

07 May 2011  
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M1 JUNE 06

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

2)  $\vec{0.4} \quad \vec{0.3} \quad \dots \quad \vec{0.4} \quad \vec{0.3}$  total mom before =  $6 \times 0.4 + 0.3 \times 2 = 1.8$

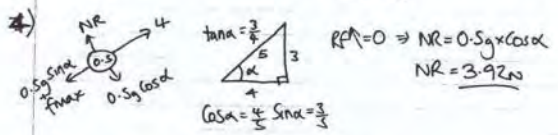
total mom after =  $0.4v + 0.3 \times 3 \Rightarrow 1.8 = 0.4v + 0.9 \Rightarrow v = 2.25$  (unchanged).

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

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

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

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



$Rf \uparrow = 0 \Rightarrow 0.5g \times \sin \alpha + f_{\max} = 4$   
 $\Rightarrow f_{\max} = 1.06 \text{N}$

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

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

b)  $A = \tan^{-1}(\frac{2.5}{6})$  bearing =  $337.3^\circ$

c) position =  $(16i + 5j) + t(-2.5i + 6j) = (16 - 2.5t)i + (5 + 6t)j$   
In 3hrs  $\Rightarrow 8.5i + 23j = \text{Rock}$

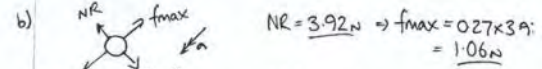
d) At 1400 position =  $(16 - 2.5(2))i + (5 + 6(2))j = 11i + 17j$   
due north,  $5 \text{ km/h} \Rightarrow 5j \text{ vel}$

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

e) due east of Rock when component = 23.  
 $17 + 5t = 23 \Rightarrow 5t = 6 \Rightarrow t = 1.2 = 1 \text{ hr } 12 \text{ min} = 1512$

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

distance from Rock =  $2.5i + 4j$   
distance =  $\sqrt{2.5^2 + 4^2} = 4.72 \text{ km}$



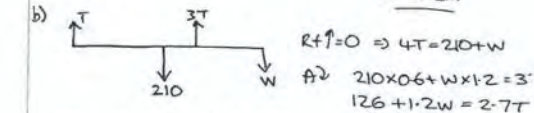
$NR = 3.92 \text{N} \Rightarrow f_{\max} = 0.27 \times 3.92 = 1.06 \text{N}$

$Rf \downarrow = ma \Rightarrow 2.94 - 1.06 = 0.5a \Rightarrow a = 3.76 \text{ms}^{-2}$



$Rf \uparrow = 0 \Rightarrow 3T = 210 \Rightarrow T = 70 \text{N}$

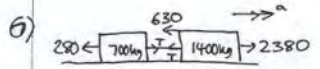
A  $\downarrow 210 \times \frac{1}{2}x = 140 \times 0.9$   
 $105x = 126 \Rightarrow x = 1.2 \text{m}$



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

A  $\downarrow 210 \times 0.6 + W \times 1.2 = 3 \times 126 + 1.2W = 2.7T$

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



a)  $910 \leftarrow \begin{matrix} 700 \text{kg} \\ \leftarrow 2100 \end{matrix} \rightarrow \begin{matrix} 1400 \text{kg} \\ \leftarrow 1400 \end{matrix} \rightarrow 2380$   
 $910 \leftarrow \begin{matrix} 2100 \\ \leftarrow 2100 \end{matrix} \rightarrow 2380 \Rightarrow Rf = ma \quad 2380 - 910 = 2100a$   
 $a = 0.7 \text{ms}^{-2}$

b)  $280 \leftarrow \begin{matrix} 700 \\ \leftarrow 700 \end{matrix} \rightarrow T$   
 $T - 280 = 700 \times 0.7 \Rightarrow T = 770 \text{N}$

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

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