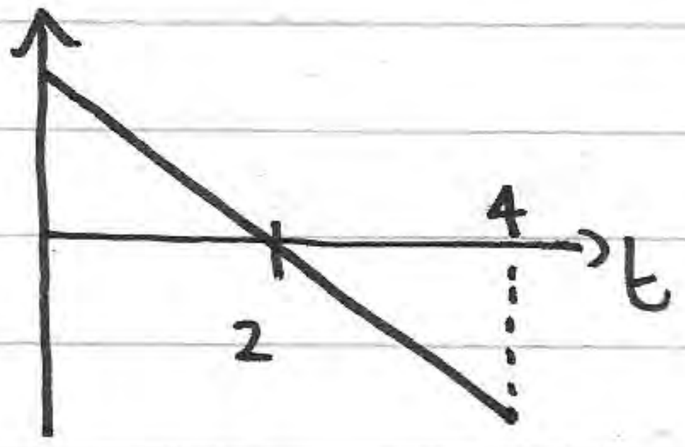
M1 JAN 09

1) $a = (2i - 5j)$ $t = 3$ $v = (-6i + j)$

$v = u + at$ $\begin{pmatrix} -6 \\ 1 \end{pmatrix} = \begin{pmatrix} x \\ y \end{pmatrix} + \begin{pmatrix} 2 \\ -5 \end{pmatrix} \times 3$

$\begin{pmatrix} -6 \\ 1 \end{pmatrix} - \begin{pmatrix} 6 \\ -15 \end{pmatrix} = \begin{pmatrix} x \\ y \end{pmatrix} \Rightarrow u = \underline{-12i + 16j}$

2)



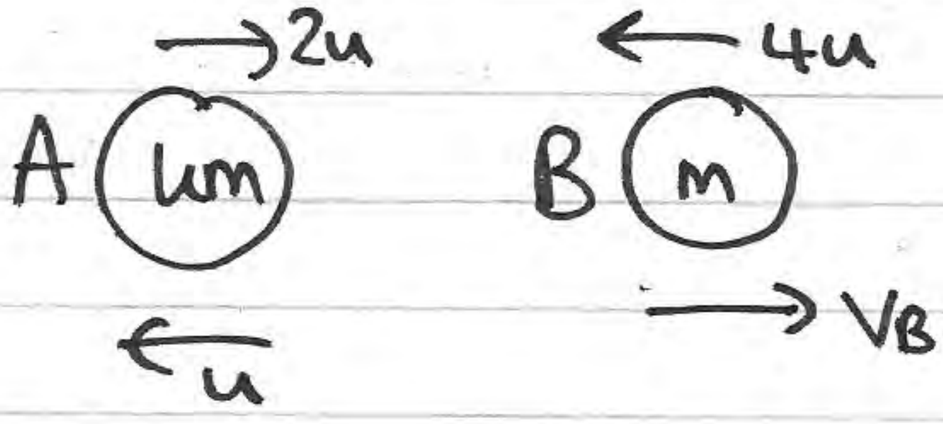
b) $v\uparrow = 0$ $v = u + at$

$a\uparrow = -9.8$ $0 = u - 9.8 \times t$

$t = 2$ $\Rightarrow u = \underline{19.6 ms^{-1}}$

$s = 19.6$

3)



CLM $\Rightarrow$ $2m \times u - 4mu$

$= -1m \times u + m \times V_B$

$\Rightarrow 3mu - 4u = V_B$

$\Rightarrow V_B = u(3u - 4)$

b) $2 < k < 3$ $\Rightarrow$ $V_{B\,min}$ $k = 2$ $V_B > 2u$ $2u < V_B < 5u$

$V_{B\,max}$ $k = 3$ $V_B < 5u$

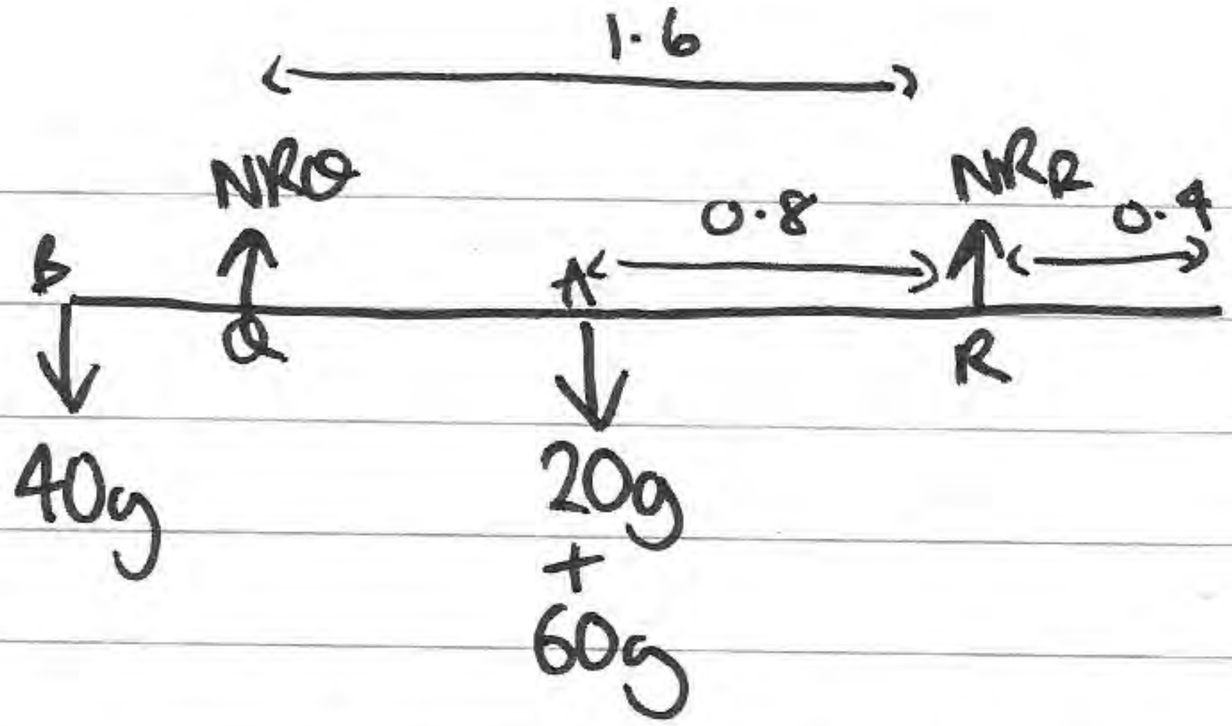
So its motion will be reversed.

c) $u = \frac{7}{3}$ $V_B = u\left(3\left(\frac{7}{3}\right) - 4\right) = 3u$

Mom B before $= m(-4u) = -4mu$

Mom B after $= m(3u) = 3mu$ $\Rightarrow$ Impulse $= \underline{7mu\ Ns}$

4)

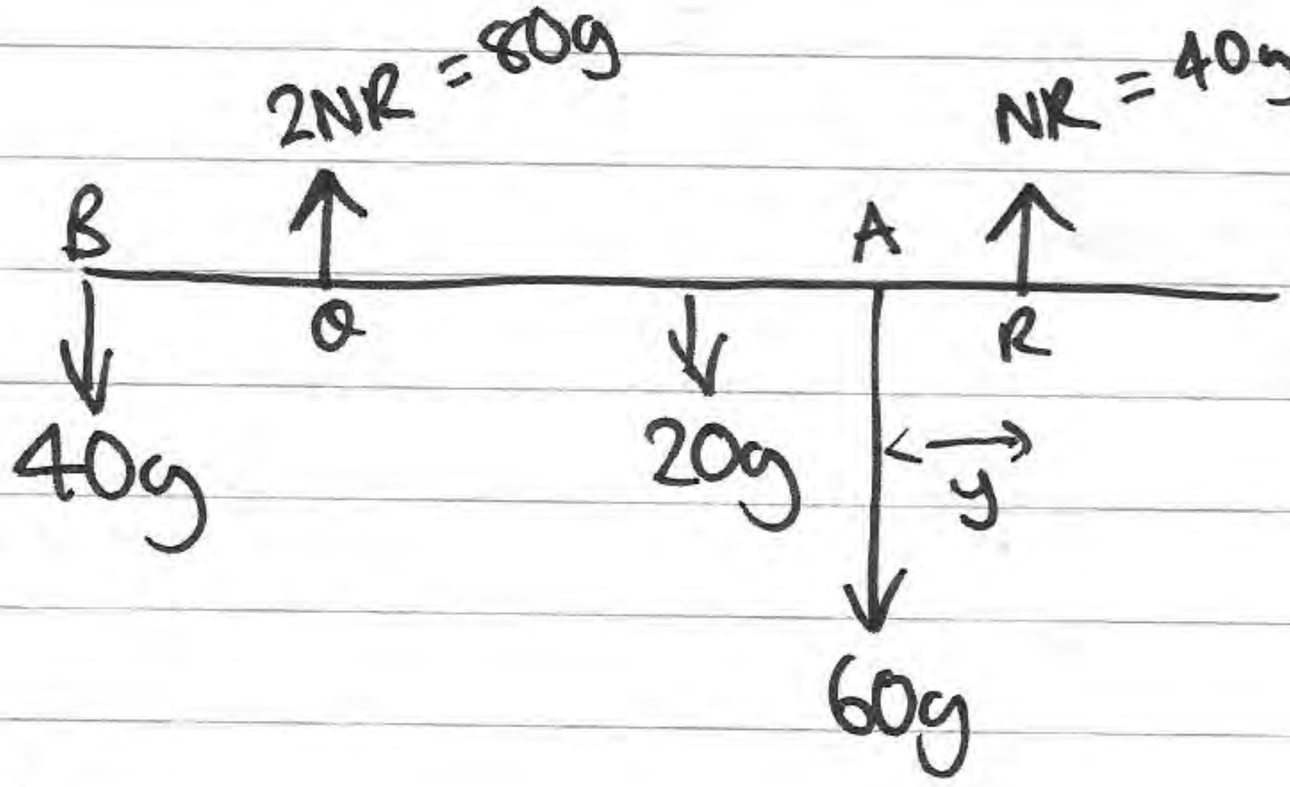


$R\curvearrowright \quad 80g \times 0.8 + 40g \times 2 = NR_Q \times 1.6$

$\Rightarrow \quad 144g = 1.6\, NR_Q \quad \Rightarrow NR_Q = \underline{90g\,N}$

$RF\uparrow = 0 \Rightarrow NR_Q + NR_P = 120g$

$NR_P = \underline{30g\,N}$



$RF\uparrow = 0 \Rightarrow 3NR = 120g$

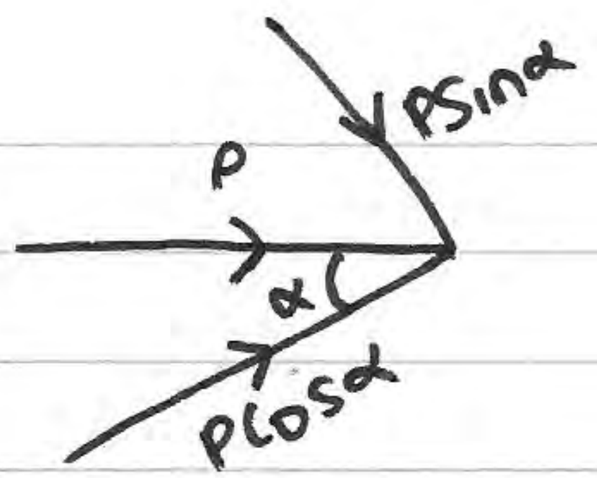
$\Rightarrow NR = 40g$

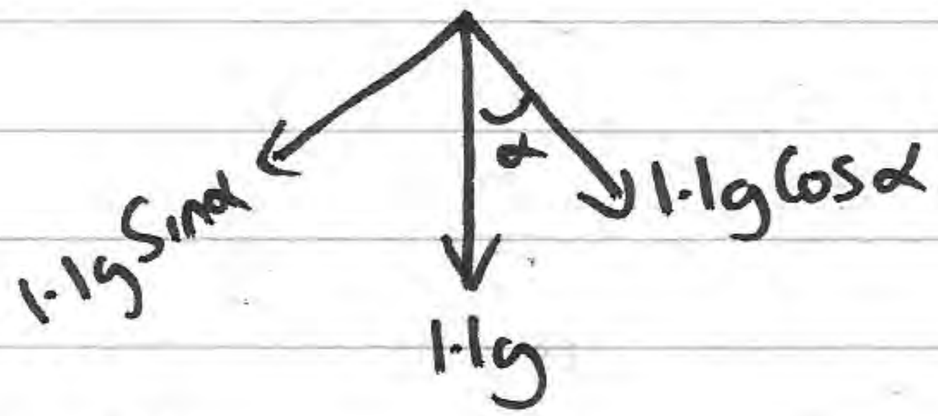
$R\curvearrowright \quad 60g \times y + 20g \times 0.8 + 40g \times 2 = 80g \times 1.6$

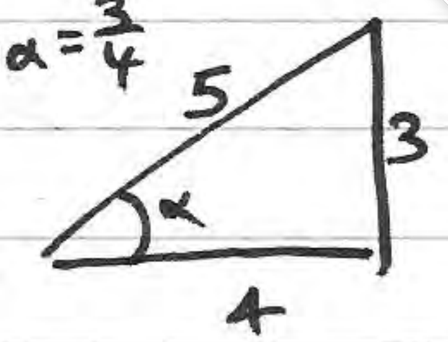
$60g\,y = 32g \qquad \bar{y} = \frac{8}{15} \Rightarrow QX = 1.6 - \frac{8}{15}$

$QX = \frac{16}{15}\,m$

5)



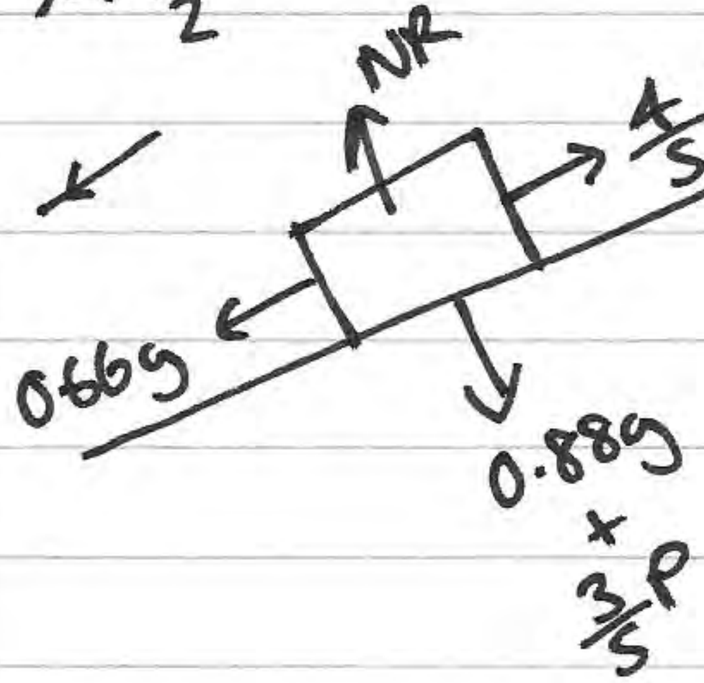




$\tan\alpha = \frac{3}{4}$

$\sin\alpha = \frac{3}{5}$ $\cos\alpha = \frac{4}{5}$

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



$\uparrow Rf = 0 \Rightarrow NR = \frac{3}{5}P + 0.88g$

$f_{max} = \mu NR \Rightarrow f_{max} = \frac{3}{10}P + 0.44g$

$\rightarrow Rf = 0 \Rightarrow \frac{4}{5}P + \frac{3}{10}P + 0.44g = 0.66g$

$\Rightarrow \frac{11}{10}P = 0.22g \Rightarrow P = \underline{0.2gN}$

$NR = \frac{3}{5}(0.2g) + 0.88g = \underline{1gN}$

6) $Rf = \begin{pmatrix} 4+p \\ -5+q \end{pmatrix} = \lambda \begin{pmatrix} 1 \\ -2 \end{pmatrix}$ ⨯ $x -2$

$(4+p)x -2 = -5+q \Rightarrow -8-2p = -5+q$

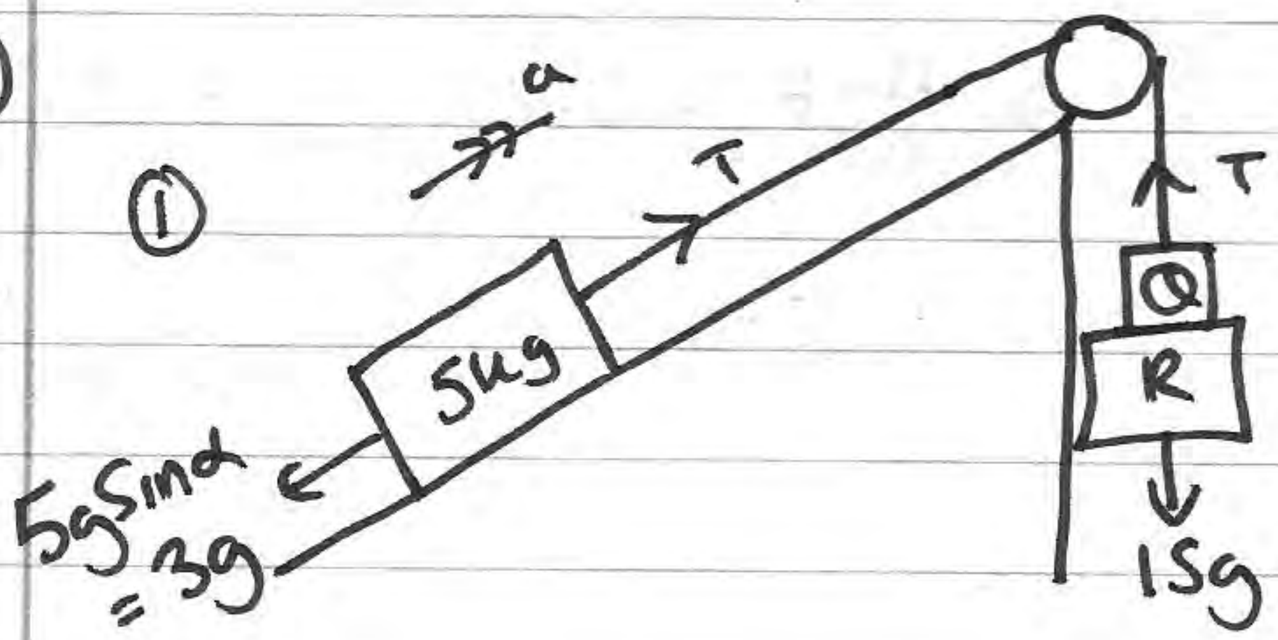
$\Rightarrow \underline{2p+q+3=0}$ #

b) $2p+1+3=0 \Rightarrow p=-2 \Rightarrow Rf = \begin{pmatrix} 4-2 \\ -5+1 \end{pmatrix} = \begin{pmatrix} 2 \\ -4 \end{pmatrix}$

$Rf = \sqrt{2^2+4^2} = \sqrt{20} = 2\sqrt{5}$

$Rf = ma \Rightarrow 2\sqrt{5} = m \times 8\sqrt{5}$ $m = \frac{2}{8} = \underline{\frac{1}{4}kg}$

(7)



① $T-3g=5a$ +

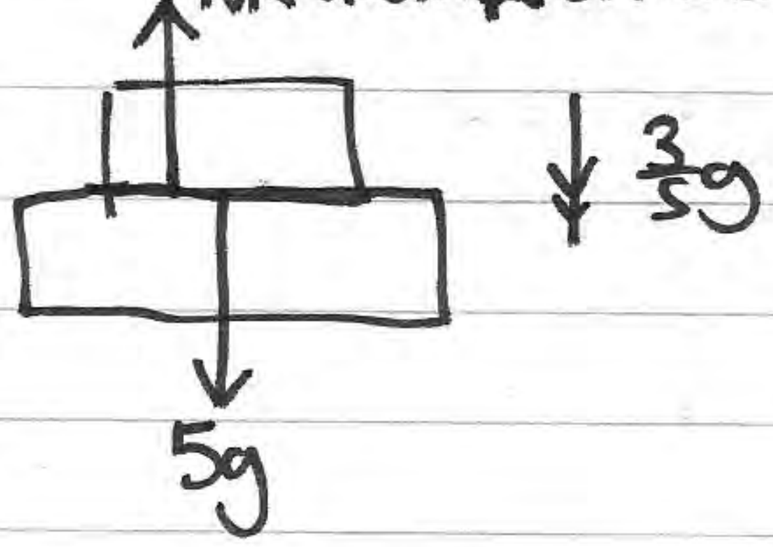
② $15g-T=15a$

$12g=20a$

$\Rightarrow a=\frac{3}{5}g\ ms^{-2}$

① $T=5(\frac{3}{5}g)+3g=6g$ N

b)

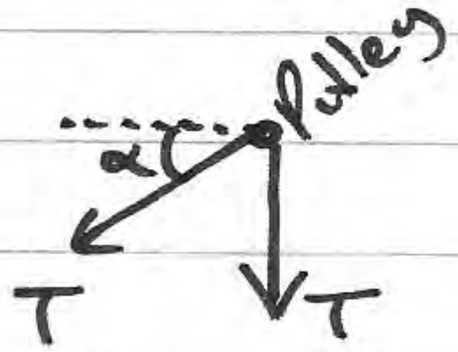


$Rf_Q\downarrow = 5g-NR = 5(\frac{3}{5}g)$

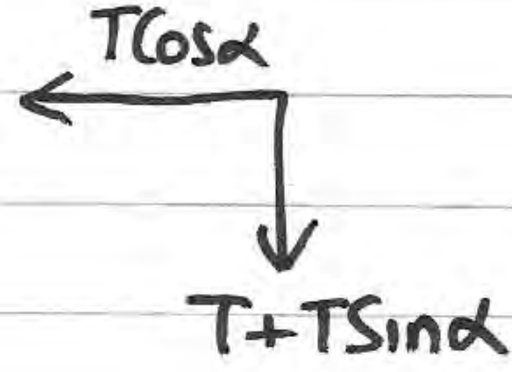
$5g-3g=NR$

$\Rightarrow NR=2g$ N

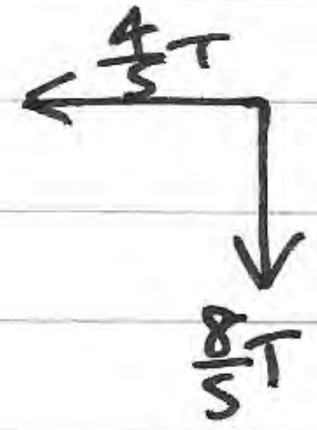
c)

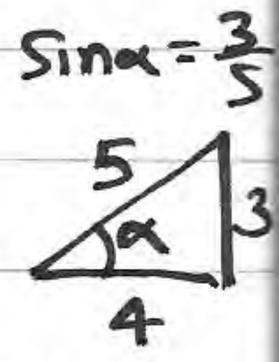


$\Rightarrow$

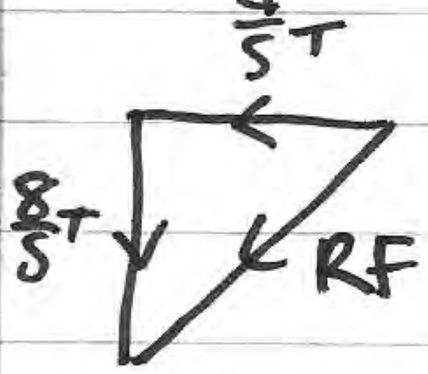


$\Rightarrow$





So Cosα=



$RF^2=(\frac{4}{5}T)^2+(\frac{8}{5}T)^2=\frac{80}{25}T^2 \Rightarrow RF=\frac{\sqrt{80}}{5}T$

$RF=\frac{4\sqrt{5}}{5}(6g)=\frac{24\sqrt{5}}{5}g$ N