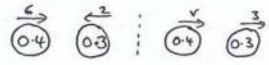
M1 JUNE 06

1) a) Constant acc b) Constant speed c) $\frac{(2+5)3}{2} + (4\times5) = 30\frac{1}{2}$ M

2) 

total mom before $= 6\times0.4 + 0.3\times-2 = 1.8$

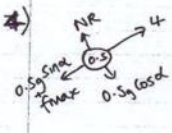
total mom after $= 0.4v + 0.3\times3 \Rightarrow 1.8 = 0.4v + 0.9 \Rightarrow v = 2.25$ (unchanged).

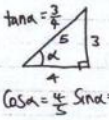
b) Mom B before $= -0.6$ Ns
Mom B after $= 0.9$ Ns $\Rightarrow$ Impulse $= 1.5$ Ns

3) $u = 22.5$, $s = 50$, $t = 2$ $\quad s = ut + \frac{1}{2}at^2 \Rightarrow 50 = 45 + \frac{1}{2}(a)(2)^2$
$5 = 2a$
$a = 2.5\ ms^{-2}$

b) $u = 22.5$, $a = 2.5$, $s = 100$ $\quad v^2 = u^2 + 2as \Rightarrow v^2 = 22.5^2 + 2(2.5)(100)$
$v^2 = 1006.25$
$v = 31.7\ ms^{-1}$

c) $u = 22.5$, $a = 2.5$, $v = 31.7$ $\quad v = u + at \Rightarrow 31.7 = 22.5 + 2.5t$
$\Rightarrow t = 3.68$ sec (−2 sec to get to 9)
$t = 1.68$ sec

4) 

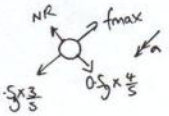


$\cos\alpha = \frac{4}{5}$ $\sin\alpha = \frac{3}{5}$

$\uparrow R = 0 \Rightarrow NR = 0.5g\times\cos\alpha$
$NR = 3.92$ N

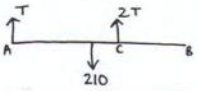
$\nearrow R = 0 \Rightarrow 0.5g\times\sin\alpha + fmax = 4$
$\Rightarrow fmax = 1.06$ N

$fmax = \mu NR \Rightarrow \mu = \frac{1.06}{3.92}$ $\quad \mu = 0.27$

b) 

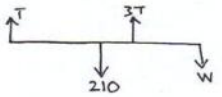
$NR = 3.92$ N $\Rightarrow fmax = 0.27\times3.9$
$= 1.06$ N

$\nearrow R = ma \Rightarrow 2.94 - 1.06 = 0.5a$
$\Rightarrow a = 3.76\ ms^{-2}$

5) 

$\uparrow R = 0 \Rightarrow 3T = 210$
$\Rightarrow T = 70$ N

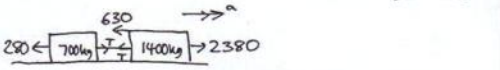
A2 $210\times\frac{1}{2}x = 140\times0.9$
$105x = 126$
$x = 1.2$ m

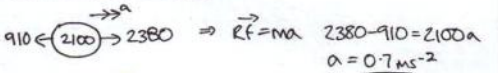
b) 

$\uparrow R = 0 \Rightarrow 4T = 210 + W$

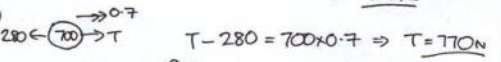
A2 $210\times0.6 + W\times1.2 = 3$
$126 + 1.2W = 2.7T$

$126 + 1.2W = 2.7\left(\frac{210+W}{4}\right) \Rightarrow 504 + 4.8W = 567 + 2$
$\Rightarrow 2.1W = 63$
$W = 30$ N

6) 

a) 

$\Rightarrow \vec{R} = ma$ $\quad 2380 - 910 = 2100a$
$a = 0.7\ ms^{-2}$

b) 

$T - 280 = 700\times0.7 \Rightarrow T = 770$ N

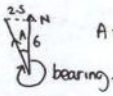
c) $u = 12$, $t = 4$ 

$2380 - 630 = 1400a$
$a = 1.25\ ms^{-2}$

$s = ut + \frac{1}{2}at^2 \Rightarrow s = 58$ m

d) Inextensible $\Rightarrow$ acceleration of trailer and car must be eq.

7) Speed $= \sqrt{2.5^2 + 6^2} = 6.5$ km/h.

b) 

$A = \tan^{-1}\left(\frac{2.5}{6}\right)$ $\quad$ Bearing $= 337.3°$

c) Position $= (16i + 5j) + t(-2.5i + 6j) = (16 - 2.5t)i + (5 + 6t)j$

In 3 hrs $\Rightarrow 8.5i + 23j =$ Rock.

d) At 1400 Position $= (16 - 2.5(2))i + (5 + 6(2))j = 11i + 17j$

due north, 5 km/h $\Rightarrow 5j$ vel

Position after 1400 $= (11i + 17j) + t(5j) = 11i + (17 + 5t)j$

e) due east of Rock when j component $= 23$.

$17 + 5t = 23 \Rightarrow 5t = 6 \Rightarrow t = 1.2 = 1$ hr 12 min $= 1512$

f) 1600 $t = 2$ from 1400 position $= 11i + (17 + 5(2))j = 11i + 27j$

distance from Rock $= 2.5i + 4j$

distance $= \sqrt{2.5^2 + 4^2} = 4.72$ km