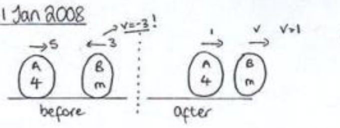
07 May 2011
22:49

M1 Jan 2008

1) 

in b) $v=2$

a) Impulse on A is change in momentum of A

before $= 4\times5$ after $=4\times1$ change $= 20-4 = 16$N

b) Total momentum does not change

before $= 4\times5 + m\times-3 = 20-3m$

after $= 4\times1 + m\times2 = 4+2m$

$20-3m = 4+2m$
$5m=16$
$m=3.2$kg

2) $u=0$ $s=27$m $t=3$. u,s,t,a

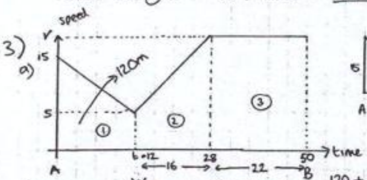
$s=ut+\frac{1}{2}at^2 \Rightarrow 27 = 0+\frac{1}{2}a\times9 \Rightarrow a=\frac{54}{9} = 6\text{ms}^{-2}$

b) $s=\frac{(u+v)t}{2} \Rightarrow 54=(0+v)\times3$ $v=18\text{ms}^{-1}$

c) After burn out ! $u=18$ $a=-g$ $t=2$ (s-3!)

$s=ut+\frac{1}{2}at^2 \Rightarrow s=18\times2-4.9\times2^2 = 16.4$m

Total height $= 16.4+27 = 43.4$m

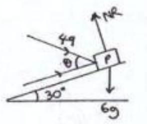
3) a) 

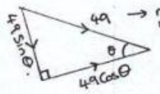
Area $= \frac{(5+15)t}{2} = 1$
$20t = 240$
$t=12$sec

b) total time $= 12+16+22$
$= 50$sec

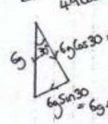
c) $120 + \text{area②} + \text{area③} = 1000$ $\quad 120+\frac{(5+v)16}{2}+22v = 1000$

$120+8(5+v)+22v = 1000$
$120+40+8v+22v = 1000$
$30v = 840$
$v = 28\text{ms}^{-1}$

4) 



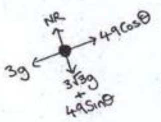
→ make force given the hypotenuse of a RA-tri



$6g\cos30 = 6g\times\frac{\sqrt3}{2} = 3\sqrt3 g$

$6g\sin30 = 6g\times\frac{1}{2} = 3g$.

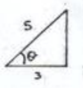
smooth = no friction



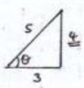
equilibrium ↗=↙ ↖=↘

a) $49\cos\theta = 3g \Rightarrow \cos\theta = \frac{3g}{49} = \frac{3}{5}$ ✓

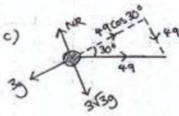
b) $NR = 3\sqrt3 g + 49\sin\theta = 50.92 + 49\times\frac{4}{5} = 90.12$N

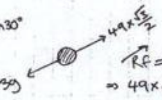


$\cos\theta = \frac{3}{5} \Rightarrow$

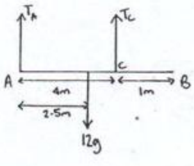


$\sin\theta = \frac{4}{5}$

c) 



$RF = ma$
$\Rightarrow 49\times\frac{\sqrt3}{2} - 3g = 6\times a$
$13.035 = 6a$ $a=2.17$

5) 

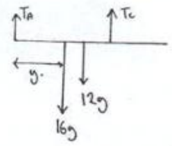
↑=↓ $T_A + T_C = 12g$

A↻ $12g\times2.5 = T_C\times4$

$30g = 4T_C \Rightarrow T_C = \frac{15}{2}g$.

a) i) $T_C = 7.5g$ N.

ii) $T_A = 4.5g$ N

b) 

$T_A + T_C = 28g$.

A↻ $16g\times y + 12g\times2.5 = T_C\times$

$16gy + 30g = 4T_C$

$4gy + 7.5g = T_C$

c) if $T_C < 98 \Rightarrow 4gy + 7.5g < 98$ $\quad 98 = 10g$

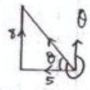
$4gy + 7.5g < 10g$

$4gy < 2.5g \Rightarrow y < \frac{2.5}{4}$

$y < 0.625$m

$\Rightarrow 0 < y < 0.625$m

6) $\text{Vel} = (-5i+8j)\text{ms}^{-1}$ speed $= \sqrt{5^2+8^2} = 9.43\text{ms}^{-1}$

b) 

$\theta = \tan^{-1}(\frac{8}{5}) = 58°$ bearing $= 270+58 = 328°$

c) $\text{Vel} = -5i+8j$ so after 3 seconds P moves $-15i+$

Original Pos $= 7i-10j$; Position after 3sec $= -8i+14j$

In 4 seconds to pass through O it must move $8i-14j$

Velocity $= \frac{8i-14j}{4} = 2i-3.5j$ $\quad u=2$ $v=-3.5$

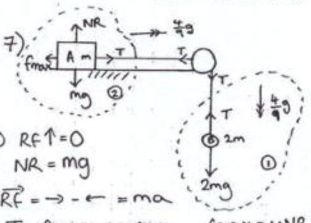
d) when $t=3$ position $= -8i+14j$ Vel $= 2i-3.5j$

position $= (-8i+14j)+(2i-3.5j)t = (-8+2t)i+(14-$

due south of A when i becomes 7 again A(7i-

$\Rightarrow -8+2t = 7 \Rightarrow 2t = 15 \Rightarrow t = 7.5$ sec

Total time to be due south $= 3+7.5 = 10.5$sec

7) 

① RF↓ = ↓-↑ = ma

$2mg - T = 2m\times\frac{4}{9}$

$2mg - T = \frac{8}{9}mg$

② RF↑ = 0

$NR = mg$

RF = → - ← = ma

$T - fmax = m\times\frac{4}{9}g$ $\quad fmax = \mu NR$, $fmax = \mu\times mg$

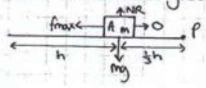
$T - \mu mg = \frac{4}{9}mg$ ②

$2mg - T = \frac{8}{9}mg$ ① +

$2mg - \mu mg = \frac{12}{9}mg$ $\quad \mu g = 2g - \frac{12}{9}g$ $\quad \mu = 2 - \frac{12}{9} =$

$\mu = \frac{2}{3}$

c) when B hits the ground



$RF = -fmax = ma \Rightarrow -\frac{2}{3}mg = ma$

$a = -\frac{2}{3}g$

Before B hits the ground

$u=0$ $a=\frac{4}{9}g$ $s=h$ $\quad v^2 = u^2+2as \Rightarrow v^2 = 2\times\frac{4}{9}g\times h$

$v^2 = \frac{8}{9}gh$.

So when B hits the ground

$u^2 = \frac{8}{9}gh$ $s=\frac{1}{3}h$ $a=-\frac{2}{3}g$

$v^2 = u^2+2as \Rightarrow v^2 = \frac{8}{9}gh + 2\times-\frac{2}{3}g\times\frac{1}{3}h$

$v^2 = \frac{8}{9}gh - \frac{4}{9}gh$

$v^2 = \frac{4}{9}gh$

$v = \frac{2}{3}\sqrt{gh}$ ms^{-1}

d) Same tension on A and B.