07 May 2011
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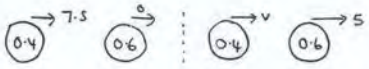
*M1 JUNE 05

(1)

1) momentum before = 0 ⇒ Impulse = 3Ns !
momentum after = 3Ns

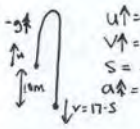
$0.4v = 3 \Rightarrow v = \frac{3}{0.4} = 7.5\,ms^{-1}$

b)



Total momentum before = 3Ns
Total momentum after = $0.4v + 0.6 \times 5$ ⇒ $3 = 3 + 0.4v$
$0.4v = 0 \Rightarrow v = 0$

2)



$u\uparrow = u$, $v\uparrow = -17.5$, $s = -10$, $a\downarrow = -9.8$

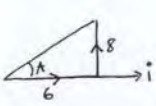
$v^2 = u^2 + 2as$

$(-17.5)^2 = u^2 - 19.6 \times -10$

$u^2 = 110.25 \Rightarrow u = 10.5\,ms^{-1}\uparrow$

b) $v = u + at$ $\quad -17.5 = 10.5 - 9.8t \Rightarrow t = \frac{-28}{-9.8} = 2.86s$

3)



$A = \tan^{-1}\left(\frac{8}{6}\right) = 53.1°$

b) $Rf = ma \Rightarrow f = 0.4(6i + 8j) = 2.4i + 3.2j$

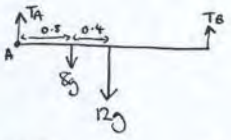
$|F| = \sqrt{2.4^2 + 3.2^2} = 4N$

c) V = original vel + t(acc)

$V = (9i - 10j) + 5(6i + 8j) = (39i + 30j)\,ms^{-1}$

(3)

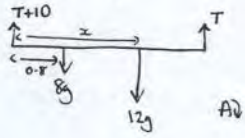
6)



A↓ $8g \times 0.8 + 12g \times 1.2 = T_B \times 2.4$

$T_B = \frac{20.8g}{2.4} = \frac{26}{3}g = 84.9N$

b)



$Rf\uparrow = 0 \Rightarrow 2T + 10 = 20g$

$2T = 186$

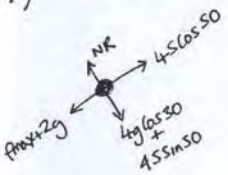
$T = 93N$

A↓ $0.8 \times 8g + 12gx = 93 \times 2.4$

$12gx = 160.48$

$x = 1.36m$

7)



$NR = 4g\cos30 + 4.5\sin50$

$NR = 68.4N$

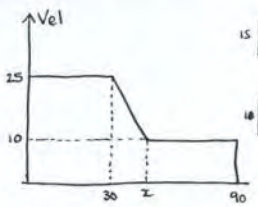
$f_{max} = \mu NR = 68.4\mu$.

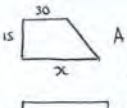
$Rf\nearrow = 0 \Rightarrow 68.4\mu + 2g = 4.5\cos50 \Rightarrow 68.4\mu = 9.325$

$\mu = 0.136$

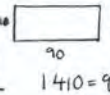
(2)

4)





$A = \frac{(30+x)\times 15}{2} = 225 + 7.5x$



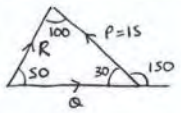
$A = 900m$

$1410 = 900 + 225 + 7.5x$

$\Rightarrow 7.5x = 285 \Rightarrow x = 38s$

gradient $= \frac{-15}{8} = -1.875 \Rightarrow$ dec $= 1.875\,ms^{-2}$

5)

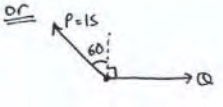


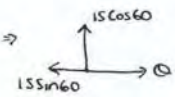
$\frac{R}{\sin30} = \frac{15}{\sin50} \Rightarrow R = \frac{7.5}{\sin50}$

$R = 9.79N$

b) $\frac{Q}{\sin100} = \frac{15}{\sin50} \Rightarrow Q = 19.3N$

or





$\Rightarrow R\sin50 = 15\cos60 \Rightarrow R = 9.79N$

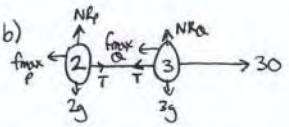
$R\cos50 = Q - 15\sin60 \Rightarrow Q = 19.3N$

(4)

8) $u = 0$ $t = 3$ $s = 6$

$s = ut + \frac{1}{2}at^2 \Rightarrow 6 = 0 + \frac{1}{2}(a)3^2 \Rightarrow a = \frac{4}{3}\,ms^{-2}$

b)



$N_{RQ} = 3g$ $\quad N_{RP} = 2g$

$f_{max\,Q} = 3g\mu$

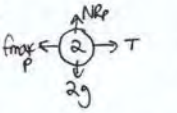
$f_{max\,P} = 2g\mu$

whole system $Rf = ma$

$30 - f_{max\,Q} - f_{max\,P} = (3+2) \times \frac{4}{3}$ (T cancels in the u system)

$30 - 5g\mu = \frac{20}{3} \Rightarrow 5g\mu = \frac{70}{3} \Rightarrow \mu = \frac{70}{15g} = \frac{10}{21} = 0$

c)



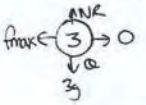
$T - f_{max\,P} = ma$

$T - 2g \times \frac{10}{21} = 2 \times \frac{4}{3} \Rightarrow T = 12N$

d) Inextensible ⇒ Same acceleration for P and Q

e) $u = 0$ $t = 3$ $s = 6$ $a = \frac{4}{3}$ $\quad v = u + at \Rightarrow v = \frac{4}{3} \times 3 = 4ms^{-1}$

once force is removed



$\vec{Rf} = 0 \Rightarrow -f_{max} = 3a \Rightarrow -\frac{10}{21} \times 3g = 3a$

$\Rightarrow a = -\frac{14}{3}\,ms^{-2}$

$u = 4$ $\quad a = -\frac{14}{3}$ $\quad v = 0$

$v = u + at \Rightarrow 0 = 4 - \frac{14}{3}t \Rightarrow t = \frac{6}{7} = 0.86\,se$