JOSEPH EDERA
#20656037

PHYSICS MID TERM #1

ESTIMATIONS & UNIT ANALYSIS

① a) · ~1.5 seconds

· ~0.5 Km away
  ↳ 500 meters

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

b) $\dfrac{Km}{hr}$ ∩ $\dfrac{333 \, m}{1 \, s}$ · $\dfrac{60 \, s}{1 \, min}$ · $\dfrac{60 \, min}{1 \, hr}$ · $\dfrac{1000 \, n}{1 \, Km}$ ≈ $\boxed{1198.8 \frac{Km}{h}}$

② a) $0.25 m^3 \rightarrow cm^3$

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

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

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

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

$\dfrac{2 \, kg \, m}{s^2}$ · $\dfrac{1000 \, g}{1 \, kg}$ · $\dfrac{100 \, cm}{1 \, m}$ · $\dfrac{1 \, s}{1000 \, ns}$ · $\dfrac{1 \, s}{1000 \, ns}$ = $\boxed{\dfrac{0.2 \, gcm}{ms^2}}$

VECTORS

① a) $\vec{x}_1$, m = 10 ns, 15°
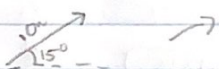
$x = \cos(15°) \cdot 10 \, m = 9.66 \, m$
$y = \sin(15°) \cdot 10 \, m = 2.59 \, m$

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

b) $\vec{x}_2$, m = 20m, (135°)
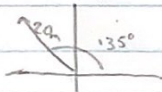
$x = \cos(135°) \cdot 20m = -14.14$
$y = \sin(135°) \cdot 20m = 14.14m$

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

② 0.5km N → 0.5km E → 45° NE for 0.25 km

a)

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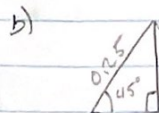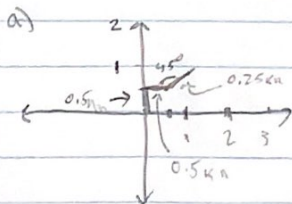
$x = \cos(45) \cdot 0.25 \, Km = 0.18$
$y = \sin(45) \cdot 0.25 \, Km = 0.18$

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

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

c) ORIGIN?

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

$\boxed{x = 0.96 \text{ km}}$
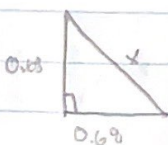
MOTION ALONG A STRAIGHT LINE

① $x(t) = -1.0 - 4.0\,t\,\text{m}$

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

   DISPLACEMENT?

$\Delta x = x_f - x_i \rightarrow$

$= -9.0 - 7.0$

$\boxed{= -16.0 \text{ m}}$

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

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

b) VELOSITY

$v = \frac{\Delta t}{\Delta t} \Rightarrow \dfrac{-16.0 \text{ m}}{4 \text{ s}} = \boxed{-4.0 \text{ m/s}}$
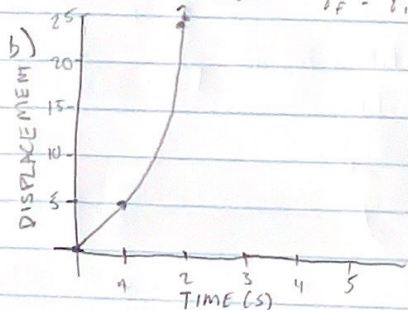
$\dfrac{-9.0 - 7.0}{2 - (-2)}$

② $x(t) = -2t + 7t^2$

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

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

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

b)

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

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

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

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

b) DISPLACEMENT?

$\boxed{t = 2s}$

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

$$\boxed{x(t) = 10m}$$

c) 100m @ 10.0 m/s

$$100m - 10m = 90m$$

$$v = \frac{\Delta x}{\Delta t} \rightarrow 10 \frac{m}{s} = \frac{90 m/k}{\Delta t} \rightarrow \Delta t = \frac{90 m}{10 m/s}$$
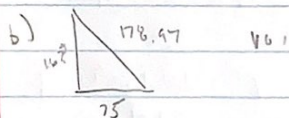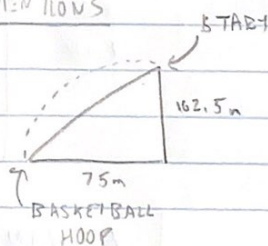
$$9s + 2s = \boxed{11s}$$ $t = 9$

MOTION IN TWO & THREE DIMENTIONS

1) 16 2.5 m __above__   a)   STARY

    75 m __away__

162.5 m

75 m

BASKETBALL HOOP

b) 178.47 V_{0} ? 16^2 75

$$162.5^2 + 75^2 = x^2$$
$$x = 178.54$$

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

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

$$V_0 = 31.08 \frac{m}{s}$$

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

$$\boxed{V_{x,i} = 13.03 \frac{m}{s}}$$

2) 45° @ 40 m/s

a) HOW FAR?

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

$$= 163.26 \text{ m}$$

b) $x(t) = (x_i + v_{x,i} \, t)$?
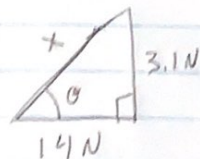
$$163 = 0_m + 40 \text{ m/s} \cdot t$$

$$t = 4.08 \text{ s}$$

FORCES

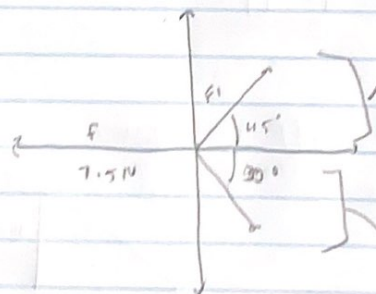① $49.0 \text{ kg} = m$

$\vec{F}_1 = 10 \text{ N}$

$\vec{F}_2 = 8 \text{ N}$

$\cos(45°) \, 10 = 7.1 \text{ N}$

$\sin(45°) \, 10 = 7.1 \text{ N}$

F_1 45°

F 30°

7.5 N

$\cos(30°) \, 8 = 6.9 \text{ N}$

$\sin(30°) \, 8 = -4.0 \text{ N}$

x 3.1 N

θ

14 N

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

$x = 14.3 \text{ N}$ ↗ $\tan(\theta) = \dfrac{3.1 \text{ N}}{14.3 \text{ N}}$

$= 12°$

↓

$x = 7.1 \text{ N} + 6.9 \text{ N}$
$= 14 \text{ N}$

$y = 7.1 \text{ N} + (-4.0 \text{ N})$
$= 3.1 \text{ N}$

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

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