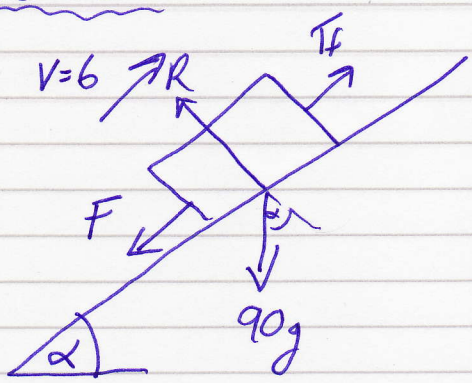
M2 - June 07

Q1



$P = 444\ W$

$P = T_F \times V$

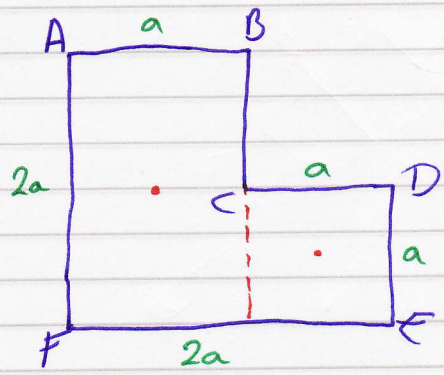
$T_F = \frac{444}{6} = 74$

NEL: $T_F - F - 90g \sin\alpha = 0$

$F = 74 - 90g \times \frac{1}{21} = 32\ N$

M2 - JUNE 07

Q3



Taking F as origin

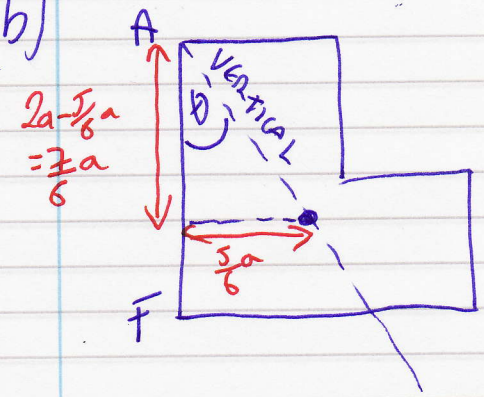
$$(2a^2 + a^2)m\begin{pmatrix}\bar{x}\\ \bar{y}\end{pmatrix} = 2am\begin{pmatrix}0.5a\\ a\end{pmatrix} + a^2m\begin{pmatrix}1.5a\\ 0.5a\end{pmatrix}$$

$$3a^2\begin{pmatrix}\bar{x}\\ \bar{y}\end{pmatrix} = \begin{pmatrix}a^3\\ 2a^3\end{pmatrix} + \begin{pmatrix}1.5a^3\\ 0.5a^3\end{pmatrix}$$

$$3a^2\begin{pmatrix}\bar{x}\\ \bar{y}\end{pmatrix} = \begin{pmatrix}2.5a^3\\ 2.5a^3\end{pmatrix}$$

$$\begin{pmatrix}\bar{x}\\ \bar{y}\end{pmatrix} = \begin{pmatrix}\frac{5}{6}a\\ \frac{5}{6}a\end{pmatrix}$$ (only $\bar{x}$ required)

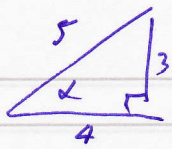
(b)



$$\tan\theta = \frac{\frac{5}{6}a}{\frac{7}{6}a} = \frac{5}{7}$$

$$\theta = 35.5^\circ$$

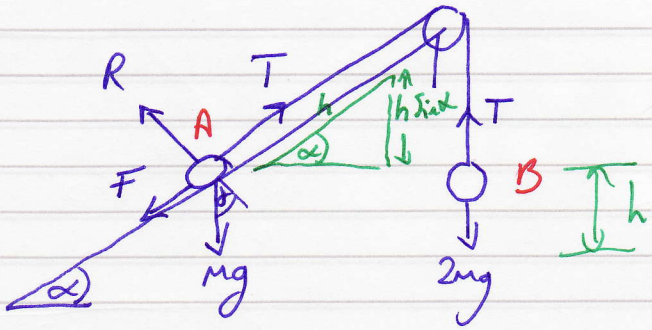
M2 – June 07



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

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

Q4



(a) Particle A gains PE $= mgh\sin\alpha = \frac{3}{5}mgh$

Particle B loses PE $= -2mgh$

$\therefore$ Net change in PE $= \frac{3}{5}mgh - 2mgh = -\frac{7}{5}mgh$

ie PE lost by system $= \frac{7}{5}mgh$

(b) Loss in PE = Gain in KE + wd v's resistance

$$\frac{7}{5}mgh = \frac{1}{2}mv^2 + \frac{1}{2}2mv^2 + F\times h \qquad \text{— (1)}$$

Now $F = \mu R$

And $R - mg\cos\alpha = 0 \quad R = mg\times\frac{4}{5}$

$\therefore F = \frac{5}{8}\times\frac{4}{5}mg = \frac{1}{2}mg$

in (1) $\frac{7}{5}mgh = \frac{3}{2}mv^2 + \frac{1}{2}mgh$

$\frac{3}{2}v^2 = \frac{7}{5}gh - \frac{1}{2}gh$

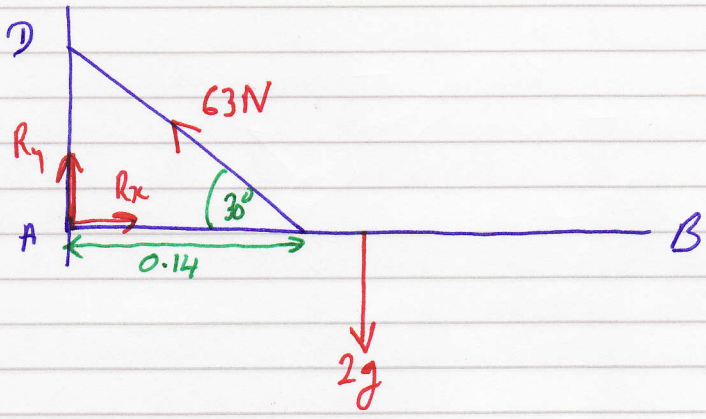
$\frac{3}{2}v^2 = \frac{9}{10}gh$

$v^2 = \frac{9}{10}gh\times\frac{2}{3} = \frac{3}{5}gh$

M2 - June 07

Let length AB = l

Q5



(a) ΣG_A: $0.14 \times 63 \sin 30 - \frac{1}{2} l \times 2g = 0$

$lg = 4.41$

$l = \frac{4.41}{9.8} = 0.45$ metres

(b) $R_y + 63 \sin 30 - 2g = 0$

$R_y = 19.6 - 31.5$

$R_y = -11.9$

$R_x - 63 \cos 30 = 0$

$R_x = \frac{63\sqrt{3}}{2}$

Now $R = \sqrt{\left(\frac{63\sqrt{3}}{2}\right)^2 + (-11.9)^2} = 55.8$ N