Ethan Saenz

Score: 22/25. Nice job!

Midterm 1

2) Estimations & Unit Analysis

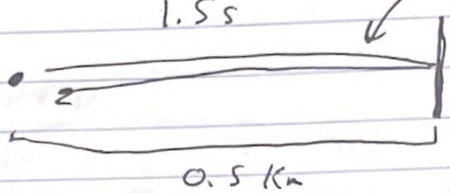
1a) $t = 1.5s$

$d = 0.5\ Km$

$\frac{0.5\ Km}{1m} \times \frac{1000m}{1\ Km} = 500m$

Since it bounces back you need

$V = \frac{2d}{t}$



$V = \frac{1000m}{1.5s} = \boxed{666.7\ m/s}$

1b) $\frac{\cancel{1Km}}{1.\cancel{5}s} \cdot \frac{\cancel{60}s}{\cancel{1min}} \cdot \frac{\cancel{60}min}{\cancel{1hr}} =$

$\frac{2 (0.5\ Km)}{1.5s} = 0.667\ Km/s \cdot \frac{3600s}{1hr} = \boxed{2400\ Km/hr}$

2a) $1m = 100cm \quad 1m^3 = 100^3 \cancel{cm} = 1000000cm^3$

$0.25m^3$

$0.25m^3 \cdot 1000000 = \boxed{250{,}000\ cm^3}$

2b) $100\ Km/hr \quad \frac{100\ \cancel{Km}}{1\ \cancel{hr}} \cdot \frac{1\ \cancel{hr}}{60\ \cancel{min}} \cdot \frac{\overset{1min}{\cancel{60s}}}{60s} \cdot \frac{1000m}{1\ \cancel{Km}}$

$\frac{100 \cdot 1000m}{3600s} = \boxed{27.78\ m/s}$

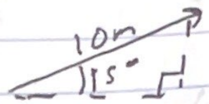
2c) $\frac{2\ \cancel{Kg}\ \cancel{m}}{s^2} \cdot \frac{1000g}{1\ \cancel{Kg}} \cdot \frac{100cm}{1\cancel{m}} \cdot \left(\frac{1s}{1000ms}\right) \cdot \frac{1s}{1000ms}$

$\cancel{s^2}\ ms^{-2}$

$\boxed{= \frac{0.2\ g\ cm}{ms^{-2}}}$

3 Vectors

1a)



$x = \cos(15) \cdot 10 = 9.66\hat{i}$

$y = \sin(15) \cdot 10 = 2.59\hat{j}$

~~$\vec{X}_1 = 9.66m\hat{i} + 2.59m\hat{j}$~~

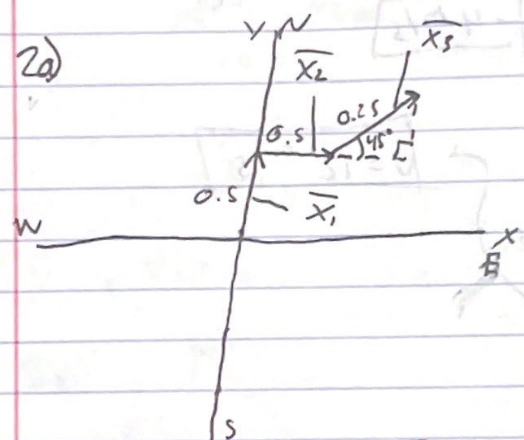
$\boxed{\vec{X}_1 = (9.66\hat{i} + 2.59\hat{j})m}$

1b) $x = \cos(135) \cdot 20m = -14.1\hat{i}$

$y = \sin(135) \cdot 20m = 14.1\hat{j}$

$\boxed{\vec{X}_2 = (-14.1\hat{i} + 14.1\hat{j})m}$

2a)



2b)

$\overline{X_3} = \cos(45) \cdot 0.25$

$= 0.18\hat{i}$

$y = \sin(45) \cdot 0.25 = 0.18\hat{j}$

$0.5 km\hat{j} + 0.5 km\hat{i}$ ~~$+ (0.18\hat{i} + 0.18\hat{j})$~~

$0.18 km\hat{j} + 0.18 km\hat{i}$

~~$\Delta x = 0.68 km\hat{i} + 0.68 km\hat{j}$~~ $\boxed{\Delta\overline{x} = 0.68\hat{i}\,km + 0.68\hat{j}\,km}$

2c) $0.68^2 + 0.68^2 = c^2$

$\sqrt{0.9248} = \sqrt{c^2}$

$\boxed{c = 0.96 km}$

4 Motion Along a straight line

1a) $\Delta x = x(2) - x(-2)$

$= (-1 - 4(2)) - (-1 - 4(-2))$

$= -1 - 8 - (-1 + 8)$

$\boxed{= -16 m}$

1b) $v = \frac{\Delta x}{\Delta t}$ $\Delta x = -16 m$

$\Delta t = 2 - (-2) = 4 s$

$v = \frac{-16}{4} = \boxed{-4 \, m/s}$

2a)

$V = \frac{x(2) - x(0)}{2}$

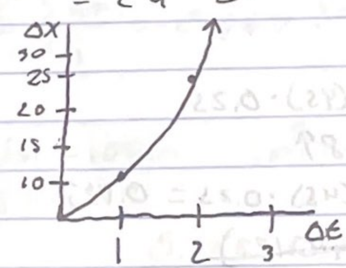
$V = -2(2) + 7(2)^2$

$= -4 + 28$

$= 24$

$\boxed{v = 12 \, m/s}$

2b)



(-1) The graph should be linear

2c) $v = \frac{-2(1) + 7(1)^2}{1}$

$v = -2 + 7$

$\boxed{V = 5 \, m/s}$

(-1) The velocity is 12 m/s

2d) $\bar{a} = \frac{\Delta \bar{v}}{\Delta t}$ $a = \frac{12 \, m/s}{2 s} = \boxed{6 \, m/s^2}$

3a) $\vec{a} = \frac{\Delta \vec{v}}{\Delta t}$

$\vec{a} = 5.0\ m/s^2$
$V_i = 0\ m/s$
$V_f = 10\ m/s$
$\Delta t = ?$

$\Delta t = \frac{10\ m/s}{5.0\ m/s^2} = \boxed{2s}$

3b) $\cancel{\Delta x = x_f - x_i}$
$\cancel{= 100m - 20m}$
$\cancel{\boxed{80m}}$

$x(t) = \frac{1}{2} a t^2 + V_i t + x_i$
$= \frac{1}{2}(5.0)(2s)^2 + 0.2s + 0m$
$\boxed{= 10.2m}$

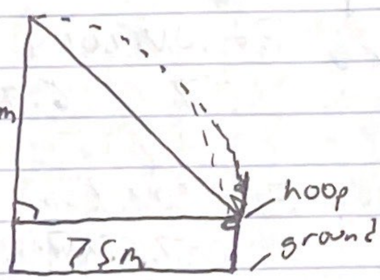
Just 10 meters, the second term has v_i = 0 m/s

3c) $100m - 10m = 90m$
$10\ m/s = 90m$
$= 9s$
$+2s$
$\boxed{=11s}$

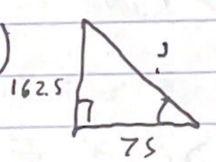
Right!

5 Motion in Two & Three Dimensions

1a)



1b)



$162.5^2 + 75^2 = c^2$
$\sqrt{32031.25} = c^2$
$c = 178.97m$

$\theta = \tan^{-1}\left(\frac{162.5}{75}\right)$
$\theta = 65.2°$

$R = \frac{V_0^2 \sin(2\theta)}{g}$

$V_0^2 = \frac{Rg}{\sin(2\theta)}$

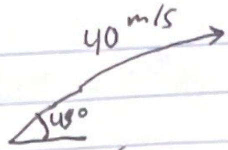
$V^2 = \frac{75m(9.81)}{\sin(2 \cdot 65.2°)}$

$\sqrt{V^2} = \sqrt{966.1}$
$\boxed{V = 31.1\ m/s}$

(-1) 13 m/s
Not sure what happened here

$R = 75m$
$V_0^2 = ?$
$\theta = 65.2°$
$g = 9.81$

2a)



$$R = \frac{(40\,m/s)^2 \sin(2 \cdot 45^\circ)}{9.81}$$

$$R = 163.1\,m$$

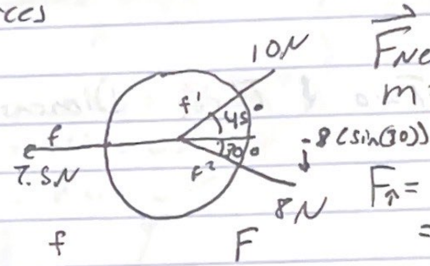
2b) $$T = \frac{2 V_0 \sin(\theta)}{g}$$

$$T = \frac{2(40\,m/s)\sin(45)}{9.81}$$

$$= \frac{80}{9.81} \cdot \frac{1}{\sqrt{2}} = \boxed{5.77\,s}$$

6 Forces

1)



$$\vec{F}_{Net} = m\vec{a}$$

$m = 49\,kg$

$$F_x = 10N(\cos 45^\circ) + (8N)(\cos 30)$$
$$= 7.07 + 6.93$$
$$= 14\,N$$

$$F_y = 10N(\sin 45) - (8N)(\sin 30)$$
$$= 7.07 - 4$$
$$= 3.07N$$

$$14^2 + 3.07^2 = c^2$$
$$c = 14.3N$$

$$\theta = \tan^{-1}\frac{3.07}{14.0}$$
$$= 12.4^\circ$$

$$\vec{F}_{Net} = m\vec{a}$$

$$\vec{a} = \frac{14.3N - 7.5N}{49\,kg}$$

$$\boxed{\vec{a} = 0.14\,m/s^2}$$

Excellent work