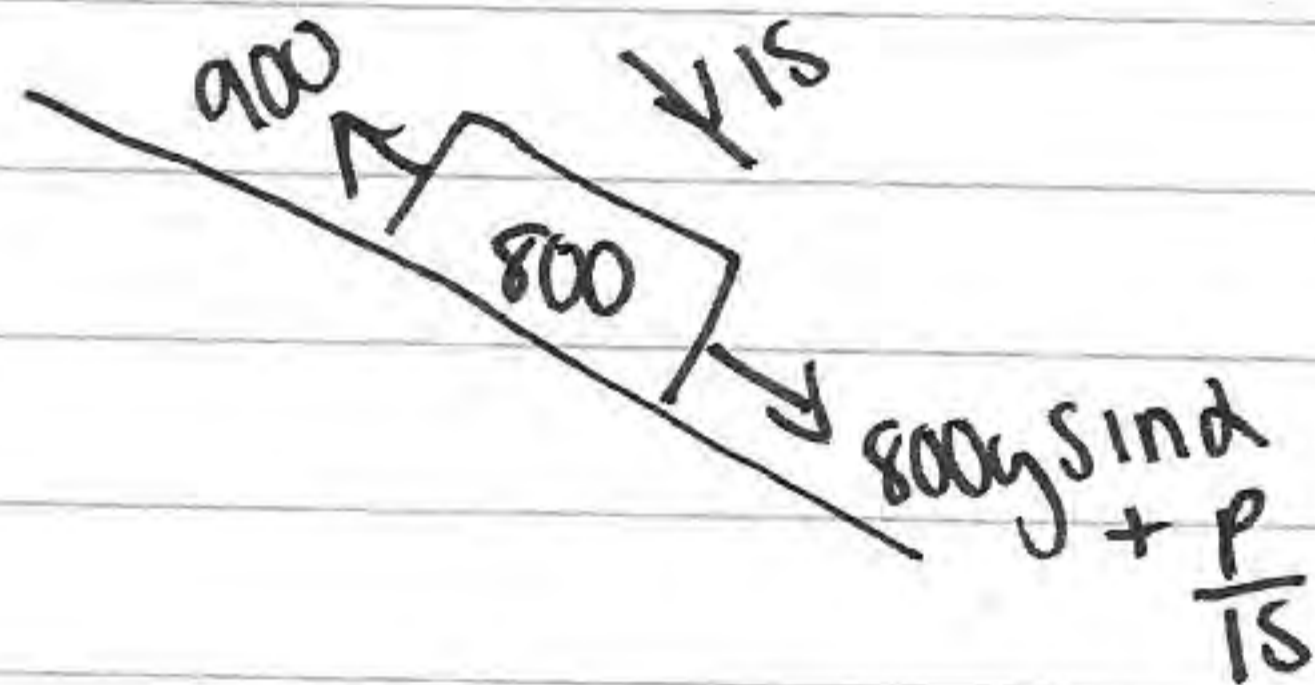


M2 JAN 07

1) Wd against friction = KE lost =  $\frac{1}{2}m(v^2 - u^2) = \frac{1}{2}(0.8)(15^2 - 10^2) = 5$

b)  $f_{\max} = \mu NR = \mu 0.8g \Rightarrow \mu 0.8g \times 20 = 50 \Rightarrow \mu = \frac{25}{8g} = \frac{0.25}{(2.5)}$

2)



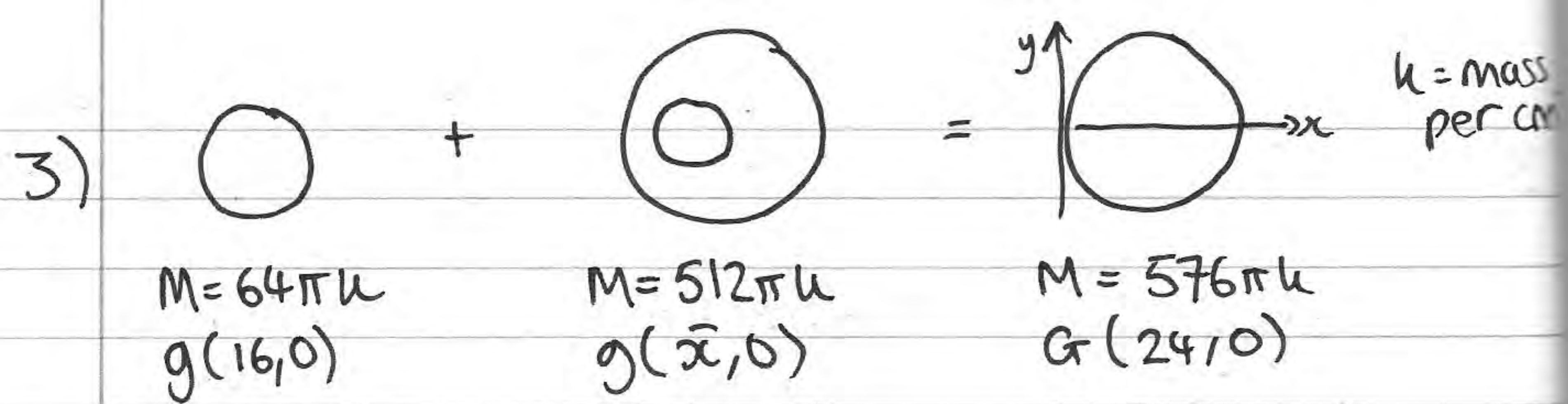
$$\frac{800g}{24} + \frac{P}{15} = 900$$

$$\Rightarrow \frac{P}{15} = \frac{1720}{3} \Rightarrow P = 8600 \text{ W}$$

$$\Rightarrow P = \underline{8.6 \text{ kW}}$$

$$Rf \downarrow = ma \Rightarrow \frac{800g}{24} - 900 = 800a \Rightarrow a = -\frac{43}{60}$$

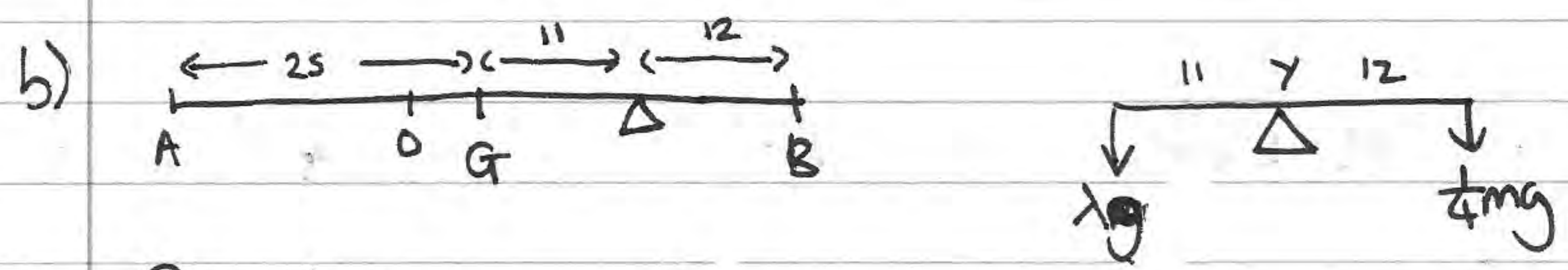
$$u = 15, a = -\frac{43}{60}, v = 0 \quad 0 = 15 - \frac{43}{60}t \Rightarrow t = \underline{20.9 \text{ sec (3sf)}}$$



$\uparrow y$   
 $\downarrow x$

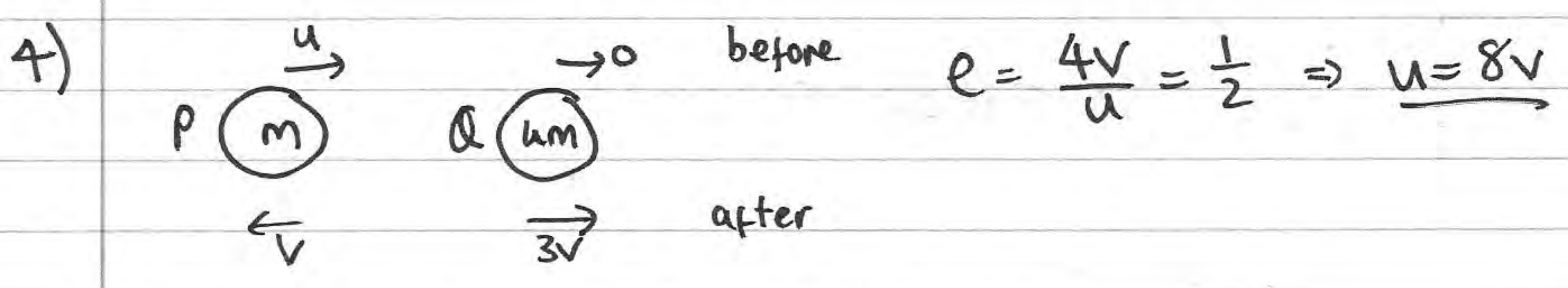
$$64\pi k g \times 16 + 512\pi k g \times \bar{x} = 576\pi k g \times 24 \Rightarrow \bar{x} = \frac{12800}{512}$$

$$\bar{x} = 25 \text{ cm}$$

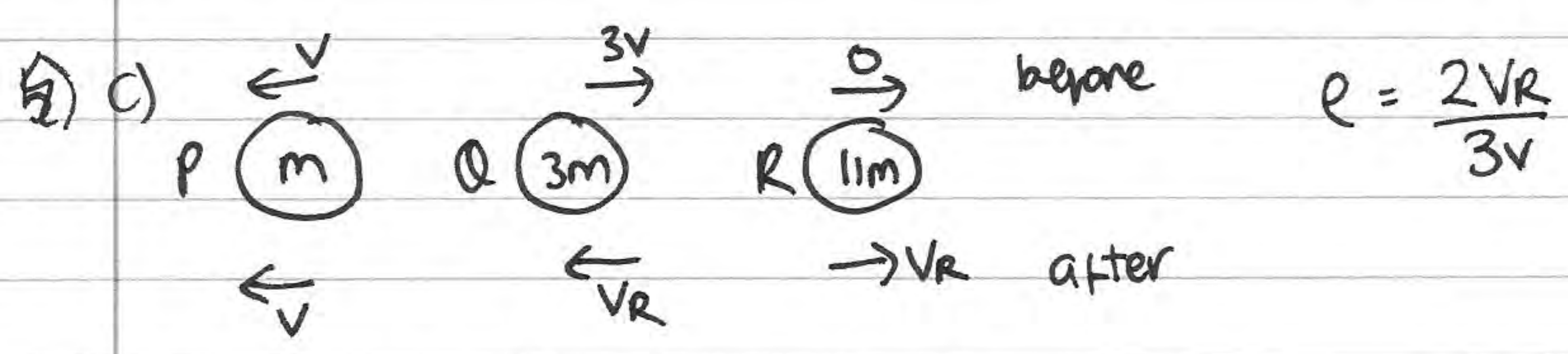


$\curvearrowright$

$$\frac{1}{4}mg \times 12 = \lambda g \times 11 \Rightarrow 3m = 11\lambda \Rightarrow \lambda = \frac{3}{11}m$$



b) CLM  $\Rightarrow mu = -mv + km3v$   
 $\Rightarrow 8mv = -mv + 3kmv$   
 $\Rightarrow 9mv = 3kmv \Rightarrow \underline{u = 3}$

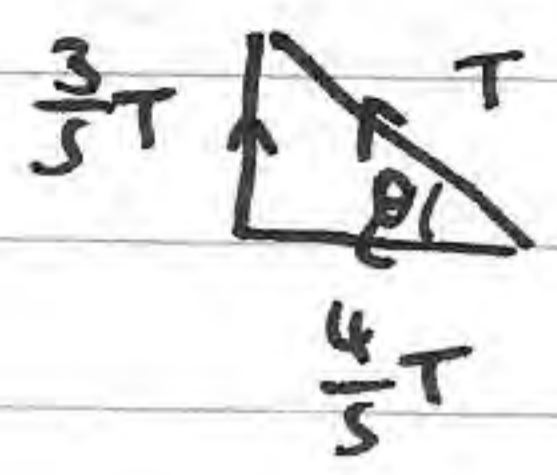
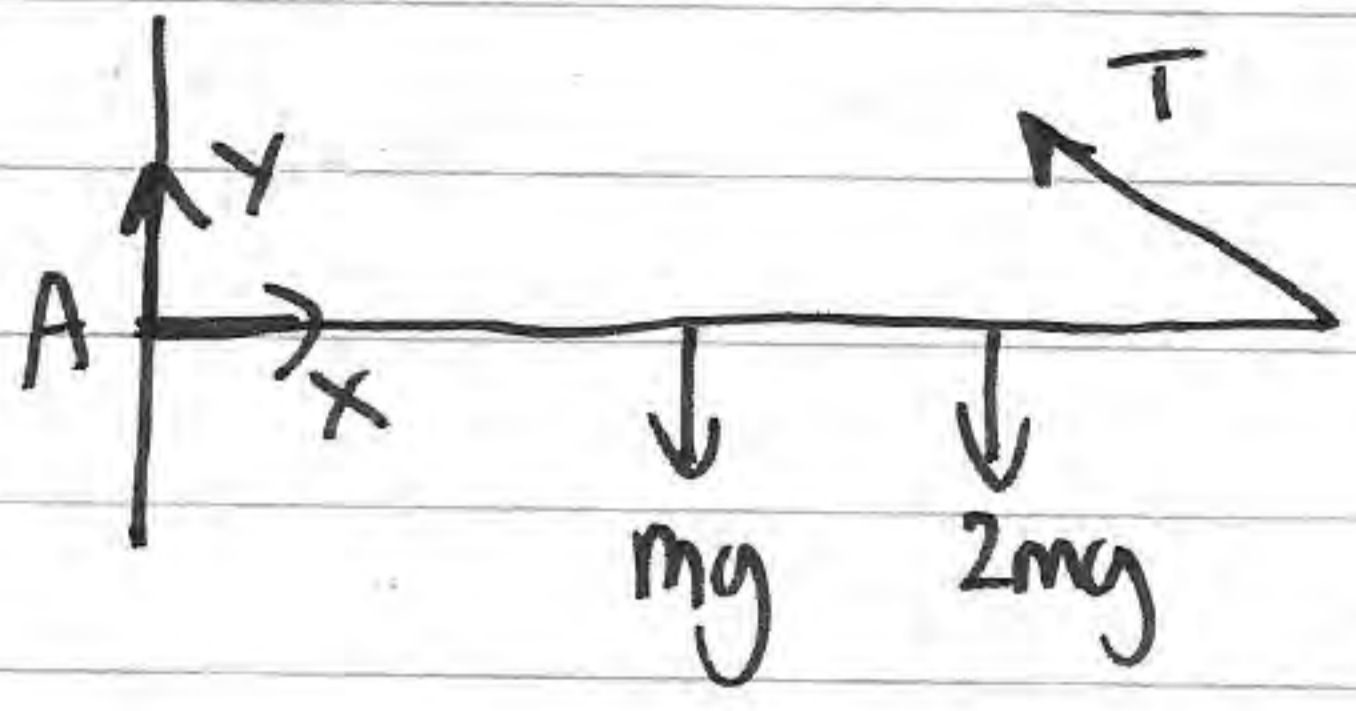
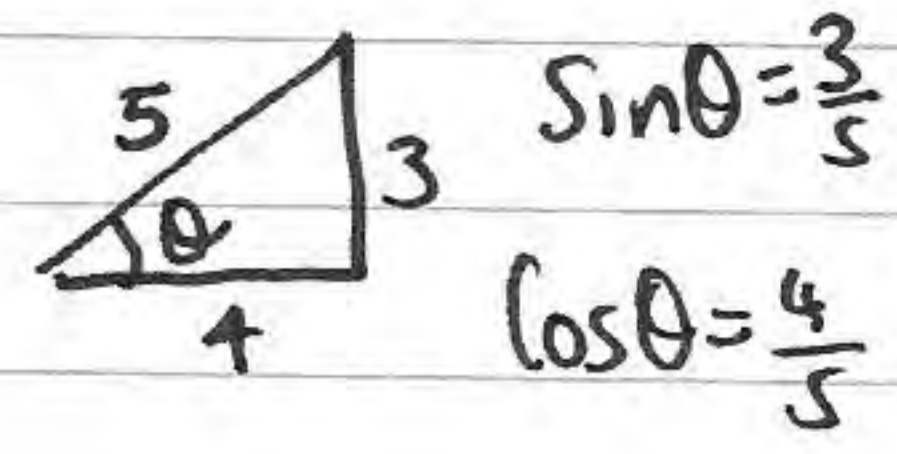


CLM<sub>QR</sub>  $\Rightarrow 9mv = -3mv_R + 11mv_R$   
 $\Rightarrow 9mv = 8mv_R$   
 $\Rightarrow v_R = \frac{9}{8}v \Rightarrow e = \frac{2(\frac{9}{8}v)}{3v} = \frac{18}{24}$

d) Since  $v_R > v$   $\frac{9}{8}v > v$   $\Rightarrow e = \frac{3}{4} \neq$   
 Q will collide into P.

5)

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



$$R_f \uparrow = 0 \quad \frac{3}{5}T + Y = 3mg \quad R_f = 0 \Rightarrow X = \frac{4}{5}T$$

$$A \curvearrowright mg \times 2x + 2mg \times 3x = \frac{3}{5}T \times 4x \Rightarrow 8mg = \frac{12}{5}T$$

$$\Rightarrow T = \frac{40}{12}mg \Rightarrow T = \frac{10}{3}mg \text{ N}$$

$$b) X = \frac{4}{5}T = \frac{4}{5} \left( \frac{10}{3}mg \right) = \frac{40}{15}mg = \frac{8}{3}mg \text{ N} \neq$$

$$c) Y = f_{\max} = \mu X = \mu \frac{8}{3}mg \quad Y = 3mg - \frac{3}{5} \left( \frac{10}{3}mg \right) = mg$$

$$1mg = \mu \frac{8}{3}mg \Rightarrow \mu = \frac{3}{8}$$

$$6) F = (1.5t^2 - 3)i + (2t)j \quad F = ma \Rightarrow a = (3t^2 - 6)i + (4t)j$$

$$b) v = \int a dt = (t^3 - 6t + C_1)i + (2t^2 + C_2)j$$

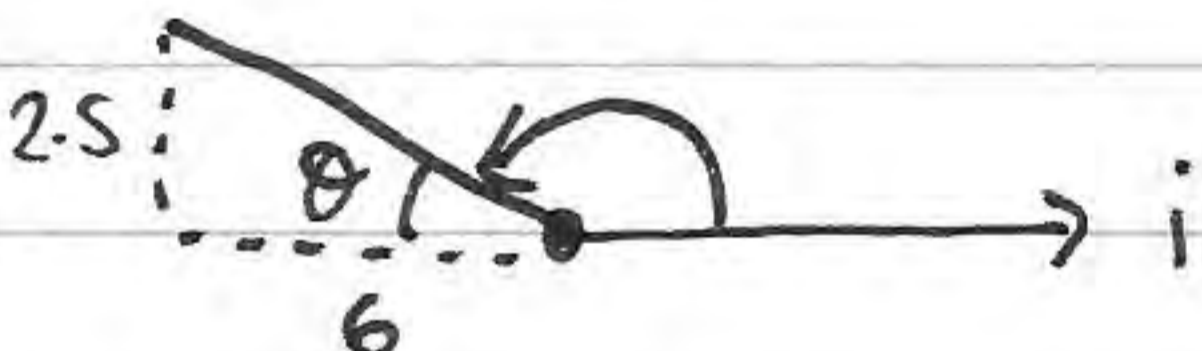
$$t=2 \quad -4i + 5j = (-4 + C_1)i + (8 + C_2)j \Rightarrow C_1 = 0; C_2 = -3$$

$$V = (t^3 - 6t)i + (2t^2 - 3)j; \quad \text{when } t=3 \quad V = (27 - 18)i + (18 - 3)j \\ V = 9i + 15j \quad \#$$

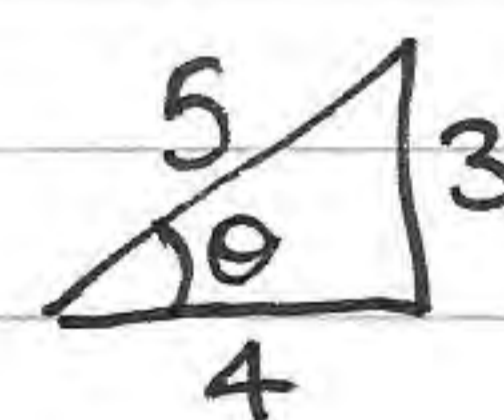
c) Momentum before =  $4.5i + 7.5j \Rightarrow$  Impulse =  $-6i + 2.5j$   
 Momentum after =  $-1.5i + 10j$

$$|Q| = \sqrt{6^2 + 2.5^2} = \underline{6.5 \text{ N s}}$$

d)  $= 180 - \tan^{-1}\left(\frac{2.5}{6}\right) = \underline{157.4^\circ}$



7) Gain in KE = loss in PE  
 $\frac{1}{2}m(24.5^2 - u^2) = mg \times 15$

$$\cos \theta = \frac{4}{5} \Rightarrow \sin \theta = \frac{3}{5}$$


$$\Rightarrow u^2 = 24.5^2 - 30g \Rightarrow u = \underline{17.5 \text{ ms}^{-1}} \quad \#$$

b)  $\vec{u} = 17.5 \cos \theta = 14$

(V↑)

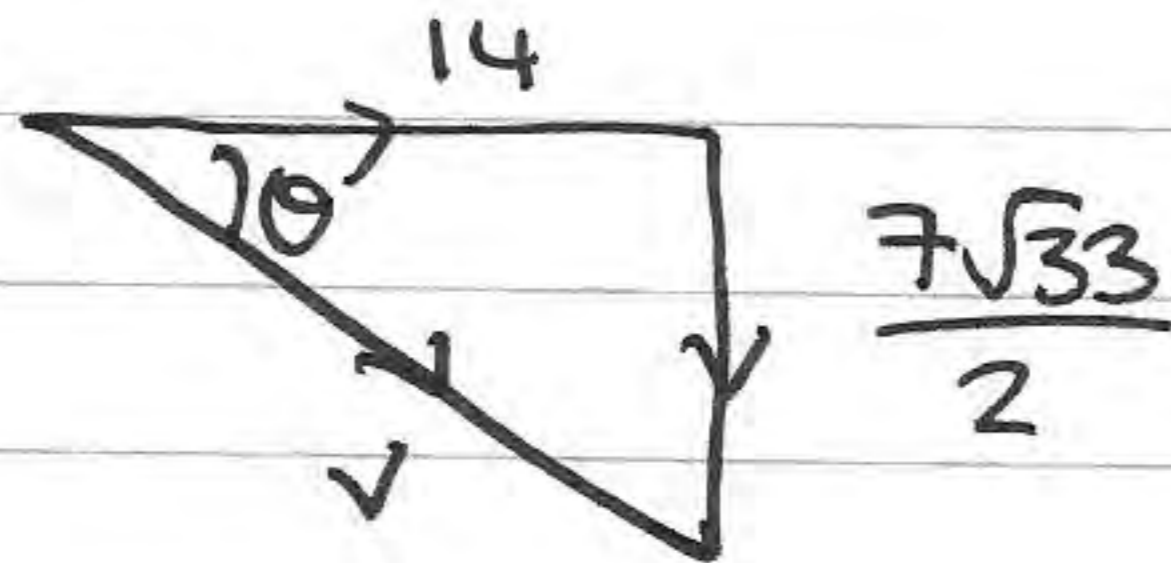
$$u = 17.5 \sin \theta = 10.5$$

$$a = -9.8$$

$$s = -15$$

$$v^2 = 10.5^2 + -19.6x - 15$$

$$v \downarrow = \frac{7\sqrt{33}}{2}$$



$$\theta = \tan^{-1} \left( \frac{\frac{7\sqrt{33}}{2}}{14} \right)$$

$$\theta = 55 \cdot 2^\circ \text{ (2sf) below H.}$$

c)  $u = 10.5$

$$a = -9.8$$

$$s = -45$$

$$-45 = 10.5t - 4.9t^2 \Rightarrow 4.9t^2 - 10.5t - 45 = 0$$

$$\Rightarrow t = \frac{30}{7}$$

(H)

$$u = 14 \quad t = \frac{30}{7}$$

$$BD = 14 \times \frac{30}{7} = \underline{60m}$$