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MI JAN 07

1) $R_f \uparrow = 0 \Rightarrow \frac{1}{2}P = 24 \Rightarrow P = 48N$
 $R_f \leftarrow = 0 \Rightarrow 0.866P = Q \Rightarrow Q = 41.6N$

2) $\sum \tau = 0$
 $80 \times x = 120 \times 0.5$
 $80x = 60$
 $x = \frac{60}{80} = 0.75m$

b) $\sum \tau = 0$
 $W \times 1.25 = 120 \times 0.25$
 $1.25W = 30$
 $W = 24N$
 $R_f \uparrow = 0 \Rightarrow 120 + W = NR_b$
 $NR_b = 144N$

- d) particle \rightarrow no physical size, so weight acts exactly at the end of the plank.
- 3) $acc = \frac{\text{change in vel}}{\text{time}} = \frac{12i - 6j}{4} = 3i - 1.5j \text{ ms}^{-2}$
- b) $F = Ma \Rightarrow R_f = 2(3i - 1.5j) = 6i - 3j$ $R_f = \sqrt{6^2 + 3^2} = 6.7N$
- c) $Vel = \text{original vel} + t(\text{acc}) \Rightarrow V = (3i + 2j) + 6(3i - 1.5j)$
 $V = 21i - 7j \text{ ms}^{-1}$

b) $R_f \uparrow = 0 \Rightarrow NR = 30g - 150 \sin 20$
 $NR = 242.7N$
 $R_f \leftarrow = ma \Rightarrow 140.95 - f_{max} = 30a$
 $\Rightarrow 43.9 = 30a \Rightarrow a = 1.46m/s^2$
 $f_{max} = 0.4(242.7) = 97.1$

7) $R_f = ma \Rightarrow T - 1.5g = 3a$
 $R_f \downarrow = ma \Rightarrow 2g - T = 2a$
 $0.5g = 5a$
 $\Rightarrow a = 0.1g$
 $a = 0.98 \text{ ms}^{-2}$
 $T = 3a + 1.5g = 17.64N$

- a) latex
- d) Inextensible \Rightarrow same acceleration for P and Q.
- c) $u \downarrow = 0$ $s = 0.8$ $a \downarrow = 0.98$
 $v^2 = u^2 + 2as \Rightarrow v^2 = 2(0.98)(0.8) \Rightarrow v = 1.25 \text{ ms}^{-1}$
- f) $T = 0$ $R_f = ma \Rightarrow -1.5g = 3a \Rightarrow a = -0.5g$
 $u \uparrow = 1.25$ $v \uparrow = 0$
 $v = u + at \Rightarrow 0 = 1.25 - 4.9t$
 $t = 0.255 \text{ sec.}$

0.255 sec for P to reach greatest height of slope
 \Rightarrow 0.51 sec to return to the point it was at when Q hit the ground; 0.51 sec for the string to become taut again.

4) $\text{total mom before} = 0.3 \times u + 0 = 0.3u$
 $\text{total mom after} = 0.3 \times -2 + 0.6 \times 5 = -0.6 + 3$
 $\Rightarrow 0.3u = -0.6 + 3 = 2.4 \Rightarrow u = 8 \text{ ms}^{-1}$

- b) $\text{Mom Q before} = 0$ $\text{Mom Q after} = 3Ns = \text{Impulse} = 3i$
- c) Impulse to bring Q to rest = 3Ns
 Impulse = force \times time $\Rightarrow 3 = R \times 1.5 \Rightarrow R = 2N$
- 5) $u \uparrow = 21$ $a \uparrow = -9.8$ $v \uparrow = 0$ (at greatest height)
 $v^2 = u^2 + 2as \Rightarrow 0 = 21^2 - 19.6s$
 $s = 22.5m$
 total height = 22.5 + 1.5 = ?
- b) $u \uparrow = 21$ $a \uparrow = -9.8$ $s = -1.5m$ $v \uparrow = u + at$
 $v = 21 + (-9.8) \times (-1.5)$
 $v^2 = u^2 + 2as \Rightarrow v^2 = 21^2 + 2(-9.8)(-1.5)$
 $\Rightarrow v^2 = 470.4 \Rightarrow v = 21.7 \text{ ms}^{-1} \downarrow$
- c) $u \uparrow = 21$ $a \uparrow = -9.8$ $v \uparrow = -21.7$
 $v = u + at \Rightarrow -21.7 = 21 - 9.8t$ $t = \frac{-42.7}{-9.8} = 4.36 \text{ sec}$

6) $R_f \uparrow = 0 \Rightarrow NR = 294 - 0.342P$
 $R_f \leftarrow = 0 \Rightarrow f_{max} = 0.94P$
 $f_{max} = \mu NR \Rightarrow 0.94P = 0.4(294 - 0.342P)$
 $\Rightarrow 0.94P = 117.6 - 0.137P$
 $1.08P = 117.6 \Rightarrow P = 109.2N$