M1 June 07

1)

$\vec{RF}=0$ $T\sin20 = 12$
$Rf\uparrow=0$ $T\cos20 = W$

$\Rightarrow T = \dfrac{12}{\sin20} = \underline{35N}$ $W = 35\cos20$
$W = \underline{33N}$

2)

a) Impulse on A = change in mom of A.
MomA before = $0.3\times8 = 2.4$
MomA after = $0.3\times-2 = -0.$
Impulse = $\underline{3\,Ns}$

b) Total Mom before = $0.3\times8 + M\times4$
$= 2.4 - 4m$

Total mom after $= 0.3\times-2 + M\times2$
$= -0.6 + 2m$

$2.4 - 4m = -0.6 + 2M \Rightarrow 6m = 3 \Rightarrow \underline{M=0.5kg}$

3)

a) $Mg\times0.6 = 8g\times0.15$
$M = \dfrac{8\times0.15}{0.6} = \underline{2kg}$

b)

$Rf\uparrow=0 \Rightarrow NR = 15g$

$A\Rightarrow NR\times x = 8g\times0.75 + 2g\times1.5$
$15g\,x = 9g$
$\underline{x = 0.6m}$

4)

b) $14(25-V) + 30V = 526 \Rightarrow 350 + 16V = 526 \Rightarrow \underline{V=11ms}$

c)

gradient $= \dfrac{-14}{8} \Rightarrow$ acc $= -1.75ms^{-2} \Rightarrow$ dec $=1.75$

5)

a) $Rf\uparrow=0 \Rightarrow NR + 1.25\sin40 = 0.25g \Rightarrow NR = \underline{1.68N}$

b) $fmax = \mu\times NR \Rightarrow fmax = \mu\times1.68$
$\vec{RF}=0 \Rightarrow \mu\times1.68 = 1.2\cos40 \Rightarrow \underline{\mu = 0.55}$

6)

P) $0.5g - T = 0.5a$ Q) $T - mg = ma$

a) $u=0$ $t=1.5$ $S=3.15$

find a, $S=ut+\tfrac{1}{2}at^2 \Rightarrow 3.15 = \tfrac{1}{2}a\times1.5^2$
$\underline{a = 2.8ms^{-2}}$

find v, $V=u+at \Rightarrow V = 2.8\times1.5$
$\underline{V = 4.2ms^{-1}}$

6b) P) $0.5g - T = 1.4 \Rightarrow \underline{T = 3.5N}$

c) Q) $T - mg = ma \Rightarrow 3.5 - mg = 2.8m \Rightarrow 3.5 = 12.6m$
$m = \dfrac{3.5}{12.6} = \underline{\dfrac{5}{8}kg}$

d) Inextensible $\Rightarrow$ acceleration of P and Q must be equal

e) Vel P when it strikes the ground is $4.2\downarrow \Rightarrow$ Vel Q $=4.2$
When P hits the ground, string isslack $\Rightarrow$ no tension
$\Rightarrow$ acc $=-g$.
$u\uparrow=4.2$ $a\uparrow=-9.8$ $v\uparrow=0$
$V=u+at \Rightarrow 0 = 4.2 - 9.8t \Rightarrow t = 0.428sec$ to reach max height
$\Rightarrow$ time to become taut again $= 0.428\times2 = \underline{0.86sec}$

7) 12:00 $(3i-4j) \rightarrow$ 14:30 $(8i+11j)$ change in Pos $= 5i+15j$

a) Vel $= \dfrac{\text{change in Pos}}{\text{time}} = \dfrac{5i+15j}{2.5} = \underline{2i+6j\ ms^{-1}}$

b) $b = \underset{\text{Pos}}{\text{starting}} + t(\text{Vel}) = (3i-4j)+t(2i+6j)$
$b = (3+2t)i + (-4+6t)j$

c) $C = (-9+6t)i + (20+\lambda t)j$
at interception, i and j must be equal
$3+2t = -9+6t \Rightarrow 4t = 12 \Rightarrow t = 3\,hrs$
$-4+6t = 20+\lambda t \Rightarrow 14 = 20+\lambda t \Rightarrow \lambda t = -6 \Rightarrow \lambda = \dfrac{-6}{3} = \underline{-2}$

d) Vel B $= 2i+6j \Rightarrow$ Speed B $= \sqrt{2^2+6^2} = \sqrt{40} = \underline{2\sqrt{10}}$
Vel C $= 6i-2j \Rightarrow$ Speed C $= \sqrt{6^2+2^2} = \sqrt{40} = \underline{2\sqrt{10}}$