07 May 2011
22:43

M1 JAN 07

1) $\uparrow R_f = 0 \Rightarrow \frac{1}{2}P = 24 \Rightarrow P = 48_N$

$\vec{R_f} = 0 \quad 0.866P = Q \Rightarrow Q = 41.6_N$

2) $\curvearrowright \quad 80x = 120 \times 0.5$

$80x = 60$

$x = \frac{60}{80} = 0.75m$

b) $\curvearrowright \quad W \times 1.25 = 120 \times 0.25$

$1.25W = 30$

$W = 24_N$

$\uparrow R_f = 0 \Rightarrow 120 + W = NR_D$

$NR_D = 144_N$

a) particle $\Rightarrow$ no physical size, so weight acts exactly at the end of the plank.

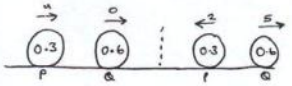
3) $\text{acc} = \frac{\text{change in vel}}{\text{time}} = \frac{12i - 6j}{4} = 3i - 1.5j \ ms^{-2}$

b) $F = Ma \Rightarrow R_f = 2(3i - 1.5j) = 6i - 3j \quad R_f = \sqrt{6^2 + 3^2} = 6.7_N$

c) $\text{Vel} = \text{original vel} + t(\text{acc}) \Rightarrow V = (3i + 2j) + 6(3i - 1.5j)$

$V = 21i - 7j \ ms^{-1}$

4)




total mom before $= 0.3 \times u + 0 = 0.3u$

total mom after $= 0.3 \times -2 + 0.6 \times 5 = -0.6 + 3$

$\Rightarrow 0.3u = -0.6 + 3 = 2.4 \Rightarrow u = 8 ms^{-1}$

b) Mom Q before $= 0$ Mom Q after $= 3Ns \Rightarrow$ Impulse $= 3i$

c) Impulse to bring Q to rest $= 3Ns$

Impulse $=$ force $\times$ time $\Rightarrow 3 = R \times 1.5 \Rightarrow R = 2_N$

5) $\uparrow u = 21$ $\quad a \uparrow = -9.8$ $\quad v \uparrow = 0$ (at greatest height)

$v^2 = u^2 + 2as \Rightarrow 0 = 21^2 - 19.6s$

$s = 22.5m$

total height $= 22.5 + 1.5 = 2$

b) $\uparrow u = 21 \quad a \uparrow = -9.8 \quad s = -1.5m \quad v \uparrow = u + at$

$v = 21 + -9.8 \times -1.5$

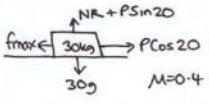
$v^2 = u^2 + 2as \Rightarrow v^2 = 21^2 + 2(-9.8)(1.5)$

$\Rightarrow v^2 = 470.4 \Rightarrow v = 21.7 ms^{-1} \downarrow$

c) $\uparrow u = 21 \quad a \uparrow = -9.8 \quad v \uparrow = -21.7$

$v = u + at \Rightarrow -21.7 = 21 - 9.8t \quad t = \frac{-42.7}{-9.8} = 4.36 sec$

6)




Constant speed $\Rightarrow \vec{R_f} = 0$

$\uparrow R_f = 0 \Rightarrow NR = 294 - 0.342P$

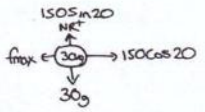
$\vec{R_f} = 0 \Rightarrow f_{max} = 0.94P$

$f_{max} = \mu NR \Rightarrow 0.94P = 0.4(294 - 0.342P)$

$\Rightarrow 0.94P = 117.6 - 0.137P$

$1.08P = 117.6 \Rightarrow P = 109.2_N$

b)




$\uparrow R_f = 0 \quad NR = 30g - 150\sin 20$

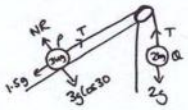
$NR = 242.7_N$

$f_{max} = 0.4(242.7) = 97.1$

$\vec{R_f} = ma \Rightarrow 140.95 - f_{max} = 30a$

$\Rightarrow 43.9 = 30a \Rightarrow a = 1.46 ms^{-2}$

7)




(P) $\vec{R_f} = ma \Rightarrow T - 1.5g = 3a$

(Q) $\downarrow R_f = ma \Rightarrow 2g - T = 2a$ +

$0.5g = 5a$

$\Rightarrow a = 0.1g$

$a = 0.98 ms^{-2}$

$T = 3a + 1.5g = 17.64N$

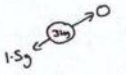
a) ~~later~~

d) Inextensible $\Rightarrow$ Same acceleration for P and Q.

e) $u \downarrow = 0 \quad s = 0.8 \quad a \downarrow = 0.98$

$v^2 = u^2 + 2as \Rightarrow v^2 = 2(0.98)(0.8) \Rightarrow v = 1.25 ms^{-1}$

f) $T = 0$




$\vec{R_f} = ma \Rightarrow -1.5g = 3a \Rightarrow a = -0.5g.$

$u \nearrow = 1.25 \quad v \nearrow = 0$

$v = u + at \Rightarrow 0 = 1.25 - 4.9t$

$t = 0.255 sec.$

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.