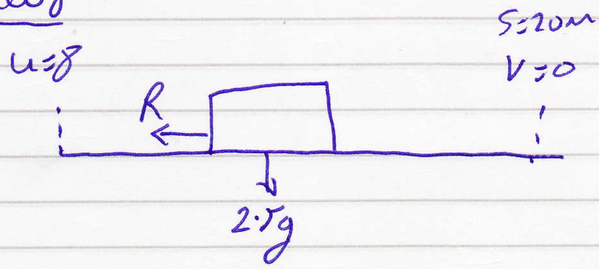
M2 - Jan 2008

Q1



(a) KE lost $= \frac{1}{2} \times 2.5 \times 8^2 = 80$ joules

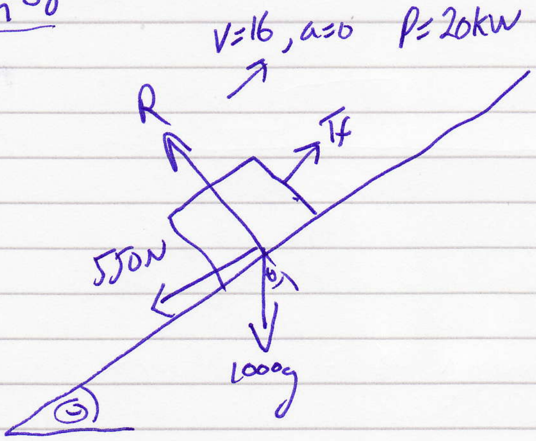
(b) KE lost = wd v's resistance

$80 = R \times 20$

$R = 4$ N.

M2 - January 08

Q3



(a) $P = T_f \times V$

$20000 = T_f \times 16$

$T_f = \frac{20000}{16} = 1250\,N$

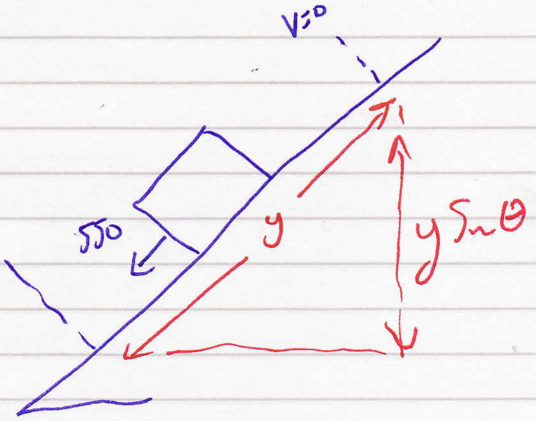
N2L $T_f - 550 - 1000g\sin\theta = 0$

$1250 - 550 = 1000g\sin\theta$

$700 = 9800\sin\theta$

$\sin\theta = \frac{700}{9800} = \frac{1}{14}$ As required

(b)



Using work-energy: Loss in KE = gain in PE + wd v's res

$\frac{1}{2} \times 1000 \times 16^2 = 1000g\,y\sin\theta + 550 \times y$

$128000 = 700y + 550y$

$y = 102.4$ metres

* You could have answered this using N2L and UVAST *

M2 – January 08

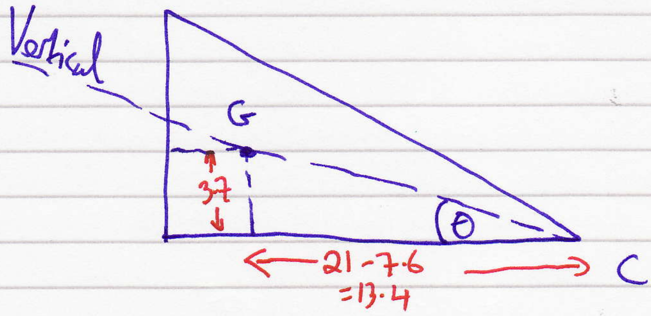
4 (a) Taking B as origin

$$\left(\frac{1}{2}\times21\times12 - \pi\times3^2\right)\cancel{M}\begin{pmatrix}\bar{x}\\ \bar{y}\end{pmatrix} = \frac{1}{2}\times21\times12\begin{pmatrix}7\\ 4\end{pmatrix}\cancel{M} - \pi\times3^2\times\cancel{M}\begin{pmatrix}5\\ 5\end{pmatrix}$$

$$(126-9\pi)\begin{pmatrix}\bar{x}\\ \bar{y}\end{pmatrix} = \begin{pmatrix}882\\ 504\end{pmatrix} - \begin{pmatrix}45\pi\\ 45\pi\end{pmatrix}$$

$$\begin{pmatrix}\bar{x}\\ \bar{y}\end{pmatrix} = \begin{pmatrix}7.6\\ 3.7\end{pmatrix}$$

(b)



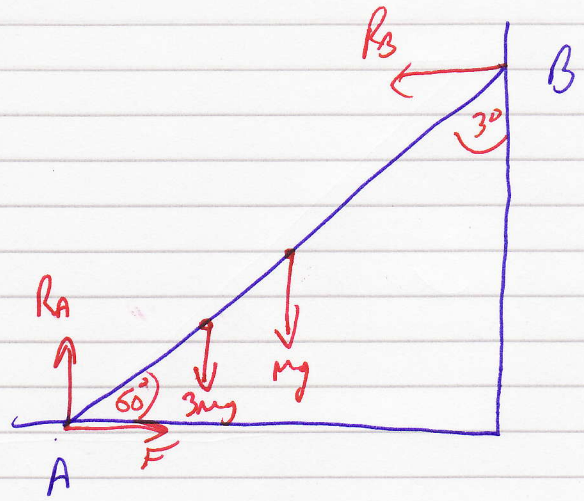
$$\tan\theta = \frac{3.7}{13.4}$$

$$\theta = 15.4^\circ$$

$= 15^\circ$ to nearest degree

M2 - January 2008

Q5



ΣG_A: $R_B \sin 60 \times 4a - mg\cos 60 \times 2a - 3mg\cos 60 \times a = 0$

$2\sqrt{3}R_B = mg + \frac{3mg}{2}$

$2\sqrt{3}R_B = \frac{5}{2}mg$

$R_B = \frac{5mg}{4\sqrt{3}}$

In limiting equilibrium ∴ $F = \mu R_A$

ΣF_y: $R_A = 4mg$

ΣF_x: $F - R_B = 0$ ∴ $F = \frac{5mg}{4\sqrt{3}}$

Now $F = \mu R_A$

$\frac{5mg}{4\sqrt{3}} = \mu\, 4mg$

$\mu = \frac{5}{16\sqrt{3}}$