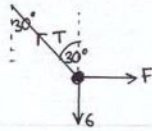


①

M1 - November 02 Solutions

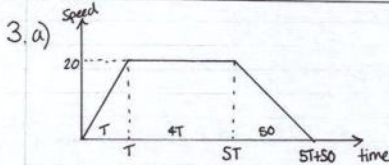
1



- a) Vertically $T \cos 30 = 6 \Rightarrow T = \frac{6}{\cos 30} = 6.93 \text{ N}$ (3sf)
 b) Horizontally $T \sin 30 = F \Rightarrow F = 6.93 \times \sin 30 = 3.46 \text{ N}$ (3sf)

2 a) $F = ma$ magnitude $= \sqrt{2^2 + 5^2} = 5.39$
 $3i - 7.5j = 1.5a \quad \therefore a = \frac{3i - 7.5j}{1.5} = (2i - 5j) \text{ ms}^{-2}$

b) $v = u + at = (2i + 3j) + (2i - 5j) \times 4 = (10i - 17j) \text{ ms}^{-1}$

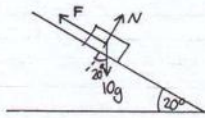


b) Dist travelled = area under graph
 $1220 = \frac{1}{2} (5T + 50 + 4T) 20$
 $1220 = 10 \times (9T + 50)$

③

5 a) $v^2 = u^2 + 2as$
 $64 = 100 + 10a$
 $10a = -36$
 $a = -3.6 \text{ ms}^{-2}$

b) Force = ma
 $= -3.6 \times 10 = -36 \text{ N}$



|| to plane $10g \sin 20^\circ - F = -36$
 $F = 10g \sin 20 + 36 = 69.5 \text{ N}$
 $F = \mu N, N = 10g \cos 20$
 $\therefore \mu = \frac{69.5}{10g \cos 20} = 0.755$ (3sf)

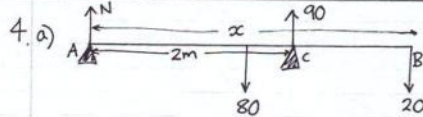
c) Greatest possible length \Rightarrow speed 0 at bottom

$v^2 = u^2 + 2as$
 $0 = 100 - 7.2s$
 $s = \frac{100}{7.2} = 13.9 \text{ m}$ (3sf)

②

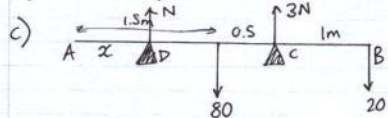
$9T = 72 \Rightarrow T = 8 \text{ s}$

c) $v = u + at$
 $20 = 0 + 8a$
 $a = \frac{20}{8} = 2.5 \text{ ms}^{-2}$



\bar{A} $90 \times 2 - 80 \times \frac{x}{2} - 20x = 0$
 $180 = 40x + 20x$
 $x = 3 \text{ m}$

b) It has mass, but no size.



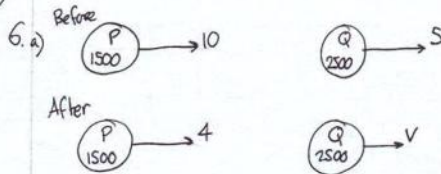
\bar{A} $Nx - 1.5 \times 80 + 2 \times 3 \text{ N} - 3 \times 20 = 0$

but $4N = 100 \Rightarrow N = 25$

$\therefore 25x - 1.5 \times 80 + 2 \times 7.5 - 3 \times 20 = 0$

$25x - 120 + 150 - 60 = 0 \quad x = \frac{30}{25} = 1.2 \text{ m}$

④



Cons. of Mom.

$15000 + 12500 = 6000 + 2500V$

$2500V = 21500$

$V = 8.6 \text{ ms}^{-1}$

b) Force = ma
 $-500 = 1500a \Rightarrow a = -\frac{1}{3} \text{ ms}^{-2}$

$v^2 = u^2 + 2as$
 $0 = 16 - \frac{2}{3}s \quad s = 24 \text{ m}$

c) $v = u + at$
 $0 = 4 - \frac{1}{3}t \quad t = 12 \text{ s}$

in 12s Q travels $8.6 \times 12 = 103.2 \text{ m}$

$\therefore PQ = 103.2 - 24 = 79.2 \text{ m}$

5

7. a) Velocity = $\frac{\text{change in displacement}}{\text{time}} = \frac{(50\mathbf{i} - 25\mathbf{j}) - (20\mathbf{i} + 35\mathbf{j})}{0.5}$
 $= \frac{30\mathbf{i} - 60\mathbf{j}}{0.5}$
 $= (60\mathbf{i} - 120\mathbf{j}) \text{ ms}^{-1}$

b) $\underline{p = 20\mathbf{i} + 35\mathbf{j} + (60\mathbf{i} - 120\mathbf{j})t}$

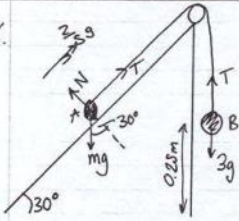
c) $\underline{q = \frac{120}{5}(4\mathbf{i} - 3\mathbf{j})t}$

d) $\underline{PQ} = q - p$ when $t=2$ $p = 140\mathbf{i} - 205\mathbf{j}$
 $q = 192\mathbf{i} - 144\mathbf{j}$

$\underline{PQ} = 52\mathbf{i} + 61\mathbf{j}$

dist PQ = $\sqrt{52^2 + 61^2} = \underline{80.2 \text{ km (3sf)}}$

8.



a) Force = ma

$3g - T = 3 \times \frac{2}{5}g$

$T = 3g - \frac{6}{5}g$

$\underline{T = 17.64 \text{ N}}$

6

$F = ma$

b) $T - mg \sin 30 = m \times \frac{2}{5}g$

$17.64 - mg \sin 30 = \frac{2}{5}mg$

$17.64 = m(\frac{2}{5}g + g \sin 30)$

$17.64 = 8.82m$

$m = \frac{17.64}{8.82} = \underline{2 \text{ kg}}$

c) velocity at floor:

s 0.25

u 0

v v

a $\frac{2}{5}g$

t x

$V^2 = u^2 + 2as$
 $V = \sqrt{2 \times \frac{2}{5}g \times 0.25} = 1.4 \text{ ms}^{-1}$

Impulse = change in mom = mom after - mom bef
 $= 0 - 1.4 \times 3$
 $= -4.2 \text{ Ns}$
 magnitude $\underline{4.2 \text{ Ns}}$

d) B strikes the ground \Rightarrow string goes slack \Rightarrow only force on A is $mg \sin 30$ down the slope.

$F = ma$
 $-mg \sin 30 = ma$
 $a = -4.9 \text{ ms}^{-2}$

s x

u 1.4

v 0

a -4.9

t t

$v = u + at$
 $0 = 1.4 - 4.9t$

$t = \frac{1.4}{4.9} = \underline{\frac{2}{7} \text{ s}}$