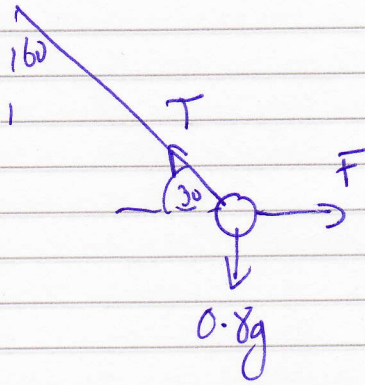


M3 - January 06

(1)



$$\sum F_y = 0 \quad T \sin 30 - 0.8g = 0$$

$$\frac{T}{2} = 0.8g$$

$$T = 1.6g$$

$$\sum F_x = 0 \quad F - T \cos 30 = 0$$

$$F = 1.6g \times \frac{\sqrt{3}}{2} = 13.6 \text{ N}$$

$$(b) \text{ Hooke's Law } T = \frac{\lambda x}{l}$$

$$1.6g = \frac{24x}{1.2}$$

$$x = 0.78 \text{ m}$$

$$(c) \text{ Elasticity} = \text{Elastic Potential Energy} = \frac{\lambda x^2}{2l} = \frac{24(0.78)^2}{2 \times 1.2} = 6.1 \text{ Joules}$$

M3 - January 06

Q1(a) $a = 2 \sin \frac{1}{2}t$

$$V = \int 2 \sin \frac{1}{2}t \, dt$$

$$V = -4 \cos \frac{1}{2}t + c$$

when $t=0, V=4$

$$4 = -4 + c$$

$$c = 8$$

$$\therefore V = 8 - 4 \cos \frac{1}{2}t$$

(b) $S = \int V \, dt$

$$S = \int_0^{\frac{\pi}{2}} 8 - 4 \cos \frac{1}{2}t \, dt$$

$$S = \left[8t - 8 \sin \frac{1}{2}t \right]_0^{\frac{\pi}{2}}$$

$$S = \left[4\pi - 8 \sin \frac{\pi}{4} \right] - 0$$

$$= 4\pi - 8 \frac{\sqrt{2}}{2}$$

$$= 4\pi - 4\sqrt{2}$$

$$= 4(\pi - \sqrt{2})$$

M3 - JANUARY 2006

$$\text{Q4(a)} \quad (3M + 2M)\bar{y} = 3M\left(\frac{1}{2}h\right) + 2M\left(h + \frac{3}{8}r\right)$$

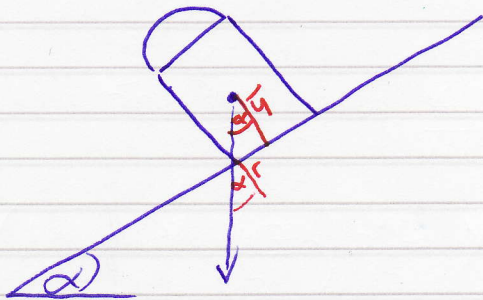
$$5\bar{y} = \frac{3}{2}h + 2h + \frac{3}{4}r$$

$$5\bar{y} = \frac{7h}{2} + \frac{3}{4}r$$

$$5\bar{y} = \frac{14h + 3r}{4}$$

$$\bar{y} = \frac{14h + 3r}{20} \quad \text{As required.}$$

(b)



$$\tan \alpha = \frac{r}{\bar{y}}$$

$$\frac{4}{3} = \frac{r}{\bar{y}}$$

$$\bar{y} = \frac{3r}{4}$$

$$\frac{14h + 3r}{20} = \frac{3r}{4}$$

$$14h + 3r = \frac{3r}{4} \times 20$$

$$14h + 3r = 15r$$

$$14h = 12r$$

$$h = \frac{12r}{14} = \frac{6r}{7}$$