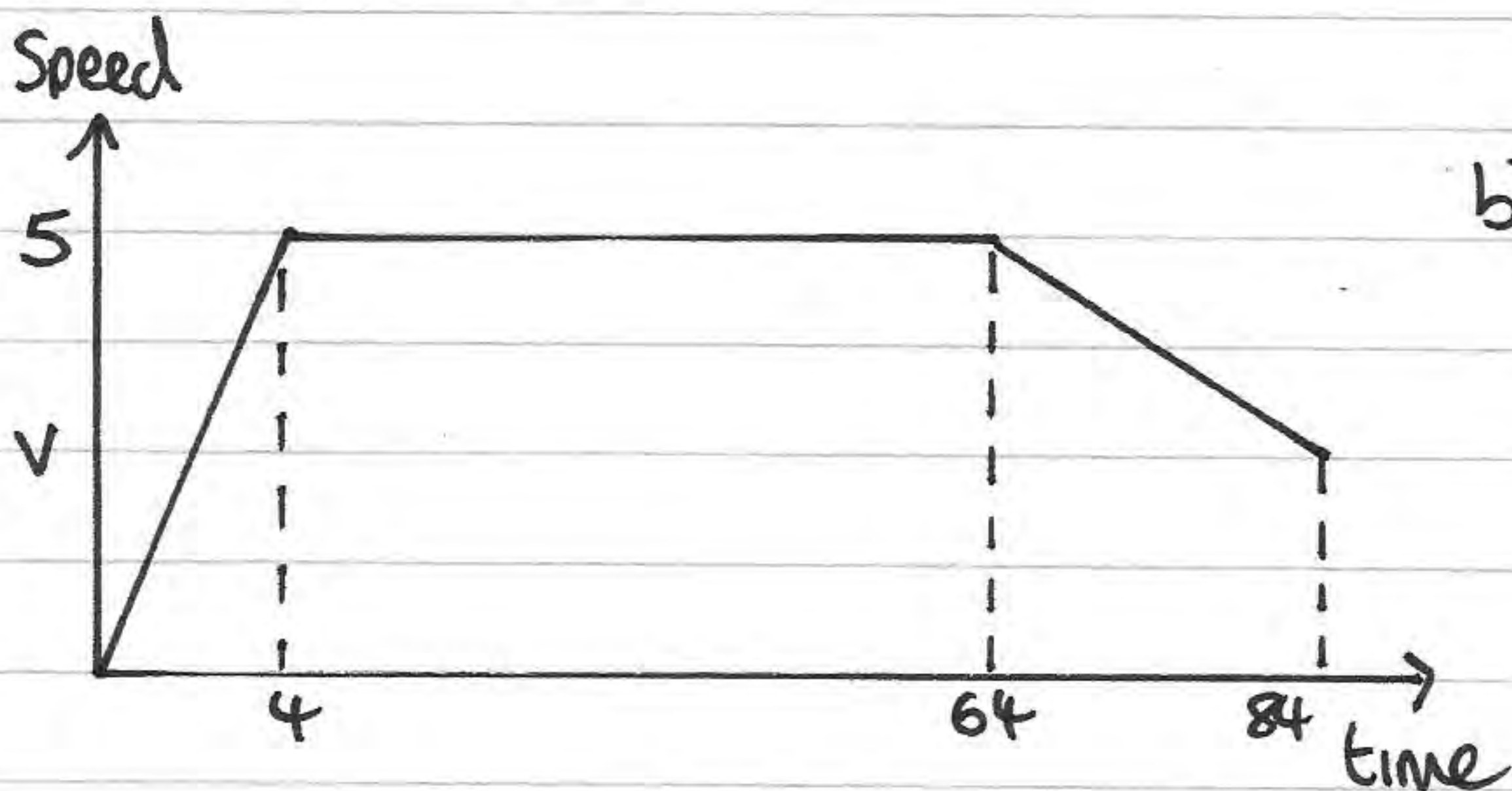
$$Rf \uparrow = 0 \Rightarrow NR = \frac{4}{5}W + \frac{12}{5} \quad f_{\max} = \mu NR = \frac{2}{5}W + \frac{6}{5}$$

$$Rf \uparrow = 0 \Rightarrow f_{\max} = \frac{3}{5}W - \frac{16}{5} \Rightarrow \frac{3}{5}W - \frac{16}{5} = \frac{2}{5}W + \frac{6}{5}$$

$$\Rightarrow \frac{1}{5}W = \frac{22}{5} \Rightarrow \underline{W = 22N} \quad (ii)$$

$$NR = \frac{4}{5}(22) + \frac{12}{5} = \frac{100}{5} = \underline{20N} \quad \# \quad (i)$$

4)

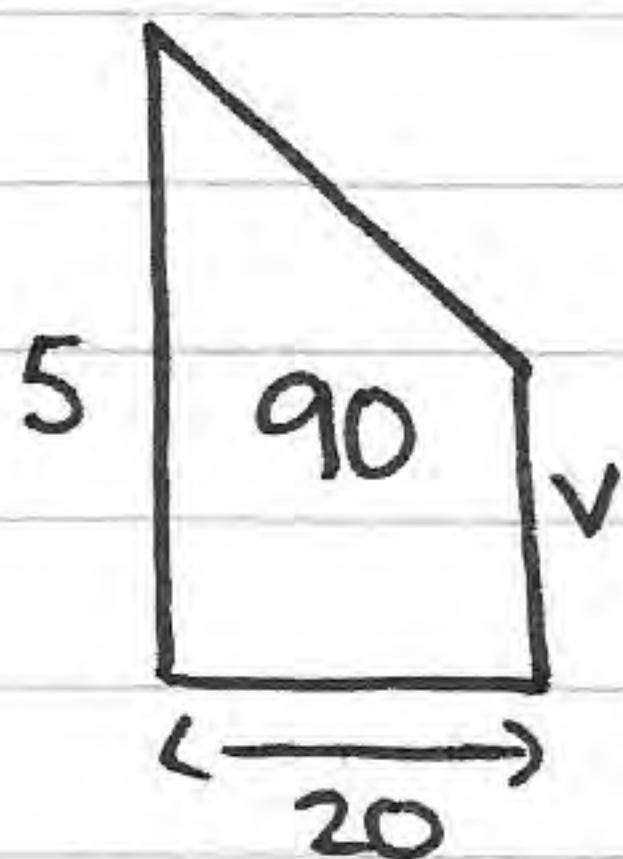


b)

$$S = \frac{1}{2}(5)(60+64)$$

$$\underline{S = 310m}$$

c)

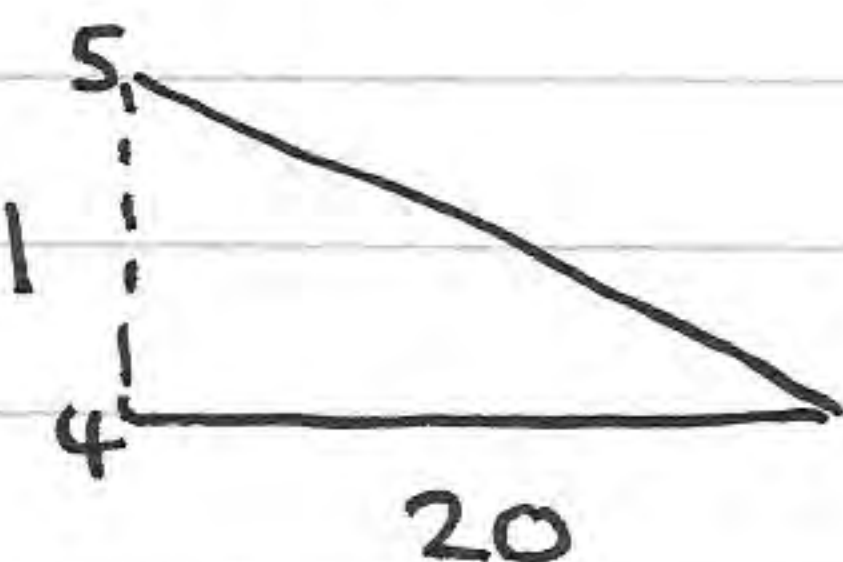


$$\frac{1}{2}(20)(5+v) = 90$$

$$\Rightarrow 5+v = 9$$

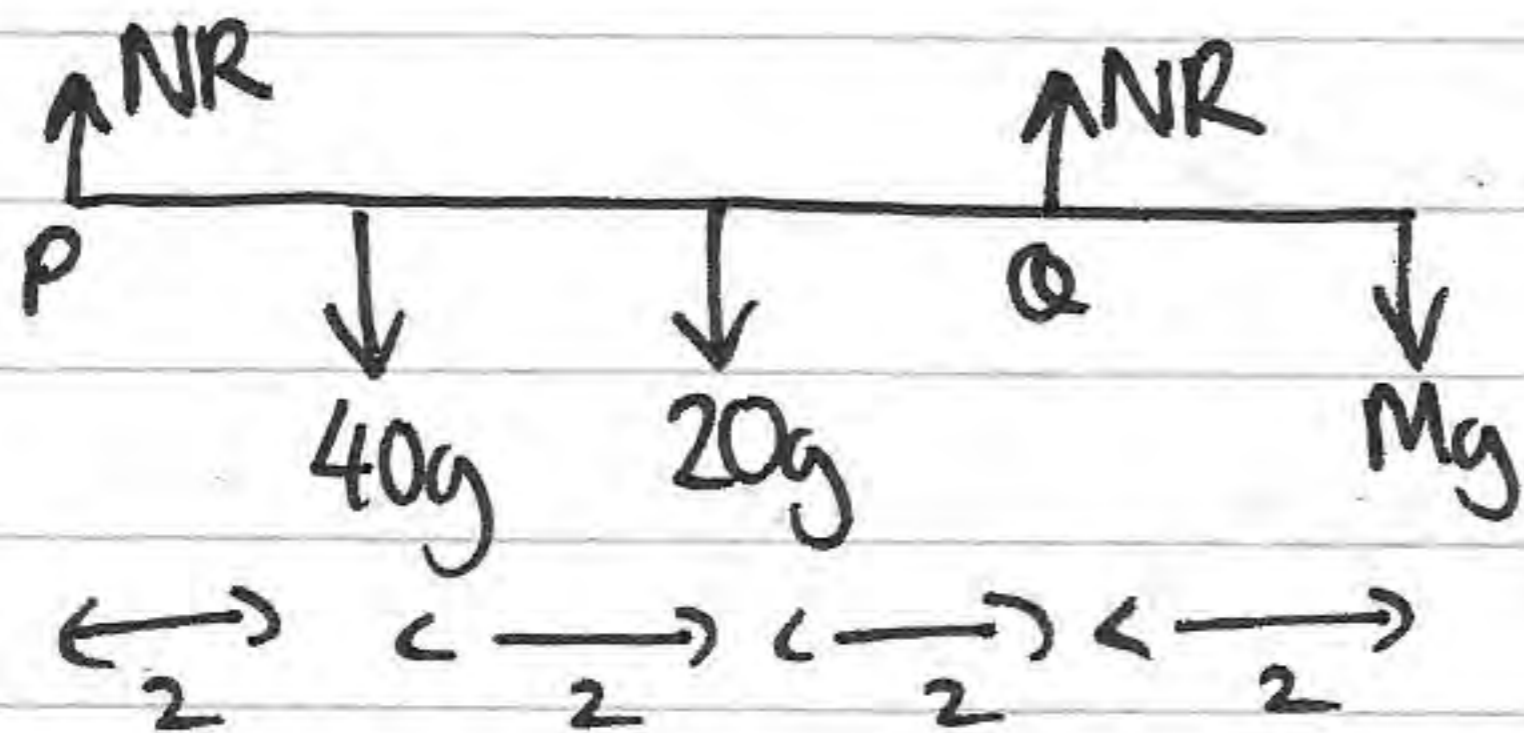
$$\Rightarrow \underline{v = 4 \text{ ms}^{-1}}$$

d)



$$\text{acc} = \frac{-1}{20} \Rightarrow \text{deceleration} = \underline{\frac{1}{20} \text{ ms}^{-2}}$$

5)



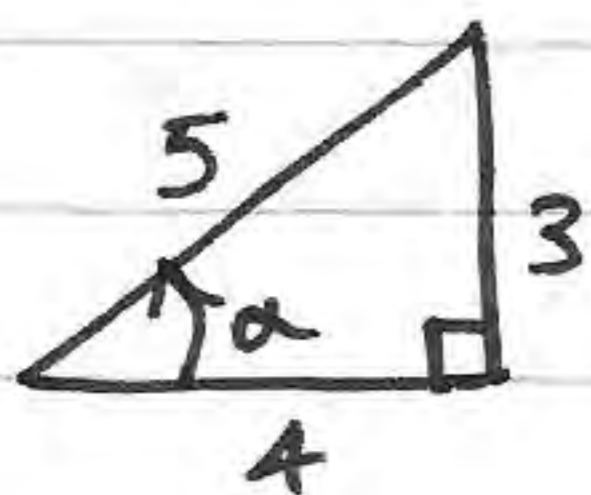
$$R \downarrow NR \times 2 + NR \times 8 = 20g \times 4 + 40g \times 6$$

$$\Rightarrow 10NR = 320g$$

$$\Rightarrow NR = \underline{32gN}$$

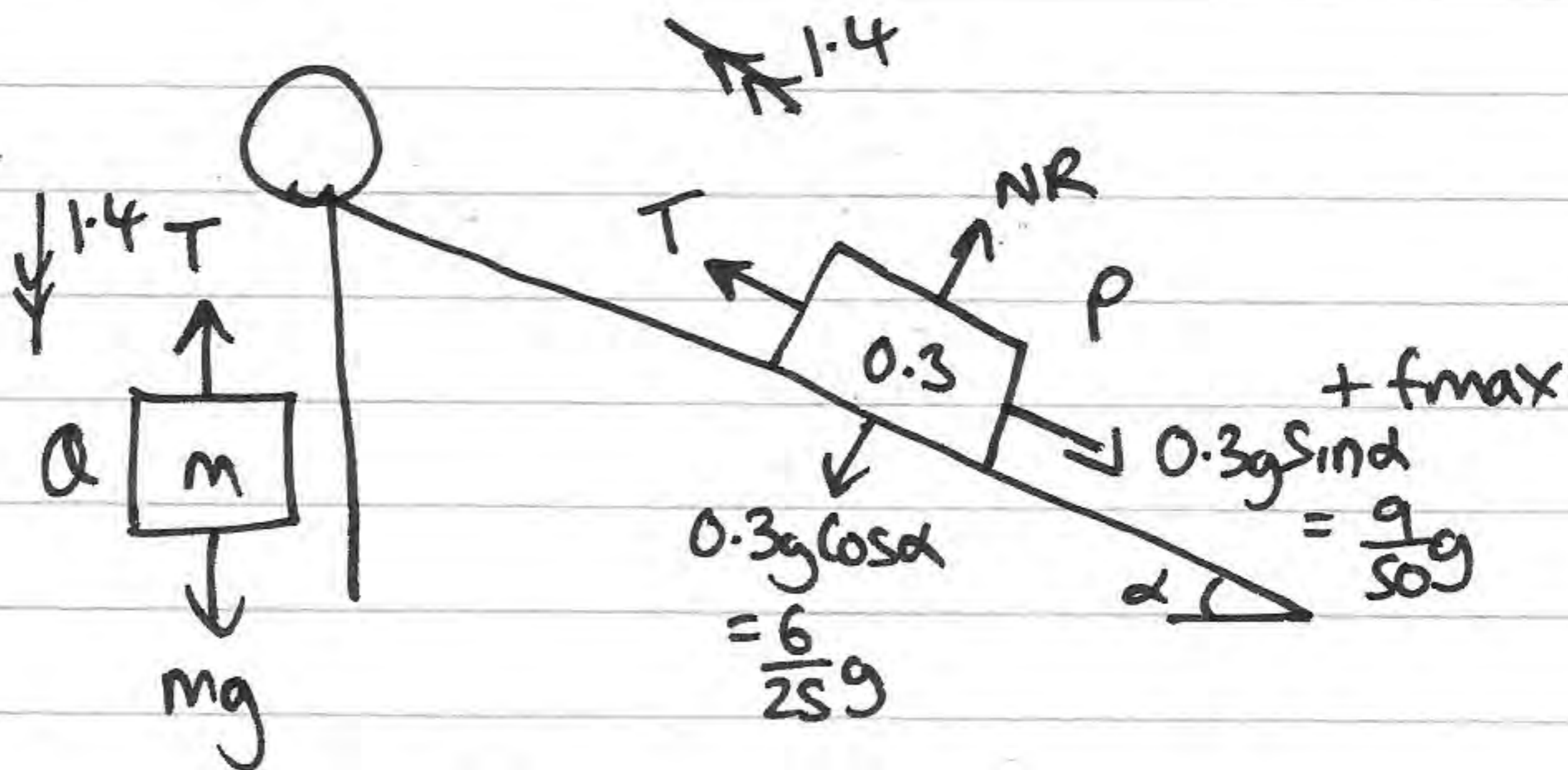
$$R_f \uparrow = 0 \Rightarrow 2NR = 60g + Mg \Rightarrow 64g = 60g + Mg \Rightarrow M = \underline{4kg}$$

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



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

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

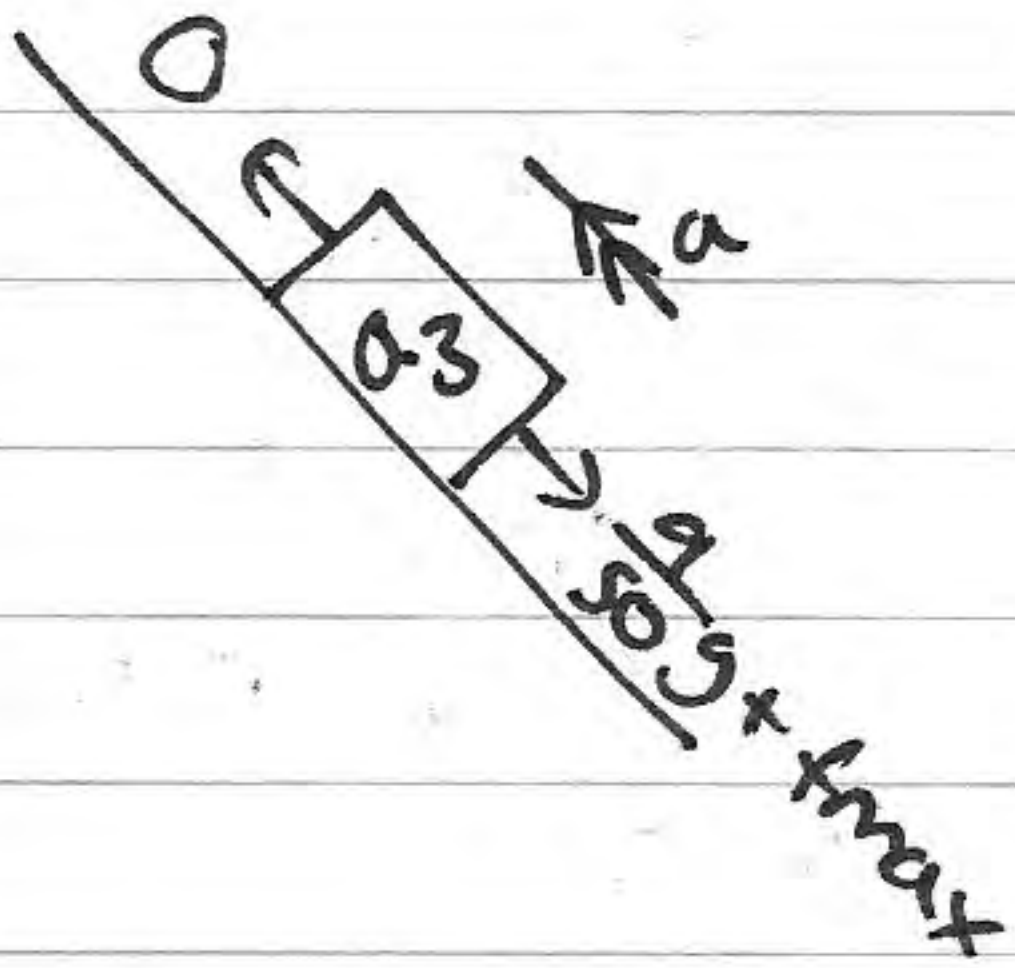


$$a) \textcircled{P} R_f \uparrow = 0 \Rightarrow NR = \frac{6}{25}g \quad f_{\max} = \mu NR = \frac{3}{25}g$$

$$b) \textcircled{P} R_f \uparrow = ma \Rightarrow T - \frac{9}{50}g - \frac{3}{25}g = 0.3 \times 1.4$$

$$\Rightarrow T = \frac{21}{50} + \frac{15}{50}g \Rightarrow T = \underline{3.36N}$$

c)  $u \uparrow = 0$   $a \uparrow = 1.4$   $t = 0.5$   $v = u + at \Rightarrow v = \underline{0.7 \text{ ms}^{-1}}$



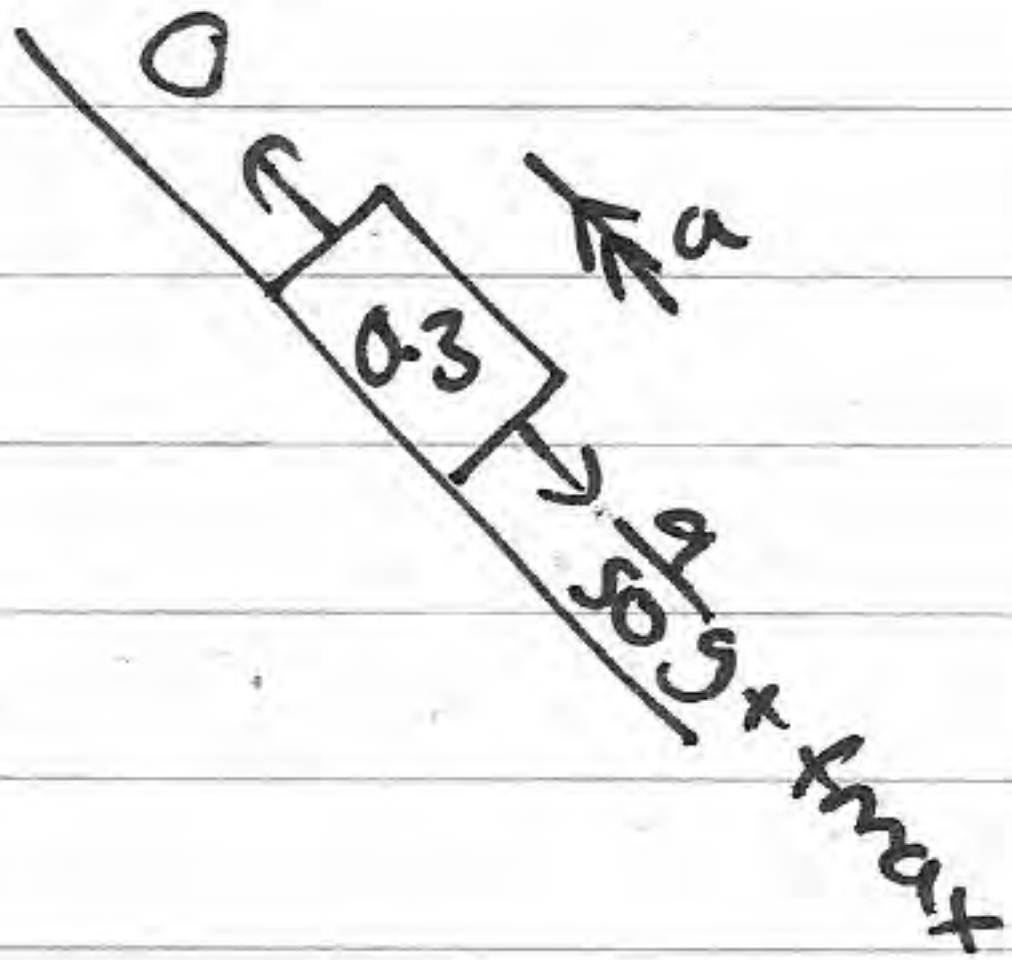
$$-\frac{9}{50}g - \frac{6}{50}g = 0.3a \Rightarrow -0.3g = 0.3a$$
$$\Rightarrow \underline{a = -g \text{ ms}^{-2}}$$

$$u \uparrow = 0.7 \quad a \uparrow = -9.8 \quad v \uparrow = 0$$

$$v = u + at \Rightarrow 0 = 0.7 - 9.8t \Rightarrow t = \underline{\frac{1}{14} \text{ sec}}$$

Q)  $Rf \downarrow = ma \Rightarrow mg - 3.36 = m \times 1.4 \Rightarrow 8.4m = 3.36$   
 $\Rightarrow \underline{m = 0.4 \text{ kg}}$

c)  $u \uparrow = 0 \quad a \uparrow = 1.4 \quad t = 0.5 \quad v = u + at \Rightarrow \underline{v = 0.7 \text{ ms}^{-1}}$



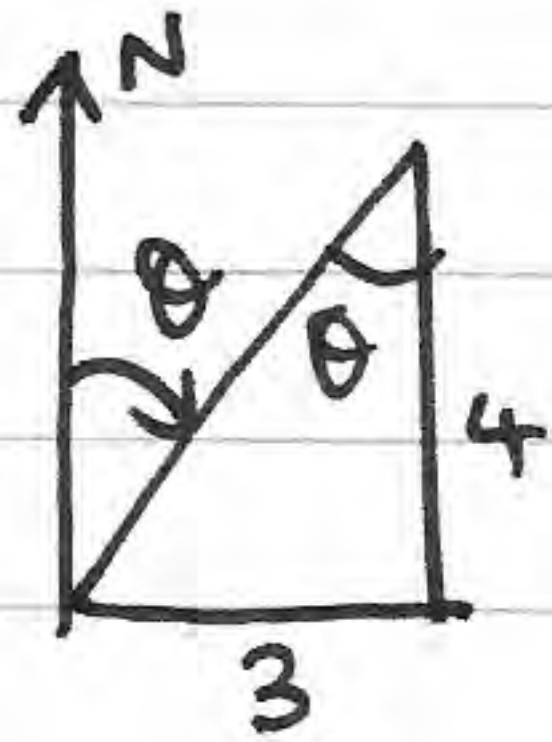
$$-\frac{9}{50}g - \frac{6}{50}g = 0.3a \Rightarrow -0.3g = 0.3a$$

$$\Rightarrow \underline{a = -g \text{ ms}^{-2}}$$

$$u \uparrow = 0.7 \quad a \uparrow = -9.8 \quad v \uparrow = 0$$

$$v = u + at \Rightarrow 0 = 0.7 - 9.8t \Rightarrow \underline{t = \frac{1}{14} \text{ sec}}$$

7)



$$\theta = \tan^{-1}\left(\frac{3}{4}\right) = 36.9^\circ$$

$$\Rightarrow \text{bearing} = \underline{\underline{037^\circ}}$$

b) position = original position + velocity  $\times$  time

(i) position =  $(i+j) + (2i-3j)t \Rightarrow p = (1+2t)i + (1-3t)j$ ;

(ii) position =  $(-2j) + (3i+4j)t \Rightarrow q = 3ti + (-2+4t)j$ ;

(iii)  $\vec{PQ} = q - p = (3t-1-2t)i + (-2+4t-1+3t)j$

$$= (t-1)i + (7t-3)j$$

c) Q is due North of P when  $i=0 \Rightarrow t=1 \Rightarrow 3\text{pm}$

d) Q is due North-West of P when  $-i=j$

$$\Rightarrow -(t-1) = 7t-3 \Rightarrow 8t=4 \Rightarrow t=\frac{1}{2} \quad (2:30\text{pm})$$