

11 JUNE 04

1)
$$\vec{R}_F = 0 \Rightarrow \frac{1}{2}T = 50 \cos 30 \Rightarrow T = 86.6 \text{ N}$$

$$R_F \uparrow = 0 \Rightarrow W = 2S + 86.6 \sin 60 \Rightarrow W = 100 \text{ N}$$

2) $u = 5 \quad v = 9.5 \quad t = 1.5$
 $v = u + at \Rightarrow 9.5 = 5 + 1.5a \Rightarrow 4.5 = 1.5a \Rightarrow a = 3 \text{ ms}^{-2}$
 $u = 5 \quad s = 24 \quad a = 3$
 $v^2 = u^2 + 2as \Rightarrow v^2 = 25 + 2(3)(24) \Rightarrow v^2 = 169 \Rightarrow v = 13 \text{ ms}^{-1}$

b) Momentum at c = $2 \times 13 = 26 \text{ N s}$
 Impulse = change in momentum = 30 N s ←
 Momentum after = -4 N s
 $-4 = 2 \times v \quad v = -2 \text{ ms}^{-1}$ 2 ms^{-1} direction changes.

3) $\begin{matrix} \rightarrow u & \rightarrow 0 & \dots & \leftarrow v & \rightarrow 3v \\ \textcircled{2} & \textcircled{4} & & \textcircled{2} & \textcircled{4} \end{matrix}$
 Total mom before = $2u$
 Total mom after = $-2v + 12v = 10v$ } $2u = 10v$
 $v = \frac{1}{5}u$

b) $a \leftarrow \textcircled{2} \rightarrow 10 \quad R_F = ma \Rightarrow -10 = 2a \Rightarrow a = -5 \text{ ms}^{-2}$
 $s = 1.6 \quad a = -5 \quad v = 0 \quad v^2 = u^2 + 2as \Rightarrow 0 = u^2 - 16 \Rightarrow u^2 = 16$
 $\Rightarrow u = 4 \text{ ms}^{-1}$
 $\textcircled{*} 4 = \frac{1}{5}u \Rightarrow u = 20 \text{ ms}^{-1}$

6) Change = $3i + 5j$ in 45 min
 Vel = direction = $\frac{3i - 1.5j}{0.75} = 4i - 2j \text{ km/h}$

 bearing = $90 + A = 90 + \tan^{-1}(\frac{2}{3})$
 bearing = 116.6°

b) $s = (4i - 6j) + t(4i - 2j) = (4 + 4t)i + (-6 - 2t)j$
 c) at 10:15 $t = 1.25 \quad s = (4 + 4(1.25))i + (-6 - 2(1.25))j$
 $s = 9i - 8.5j$
 Motor boat travels $9i - 8.5j$ in 15 min
 Vel = $\frac{9i - 8.5j}{0.25} = 36i - 34j \text{ km/h}$

7)
 $f_{\max Q} = \mu NR = \frac{2}{7} \times 6g = \frac{12}{7}g \text{ N}$
 $f_{\max P} = \mu NR = \frac{2}{7} \times 4g = \frac{8}{7}g \text{ N}$ } Res = $\frac{20}{7}$
 $\vec{R}_F = 40 - \frac{20}{7}g = 10a \Rightarrow a = \frac{12}{10} = 1.2 \text{ ms}^{-2}$
 $\frac{8}{7}g \leftarrow \textcircled{4} \rightarrow T \quad \vec{R}_F = ma \Rightarrow T - \frac{8}{7}g = 4a$
 $T = 4.8 + \frac{8}{7}g$
 $T = 16 \text{ N}$

4)
 $D \downarrow 10g \times 1 + 20g \times 1.5 = NR_b \times 3$
 $40g = 3NR_b$
 $NR_b = \frac{40}{3}g \text{ N}$
 $NR_b = 13\frac{1}{3}g \text{ N}$
 $R_F \uparrow = 0 \Rightarrow 30g = 13\frac{1}{3}g + NR_d \Rightarrow NR_d = 16\frac{2}{3}g \text{ N}$

$D \downarrow 20g \times x = 10g \times 1$
 $x = \frac{10g}{20g} = 0.5 \text{ m}$

5)
 $R_F \uparrow = 0 \Rightarrow NR = 0.4g \cos 15 = 3.79 \text{ N}$
 $f_{\max} = \mu NR = 0.2 \times 3.79 = 0.757 \text{ N}$
 $R_F \uparrow = 0 \Rightarrow T + 0.757 = 0.4g \sin 15$
 $T = 0.257 \text{ N}$

b)
 $R_F \downarrow = ma \Rightarrow 0.4g \sin 15 - f_{\max} = 0.4a$
 $0.257 = 0.4a \Rightarrow a = 0.643$
 $a = 0.643 \quad u = 0 \quad s = 50$
 $s = ut + \frac{1}{2}at^2 \Rightarrow 50 = \frac{1}{2}(0.643)t^2 \Rightarrow t^2 = 155.47$
 $t = 12.5 \text{ sec}$

d) after 7 sec $u = 0 \quad t = 7 \quad a = 1.2$
 $v = u + at \Rightarrow v = 0 + 1.2 \times 7 = 8.4 \text{ ms}^{-1}$

e)
 $\vec{R}_F = ma \Rightarrow 40 - \frac{12}{7}g = 6a$
 $\Rightarrow a = 3.86 \text{ ms}^{-2}$
 $u = 8.4 \quad a = 3.86 \quad t = 3$
 $v = u + at \Rightarrow v = 8.4 + 3.86 \times 3 \Rightarrow v = 20 \text{ ms}^{-1}$

* d) $u = 8.4 \quad v = 0$

 $\vec{R}_F = ma \Rightarrow -\frac{8}{7}g = 4a \Rightarrow a = -2.8 \text{ ms}^{-2}$
 $v = u + at \Rightarrow 0 = 8.4 - 2.8(t)$
 $t = \frac{8.4}{2.8} = 3 \text{ sec}$