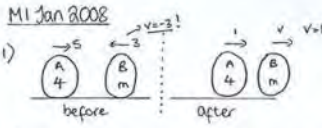
07 May 2011
22:49

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 $=20-4=\underline{16N}$

b) Total momentum does not change

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

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

$20-3m=4+2m$
$5m=16$
$m=\underline{3.2kg}$

2) $u=0$ $s=27m$ $t=3$. $u,s,t,\underline{a}$

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

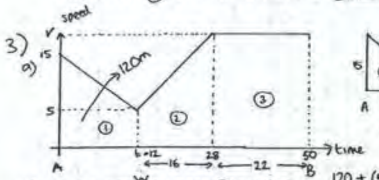
b) $s=\frac{(u+v)t}{2} \Rightarrow 54=(0+v)\times3$ $\underline{v=18ms^{-1}}$

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

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

Total height $=16.4+27=\underline{43.4m}$

3) a)



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

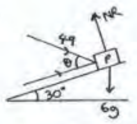
b) total time $= 12+16+$
$=\underline{50sec}$

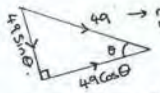
c) $120+\text{area}②+\text{area}③=1000$

$120+\frac{(5+v)16}{2}+22v=1000$

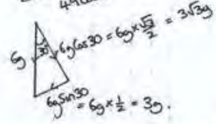
$120+8(5+v)+22v=1000$
$120+40+8v+22v=1000$
$30v=840$
$v=\underline{28ms^{-1}}$

4)

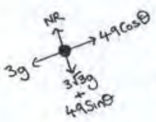




→ make force given the hypotenuse of a RA-tri



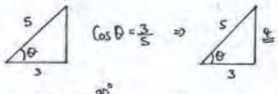
smooth = no friction



equilibrium $\nearrow=\swarrow$ $\nwarrow=\searrow$

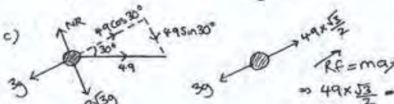
a) $49\cos\theta=3g \Rightarrow \cos\theta=\frac{3g}{49}=\frac{3}{5}$ ✓

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



$\cos\theta=\frac{3}{5} \Rightarrow$ $\sin\theta=\frac{4}{5}$

c)

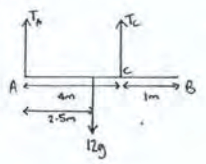


$\vec{RF}=ma\nearrow$

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

$13.035=6a$ $a=\underline{2.17}$

5)



$\uparrow=\downarrow$ $T_A+T_C=12g$

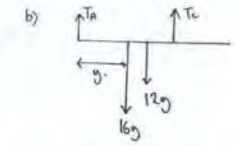
A↻ $12g\times2.5\downarrow = T_C\times4$↺

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

a)i) $T_C=\underline{7.5g}$ N.

ii) $T_A=\underline{4.5g}$N

b)



$T_A+T_C=28g$.

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

$16gy+30g=4T_C$

$\underline{4gy+7.5g=T_C}$

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

$4gy+7.5g<10g$

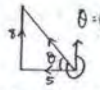
$4\cancel{g}y<2.5\cancel{g}$ $\Rightarrow y<\frac{2.5}{4}$

$y<0.625m$

$\Rightarrow$ $\underline{0<y<0.625m}$

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

b)



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

c) $Vel=-5i+8j$ 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 $=\frac{8i-14j}{4}=2i-3.5j$ $\underline{u=2}$ $\underline{v=-3.5}$

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

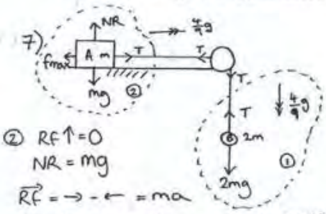
position $=(-8i+14j)+(2i-3.5j)t$ $=(-8+2t)i+(14-$

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

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

Total time to be due south $=3+7.5=\underline{10.5sec}$

7)



① $RF\downarrow=\downarrow-\uparrow=ma$

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

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

② $RF\uparrow=0$

$NR=mg$

$\vec{RF}=\to-\leftarrow=ma$

$T-fmax=m\times\frac{4}{9}g$

$fmax=\mu NR$
$fmax=\mu\times mg$

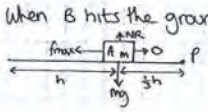
$T-\mu mg=\frac{4}{9}mg$ ②

$2mg-T=\frac{8}{9}mg$ ① +

$2\cancel{m}g-\mu\cancel{m}g=\frac{12}{9}\cancel{m}g$ $\mu\cancel{g}=2\cancel{g}-\frac{12}{9}\cancel{g}$ $\mu=2-\frac{12}{9}=$

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

c) When B hits the ground



$\vec{RF}=-fmax=ma \Rightarrow -\frac{2}{3}\cancel{m}g=\cancel{m}a$

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

Before B hits the ground

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

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

So when B hits the ground

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

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

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

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

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

d) Same tension on A and B.