Score: 22/25. Well done!

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PHYSICS MID TERM #1

ESTIMATIONS & UNIT ANALYSIS

① a) · 1.5 seconds
· ~ 0.5 Km away
↳ 500 meters

$S = \frac{d}{t} \rightarrow \frac{500\,m}{1.5\,s} = \boxed{333\,\frac{m}{s}}$

b) $\frac{Km}{hr}$? $\frac{333\,m}{1\,s} \cdot \frac{60\,s}{1\,min} \cdot \frac{60\,min}{1\,hr} \cdot \frac{1000\,m}{1\,Km} \approx \boxed{1198.8\,\frac{Km}{h}}$

② a) $0.25\,m^3 \rightarrow cm^3$

$0.25\,m^3 \cdot \frac{100\,cm}{1\,m} \cdot \frac{100\,cm}{1\,m} \cdot \frac{100\,cm}{1\,m} = \boxed{250{,}000\,cm^3}$

b) $100\,\frac{Km}{hr}$ to $\frac{m}{s}$

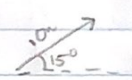
$100\,\frac{Km}{hr} \cdot \frac{1\,hr}{60\,min} \cdot \frac{1\,s}{60\,s} \cdot \frac{1000\,m}{1\,Km} = \boxed{27.78\,\frac{m}{s}}$

c) $2\,kg\;m\;s^{-2} \rightarrow gm\;ms^{-2}$

$\frac{2\,kg\,m}{s^2} \cdot \frac{1000\,g}{1\,kg} \cdot \frac{100\,cm}{1\,m} \cdot \frac{1\,s}{1000\,ms} \cdot \frac{1\,s}{1000\,ms} = \boxed{\frac{0.2\,g\,cm}{ms^2}}$

VECTORS

① a) $\vec{x}_1$, $m = 10\,ms$, $15°$

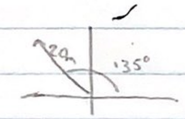


$x = \cos(15°) \cdot 10\,m = 9.66\,m$

$y = \sin(15°) \cdot 10\,m = 2.59\,m$

$\boxed{9.66\,\hat{i} + 2.59\,\hat{j}}$

b) $\vec{x}_2$, $m = 20\,m$, $(135°)$



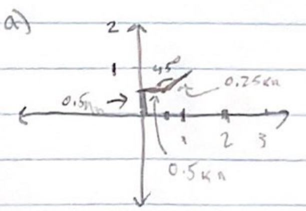
$x = \cos(135°) \cdot 20\,m = -14.14\,m$

$y = \sin(135°) \cdot 20\,m = 14.14\,m$

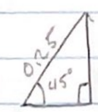
$\boxed{-14.14\,m\,\hat{i} + 14.14\,m\,\hat{j}}$

② 0.5Km N → 0.5KmE → 45° NE for 0.25 Km

a)



b)



$x = \cos(45) \cdot 0.25\,Km = 0.18$

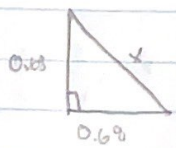
$y = \sin(45) \cdot 0.25\,Km = 0.18$

$0.5\,Km\,\hat{j} + 0.5\,Km\,\hat{i} + 0.18\,Km\,\hat{i} + 0.18\,Km\,\hat{j}$

$\boxed{= 0.68\,Km\,\hat{i} + 0.68\,Km\,\hat{j}}$

c) ORIGIN?

$0.68^2 + 0.68^2 = x^2$



$\boxed{x = 0.96\ \text{Km}}$

MOTION ALONG A STRAIGHT LINE

① $x(t) = -1.0 - 4.0t\ m$

a) $t = -2.0$
$t = 2.0$

DISPLACEMENT?

$\Delta x = \underbrace{x_f}_{} - \underbrace{x_i}_{} \rightarrow$

$x_f = x(2) = -1.0 - 4.0(2)$
$= -9.0\ m$

$x_i = x(-2) = -1.0 - 4.0(-2)$
$= 7.0\ m$

$= -9.0 - 7.0$

$\boxed{= -16.0\ m}$

b) VELOCITY

$v = \frac{\Delta x}{\Delta t} \rightarrow \frac{-16.0\ m}{4\ s} = \boxed{-4.0\ m/s}$

$\frac{-9.0 - 7.0}{2 - (-2)}$

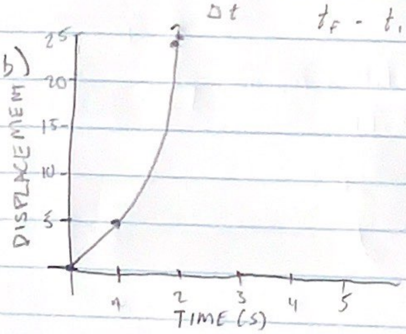
② $x(t) = -2t + 7t^2$

a) AVG VELOCITY
$0_s \rightarrow 2_s$

$x_f(2s) = -2(2) + 7(2)^2 = 24$
$x_i(0s) = -2(0) + 7(0)^2 = 0$

$v = \frac{\Delta x}{\Delta t} = \frac{x_f - x_i}{t_f - t_i} = \frac{24_m - 0_m}{2_s - 0_s} = \frac{24\ m}{2\ s} = \boxed{12\ \frac{m}{s}}$

b)



c) $-2(1) + 7(1)^2$
$-2 + 7$
$\boxed{5\ m/s}$ (-1)

d) $a = \frac{\Delta v}{\Delta t} = \frac{12\ m/s}{2 - 0} = \frac{12\ m/s}{2\ s} = \boxed{6\ m/s^2}$ (-1)

3) FROM REST: $5.0 \frac{m}{s^2}$ a) TOP SPEED @ $10.0 \, m/s$

$$a = \frac{\Delta v}{\Delta t} \rightarrow 5.0 \frac{m}{s^2} = \frac{10.0 \frac{m}{s}}{\Delta t} \rightarrow \Delta t = \frac{10.0 \, m/s}{5.0 \, m/s^2}$$

$$\boxed{t = 2s}$$

b) DISPLACEMENT?

$$x(t) = \tfrac{1}{2}(5.0 \, m/s^2)(2s)^2 + 0.2s + 0$$
$$= 2.5 \, m/s^2 + 4 + 0.2$$
$$\boxed{x(t) = 10m}$$

c) 100m @ $10.0 \, m/s$

$100m - 10m = 90m$

$$v = \frac{\Delta x}{\Delta t} \rightarrow 10 \frac{m}{s} = \frac{90 \, m/s}{\Delta t} \rightarrow \Delta t = \frac{90 \, m}{10 \, m/s}$$

$$9s + 2s = \boxed{11s}$$

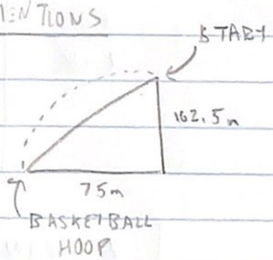
Well done!

$t = 9$

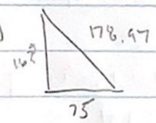
MOTION IN TWO & THREE DIMENTIONS

1) 162.5 m above
75 m away

a)



b)



V_0,

$$162.5^2 + 75^2 = x^2$$
$$x = 178.97$$

$$\tan(\theta) = \frac{162.5m}{75m} = 65.22°$$

$$R = \frac{V_0^2 \sin(2\theta_0)}{g} \rightarrow 75 = \frac{V_0^2 \sin(2 \cdot 65.22)}{9.8}$$

$$V_0 = 31.08 \, m/s$$

$$V_{x,i} = V_0 \cos(\theta)$$
$$= 31.08 \, m/s \cdot \cos(65.22°)$$
$$\boxed{V_{x,i} = 13.03 \, m/s}$$

Though your method is technically incorrect, it is clever and remarkably close to the right answer. The basketball is meant to be shot horizontally, not at an angle, and its trajectory is quadratic.

2) $45°$ @ $40 \frac{m}{s}$

a) HOW FAR?

$$R = \frac{V_0^2 \sin(2 \cdot \theta)}{g} = \frac{(40 \frac{m}{s})^2 \sin(2 \cdot 45)}{9.8}$$

$$\boxed{= 163.26m}$$

b) $x(t) = (x_i + V_{x,i} \, t)$

$163 = 0m + 40 \frac{m}{s} \cdot t$

$$\boxed{t = 4.08 \, s}$$

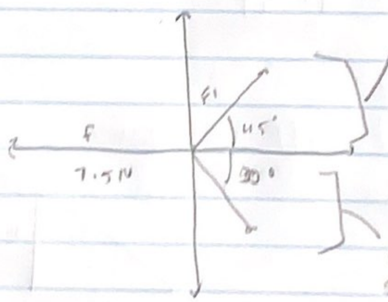
(-1) Use the time-of-flight formula

FORCES

① $49.0kg = m$

$\vec{F_1} = 10N$

$\vec{F_2} = 8N$

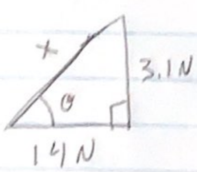


$\cos(45°) 10 = 7.1 N$

$\sin(45°) 10 = 7.1 N$

$\cos(30°) 8 = 6.9N$

$\sin(30°) 8 = -4.0N$



$x = 7.1N + 6.9N$
$= 14N$

$y = 7.1N + (-4.0N)$
$= 3.1N$

$x^2 = 14^2 + 3.1^2$

$x = 14.3N$ → $\tan(\theta) = \frac{3.1N}{14.3N}$

$= 12°$

$$\frac{14.3 - 7.5}{49.0} = \frac{49.0 \cdot a}{49.0}$$

Excellent work

$$a = \frac{6.8}{49.0} = \boxed{0.14 \, m/s^2}$$