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M1 June 07

1) $\vec{Rf} = 0$ $T \sin 20 = 12$
 $Rf \uparrow = 0$ $T \cos 20 = W$
 $\Rightarrow T = \frac{12}{\sin 20} = 35 \text{ N}$ $W = 35 \cos 20$
 $W = 33 \text{ N}$

2) a) Impulse on A = change in Mom of A.
 Mom A before = $0.3 \times 8 = 2.4$
 Mom A after = $0.3 \times -2 = -0.6$
 Impulse = 3 Ns
 b) Total Mom before = $0.3 \times 8 + m \times 4 = 2.4 + 4m$
 Total mom after = $0.3 \times -2 + m \times 2 = -0.6 + 2m$
 $2.4 + 4m = -0.6 + 2m \Rightarrow 6m = 3 \Rightarrow m = 0.5 \text{ kg}$

3) $\Sigma \tau$ $mg \times 0.6 = 8 \times 0.15$
 $M = \frac{8 \times 0.15}{0.6} = 2 \text{ kg}$

b) $Rf \uparrow = 0 \Rightarrow NR = 15g$
 $A \downarrow NR \times L = 8g \times 0.75 + 2g \times 1.5$
 $15g \times x = 9g$
 $x = 0.6 \text{ m}$

6b) P) $0.5g - T = 1.4 \Rightarrow T = 3.5 \text{ N}$
 c) Q) $T - mg = ma \Rightarrow 3.5 - mg = 2.8m \Rightarrow 3.5 = 12.6m$
 $m = \frac{3.5}{12.6} = \frac{5}{8} \text{ kg}$
 d) Inextensible \Rightarrow acceleration of P and Q must be equal
 e) Vel P when it strikes the ground is $4.2 \text{ m/s} \downarrow \Rightarrow \text{Vel Q} = 4.2$
 When P hits the ground, string is slack \Rightarrow no tension $\Rightarrow \text{acc} = -g$
 $u \uparrow = 4.2$ $a \uparrow = -9.8$ $v \uparrow = 0$
 $v = u + at \Rightarrow 0 = 4.2 - 9.8t \Rightarrow t = 0.428 \text{ sec}$ to reach max height
 \Rightarrow time to become taut again = $0.428 \times 2 = 0.86 \text{ sec}$

7) $12:00 (3i - 4j) \Rightarrow 14:30 (8i + 11j)$ change in Pos = $5i + 15j$
 a) Vel = $\frac{\text{change in Pos}}{\text{time}} = \frac{5i + 15j}{2.5} = 2i + 6j \text{ ms}^{-1}$
 b) $b = \text{starting Pos} + t(\text{Vel}) = (3i - 4j) + t(2i + 6j)$
 $b = (3 + 2t)i + (-4 + 6t)j$
 c) $C = (-9 + 6t)i + (20 + \lambda t)j$
 at interception, i and j must be equal
 $3 + 2t = -9 + 6t \Rightarrow 4t = 12 \Rightarrow t = 3 \text{ hrs}$
 $-4 + 6t = 20 + \lambda t \Rightarrow 14 = 20 + \lambda t \Rightarrow \lambda t = -6 \Rightarrow \lambda = \frac{-6}{3} = -2$
 d) Vel B = $2i + 6j \Rightarrow \text{Speed B} = \sqrt{2^2 + 6^2} = \sqrt{40} = 2\sqrt{10}$
 Vel C = $6i - 2j \Rightarrow \text{Speed C} = \sqrt{6^2 + 2^2} = \sqrt{40} = 2\sqrt{10}$

4) $A = 30V$
 $A = \frac{25(25 - 0)}{2} = 312.5$

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

c) gradient = $\frac{-14}{8} \Rightarrow \text{acc} = -1.75 \text{ ms}^{-2} \Rightarrow \text{dec} = 1.75$

5) $Rf \uparrow = 0 \Rightarrow NR + 1.25 \sin 40 = 0.25g \Rightarrow NR = 1.68 \text{ N}$

b) $f_{\text{max}} = \mu \times NR \Rightarrow f_{\text{max}} = \mu \times 1.68$
 $Rf = 0 \Rightarrow \mu \times 1.68 = 1.2 \cos 40 \Rightarrow \mu = 0.55$

6) P) $0.5g - T = 0.5a$ Q) $T - mg = ma$
 a) $u = 0$ $t = 1.5$ $s = 3.15$
 find a, $s = ut + \frac{1}{2}at^2 \Rightarrow 3.15 = \frac{1}{2}a \times 1.5^2$
 $a = 2.8 \text{ ms}^{-2}$
 find v, $v = u + at \Rightarrow v = 2.8 \times 1.5$
 $v = 4.2 \text{ ms}^{-1}$