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Midterm - 1 (Physics - 150 - 01) Due Date 10th October 2022

ESTIMATION AND UNITS

1-> (a) 0.5 km -> distance

1.5 seconds -> time

Speed in m/s = $\frac{0.5 \times 1000}{1.5} \approx 333.33$ m/s

(b) Speed in km/hour = $\frac{0.5 \times 3600}{1.5}$ = 1200 km/hour

2-> (a) $0.25\ m^3$ in cm^3.

$0.25 \times (100)^3 = 2.5 \times 10^5\ cm^3$

(b) 100 km/h in m/s.

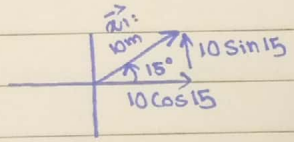
$\frac{100 \times 1000}{3600} = 27\frac{7}{9}$ or 27.778 m/s

(c) $2\ kg\ m\ s^{-2}$ in $gm\ cm\ ms^{-2}$

$2 \times 1000 \times 100 \times 1 \times 10^{-6} = 0.2\ gm\ cm\ ms^{-2}$

VECTORS

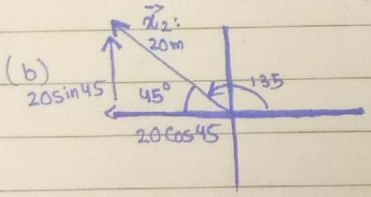
1-> (a)



x-component = 10 Cos 15

y-component = 10 Sin 15

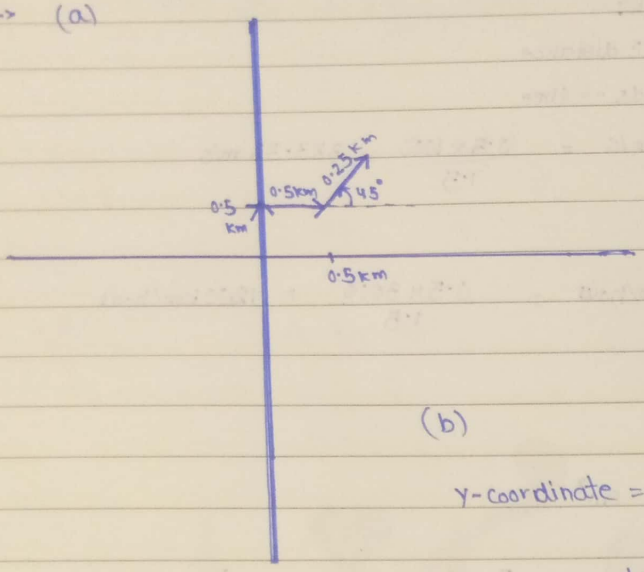
(b)

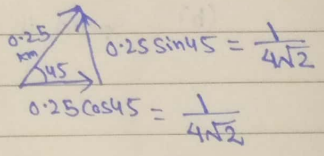


x-component = $20 \cos 45 = 20 \times \frac{1}{\sqrt{2}} = \frac{20}{\sqrt{2}}$

y-component = $20 \sin 45 = 20 \times \frac{1}{\sqrt{2}} = \frac{20}{\sqrt{2}}$

2-> (a)





(b)

y-coordinate = $\left(0.5 + \frac{1}{4\sqrt{2}}\right)$ km

x-coordinate = $\left(0.5 + \frac{1}{4\sqrt{2}}\right)$ km

(c) DISTANCE from origin = 0.5 + 0.5 + 0.25 = 1.25 km

MOTION ALONG STRAIGHT LINE

1-> $x(t) = (-1 - 4t)$ m

(a) ~~x(t)~~ ① $x(-2) = -1 - 4(-2)$

$x(-2) = 7$ m

② $x(2) = -1 - 4(2)$

$x(2) = -9$

Displacement between $t = 2$ & $t = -2$.

displacement => $\frac{-9+7}{2} = \frac{-2}{2} = 1$ m

(b) differentiating the original equation gives velocity:

$\frac{d}{dt}(-1-4t) = -4$

∴ velocity is −4 m/s

Date

2-> (a) $x(t) = -2t + 7t^2$

$v(t) = -2 + 14t$ (by differentiating $x(t)$)

(a) Average velocity between $t=0s$ & $t=2s$.

at $t=0$

$v(0) = -2 + 14(0) = -2 m/s$

at $t=2$

$v(2) = -2 + 14(2)$

$v(2) = 26 m/s$

Average velocity $= \frac{26-2}{2} = 12 m/s$

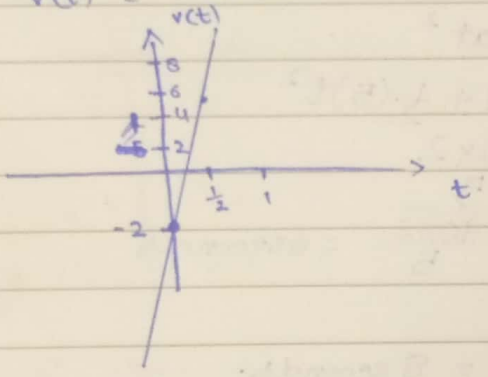
(b) Graph of velocity

$v(t) = 14t - 2$

Points to plot

$t = \frac{1}{2}$, $v(t) = 5$

$t = 0$, $v(t) = -2$



(c) Instantaneous velocity at $t=1s$

$v(t) = -2 + 14t$

$v(1) = -2 + 14(1) = 12 m/s$

(d) acceleration

$v(t) = 14t - 2$

$a(t) = 14$ (by differentiating $v(t)$)

$\therefore$ acceleration is $14 m/s^2$

Date

3-> • Constant acceleration = $5m/s^2$
• Starts from REST (Initial velocity = 0)

(a) $v = u + at$

$10 = 0 + (5)t$

$t = \frac{10}{5} = 2s$

(b) $2as = v^2 - u^2$

$s = \frac{(10)^2 - 0^2}{2(5)} = 10 \text{ meters}$

(c) • For 1st 10 meters
time is = 2 seconds
• For rest 90 meters
finding time :-

~~$v = u + at$~~

$s = ut + \frac{1}{2}at^2$

$90 = 0(t) + \frac{1}{2}(5)t^2$

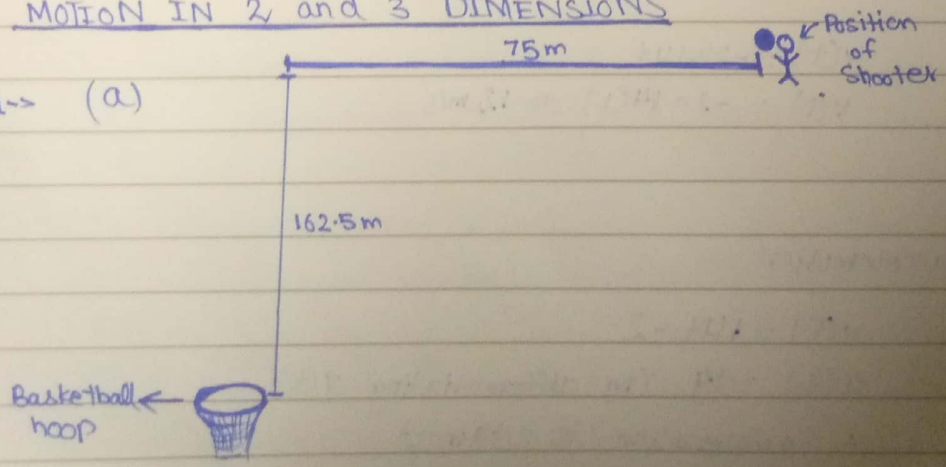
$t^2 = \frac{90 \times 2}{5}$

$t = \sqrt{\frac{90 \times 2}{5}} = 6 \text{ seconds}$

Total time = 6 + 2 = 8 seconds.

MOTION IN 2 and 3 DIMENSIONS

1-> (a)

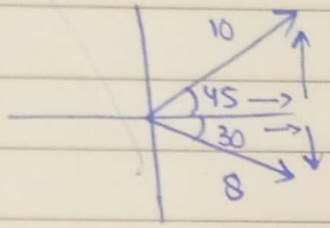


FORCES

1 →

Component table

	x	y
F_1	7.1	7.1
F_2	6.9	-4
R	14	3.1



- $10\cos 45 = F_{1x}$

  $F_{1x} = 7.1N$

- $10\sin 45 = F_{1y}$

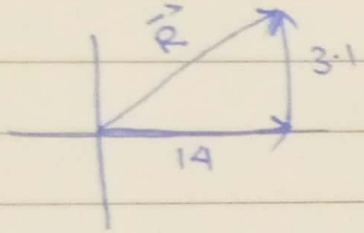
  $F_{1y} = 7.1N$

- $8\cos 30 = F_{2x}$

  $F_{2x} = 6.9N$

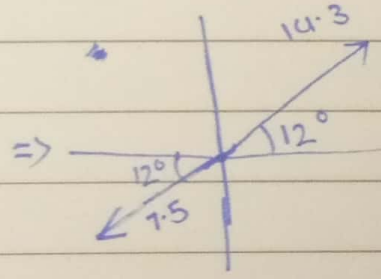
- $-F_{2y} = 8\sin 30$

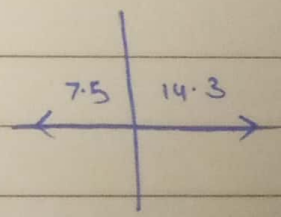
  $F_{2y} = -4N$



- $\vec{R} = \sqrt{(3.1)^2 + (14)^2}$

$\boxed{\vec{R} = 14.3N}$





$a = ?$

- $\tan\theta = \frac{3.1}{14}$

$\theta = \tan^{-1}\left(\frac{3.1}{14}\right)$

$\boxed{\theta = 12°}$

$\Sigma F = ma$

$14.3 - 7.5 = 49 \times a$

$a = \frac{6.8}{49}$

$a = 0.1387 m/s^2$

$a \simeq 0.14 m/s^2$