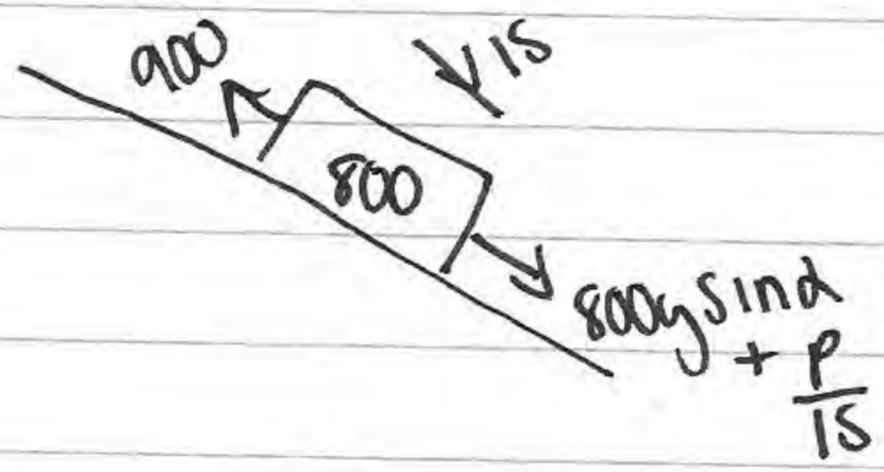
M2 JAN 07

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

b) $f_{max} = \mu NR = \mu 0.8g \Rightarrow \mu 0.8g \times 20 = 50 \Rightarrow \mu = \frac{25}{8g} = \frac{0}{(25}$

2)



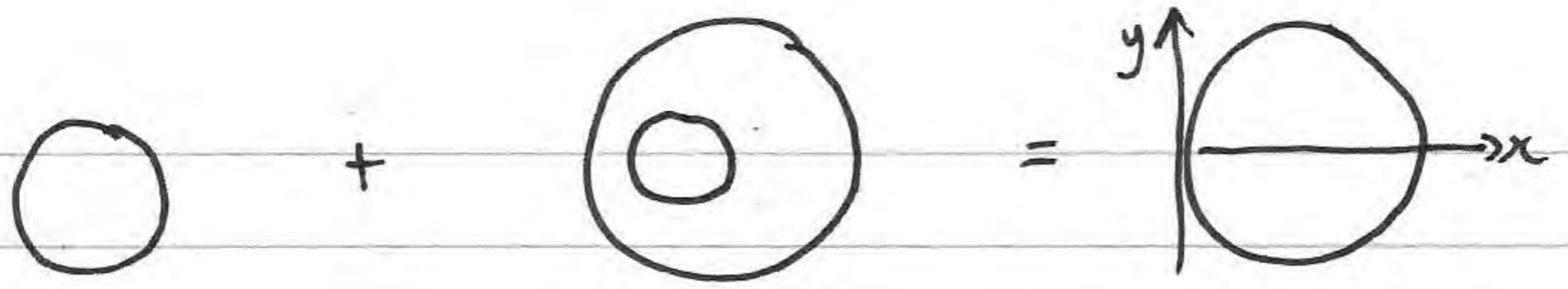
$\frac{800g}{24} + \frac{P}{15} = 900$

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

$\Rightarrow P = 8.6kW$

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

$u = 15, a = -\frac{43}{60}, v = 0 \quad 0 = 15 - \frac{43}{60}t \Rightarrow t = 20.9 sec (35s$

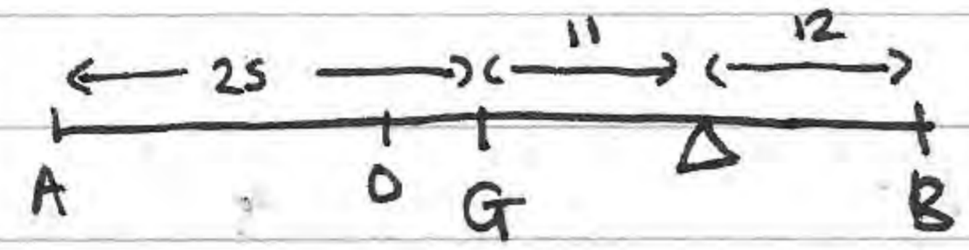
3) 

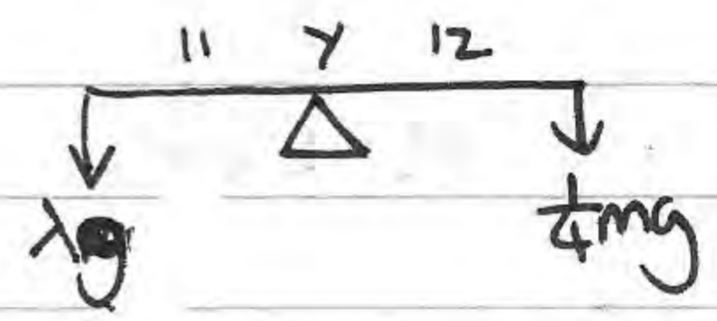
μ = mas
per ar

$M = 64\pi\mu$ $g(16,0)$ + $M = 512\pi\mu$ $g(\bar{x},0)$ = $M = 576\pi\mu$ $G(24,0)$

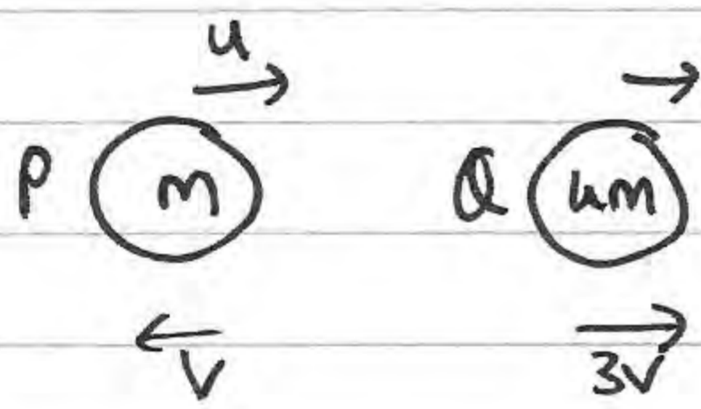
$\uparrow\downarrow y$ $64\pi\mu g \times 16 + 512\pi\mu g \times \bar{x} = 576\pi\mu g \times 24 \Rightarrow \bar{x} = \frac{12800}{512}$

$\bar{x} = 25cm$

b) 



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

4) 

before

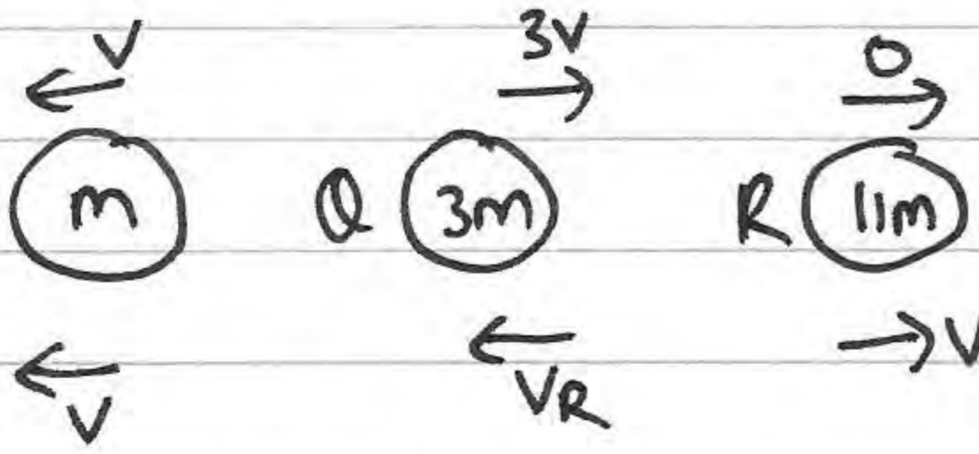
after

$e = \frac{4V}{u} = \frac{1}{2} \Rightarrow u = 8V$

b) CLM $\Rightarrow mu = -mV + 4m3V$

$\Rightarrow 8mV = -mV + 3u mV$

$\Rightarrow 9mV = 3u mV$ $\Rightarrow u = 3$

5) c) 

before

after

$e = \frac{2V_R}{3V}$

CLM@R $\Rightarrow 9mV = -3mV_R + 11mV_R$

$\Rightarrow 9mV = 8mV_R$

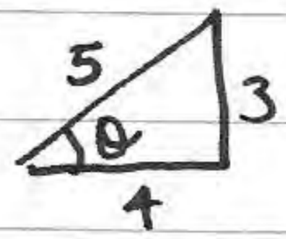
$\Rightarrow V_R = \frac{9}{8}V$ $\Rightarrow e = \frac{2(\frac{9}{8}V)}{3V} = \frac{18}{24}$

d) Since $V_R > V$ (both $\leftarrow$) $\frac{9}{8}V > V$ $\Rightarrow e = \frac{3}{4}$ #

Q will collide into P.

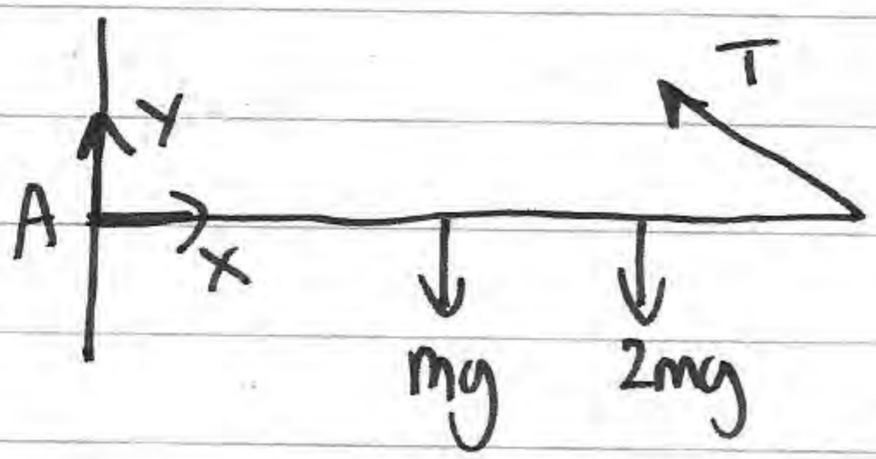
5)

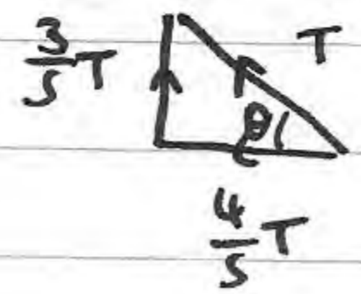
$\tan\theta = \frac{3}{4}$



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

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





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

$A\circlearrowleft \quad mg \times 2a + 2mg \times 3a = \frac{3}{5}T \times 4a \Rightarrow 8mg = \frac{12}{5}T$

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

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

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

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

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

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

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

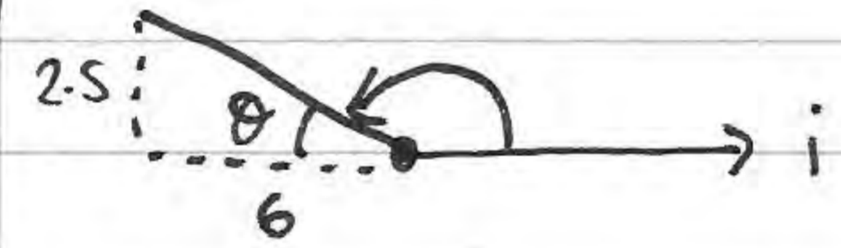
$V = (t^3-6t)i + (2t^2-3)j$; when $t=3$ $V = (27-18)i + (18-3)$

$V = 9i+15j$ ##

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

$|Q| = \sqrt{6^2+2.5^2} = \underline{6.5\ Ns}$

d)



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

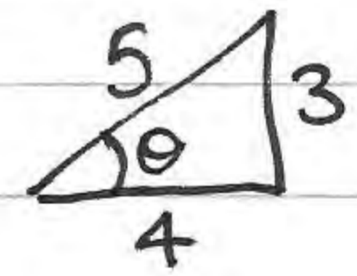
7) Gain in KE = loss in PE

$\frac{1}{2}m(24.5^2-u^2) = mgx\ 15$

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

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

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



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

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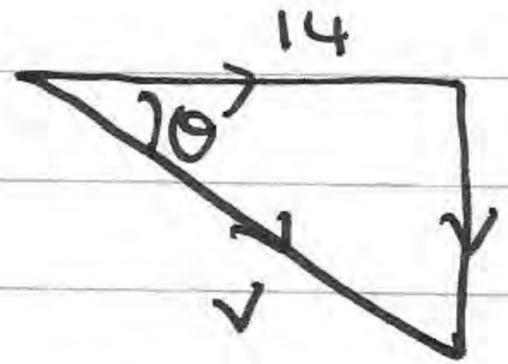
(V↑) $u = 17.5\sin\theta = 10.5$

$a = -9.8$

$s = -15$

$V^2 = 10.5^2 + -19.6\times -15$

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



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

$\theta = 55.2°$ (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) $u = 14$ $t = \frac{30}{7}$ $BD = 14 \times \frac{30}{7} = \underline{60m}$