M1 JUNE 06

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

2)   total mom before
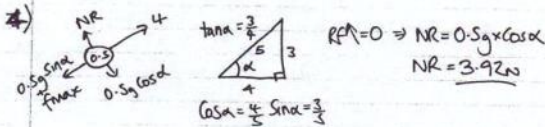$= 6 \times 0.4 + 0.3 \times 2 = 1.8$

total mom after $= 0.4v + 0.3 \times 3 \Rightarrow 1.8 = 0.4v + 0.9 \Rightarrow v = \underline{2.25}$ (unchanged).

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

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

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

c) $u = 22.5$ $a = 2.5$ $v = 31.7$
$v = u + at \Rightarrow 31.7 = 22.5 + 2.5t$
$\Rightarrow t = 3.68$ sec (-2 sec to get to B)
$t = \underline{1.68 \text{ sec}}$

4) $\tan\alpha = \frac{3}{4}$
$RF\nwarrow = 0 \Rightarrow NR = 0.5g \times \cos\alpha$
$NR = \underline{3.92N}$
$\cos\alpha = \frac{4}{5}$ $\sin\alpha = \frac{3}{5}$

$RF\nearrow = 0 \Rightarrow 0.5g \times \sin\alpha + f_{max} = 4$
$\Rightarrow f_{max} = \underline{1.06N}$

$f_{max} = \mu NR \Rightarrow \mu = \frac{1.06}{3.92}$ $\mu = \underline{0.27}$

b) $NR = 3.92N \Rightarrow f_{max} = 0.27 \times 3.92$
$= \underline{1.06N}$
$Rf\swarrow = ma \Rightarrow 2.94 - 1.06 = 0.5a$
$\Rightarrow a = \underline{3.76 \text{ ms}^{-2}}$

5) $RF\uparrow = 0 \Rightarrow 3T = 210$
$\Rightarrow T = \underline{70N}$
$A\circlearrowleft$ $210 \times \frac{1}{2}x = 140 \times 0.9$
$105x = 126$
$x = \underline{1.2m}$

b) $Rf\uparrow = 0 \Rightarrow 4T = 210 + W$
$A\circlearrowleft$ $210 \times 0.6 + W \times 1.2 = 3T$
$126 + 1.2W = 2.7T$
$126 + 1.2W = 2.7\left(\frac{210+W}{4}\right) \Rightarrow 504 + 4.8W = 567 + 2.7W$
$\Rightarrow 2.1W = 63$
$\underline{W = 30N}$
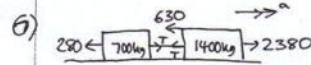
6)
a) $910 \leftarrow (2100) \rightarrow 2380 \Rightarrow Rf = ma$ $2380 - 910 = 2100a$
$a = \underline{0.7 \text{ ms}^{-2}}$

b) $280 \leftarrow (700) \rightarrow T$ $T - 280 = 700 \times 0.7 \Rightarrow T = \underline{770N}$

c) $u = 12$ $t = 4$ $630 \leftarrow (1400) \rightarrow 2380$ $2380 - 630 = 1400a$
$a = \underline{1.25 \text{ ms}^{-2}}$
$S = ut + \frac{1}{2}at^2 \Rightarrow S = \underline{58m}$

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

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

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

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, Smith $\Rightarrow 5j$ 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 12min $= \underline{1512}$

f) 1600 $t = 2$ from 1400 position $= 11i + (17 + 5(2))j = 11i + 27j$
distance from Rock $= 2.5i + 4j$
distance $= \sqrt{2.5^2 + 4^2} = \underline{4.72 \text{ km}}$