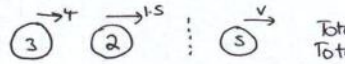
07 May 2011
22:41

M1 JAN06

1) $u\uparrow = 16$ $a\uparrow = -9.8$ $t = 4$

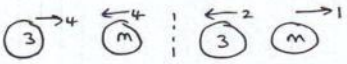
$s = ut + \frac{1}{2}at^2 \Rightarrow s = 16\times4 - 4.9\times16 \Rightarrow s = -14.4$m (14.4m below point of projection).

b) $v^2 = u^2 + 2as \Rightarrow v^2 = 16^2 - 19.6\times14.4$
$\Rightarrow v^2 = 538.24 \Rightarrow v = 23.2 ms^{-1}\downarrow$

2) 

Total mom before = 12+3=15
Total mom after = 5v

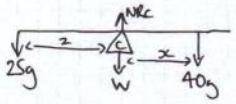
$15 = 5v \Rightarrow v = 3 ms^{-1}$

b) 

Total mom before = $12 - 4m$
Total mom after = $-6 + m$

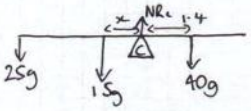
$12 - 4m = -6 + m$
$18 = 5m \Rightarrow m = 3.6$kg

c) Mom Q before = $3.6\times4 = 14.4$ Ns
Mom Q after = $3.6\times1 = 3.6$ Ns
$\Rightarrow$ Impulse = 18 Ns

3) 

$\circlearrowright$ $25g\times2 = 40g\times x$
$x = \frac{50}{40} = 1.25$m

b) Weight acts at centre of rod.

c) 

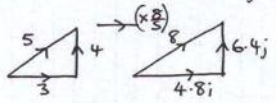
$\circlearrowright$ $25g\times2 + 15g\times x = 40g\times1.4$
$50g + 15gx = 56g$
$x = \frac{6g}{15g} = 0.4$m

c) $B = (-26i+4j) + (3i+4j)t = (-26+3t)i + (4+4t)j$ (3)
$A = (2i-10j) + (-1i+6j)t = (2-t)i + (-10+6t)j$

$i \Rightarrow -26 + 3t = 2 - t$
$4t = 28$
$t = 7$ sec

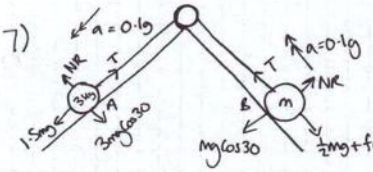
$j \Rightarrow 4 + 4t = -10 + 6t$
$2t = 14$
$t = 7$sec

when $t = 7$ $A = -5i + 32j$ $(-5, 32)$

d) 

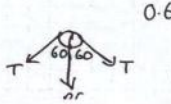
$B = (-26i+4j) + (4.8i+6.4j)t$, $t = 7$
$B = 7.6i + 48.8j$

distance = $12.6i + 16.6j \Rightarrow \sqrt{12.6^2 + 16.6^2} = 20.8$m

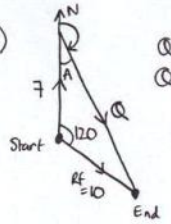
7) 

(A) $R\!F\!\uparrow = ma$
$1.5mg - T = 3m\times\frac{1}{10}g$
$T = 1.2mg$N

b) (B) $R\!F\!\uparrow = 0 \Rightarrow NR = 0.866mg \Rightarrow fmax = \mu\times0.866mg$
$R\!F\!\uparrow = ma \Rightarrow T - \frac{1}{2}mg - \mu\times0.866mg = m\times0.1g$ $T = 1.2mg$
$0.6mg = 0.866mg\times\mu$ $\mu = \frac{0.6}{0.866} = 0.693$

c) 

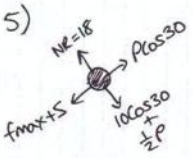
$R\!F = 2T\cos60 = 1.2mg$
acting vertically downwards

4) 

$Q^2 = 7^2 + 10^2 - 2(7)(10)\cos120$
$Q^2 = 219 \Rightarrow Q = 14.8$N

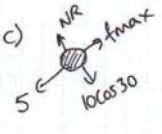
$\frac{\sin A}{10} = \frac{\sin120}{14.8} \Rightarrow A = 35.8°$

Bearing = 144°

5) 

$R\!F\!\uparrow = 0 \Rightarrow 18 = 10\cos30 + \frac{1}{2}P$
$\frac{1}{2}P = 9.3397$
$P = 18.68$N

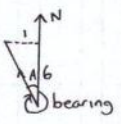
b) $fmax = \mu NR = 18\mu$
$R\!F\!\nearrow = 0 \Rightarrow P\cos30 = fmax + 5$
$fmax = 11.18$N
$\mu = \frac{11.18}{18} = 0.62$

c) 

$NR = 10\cos30 = 8.66$N $fmax = \mu NR = 5.37$

Since fmax > 5 it will not move.

6) Speed = $\sqrt{12^2 + 6^2} = \sqrt{57} = 6.08 ms^{-1}$

b) 

$A = \tan^{-1}\left(\frac{1}{6}\right) = 9.46°$

Bearing = 351°