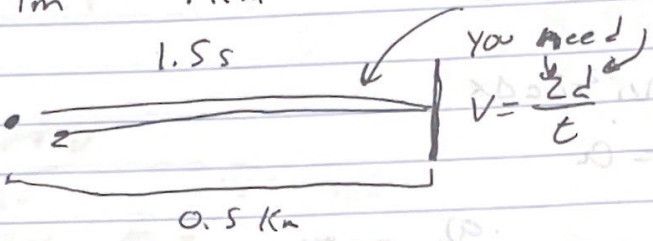
Midterm 1

2) Estimations & Unit Analysis

1a) $t = 1.5s$

$d = 0.5\ Km$

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



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

1b) $\frac{\cancel{Km}}{1.5s} \cdot \frac{60s}{\cancel{1min}} \cdot \frac{60min}{\cancel{1hr}} =$

$\frac{20.5\ Km}{1.5s} = 0.667\ Km/s \cdot \frac{3600s}{1hr} = \boxed{2400\ Km/hr}$

2a) $1m = 100cm \quad 1m^3 = 10^3 = 1000000cm^3$

$6.25m^3$

$6.25m^3 \cdot 1000000 = \boxed{250,000\ cm^3}$

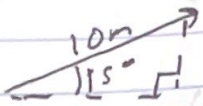
2b) $100\ Km/hr \quad \frac{100\ Km}{1hr} \cdot \frac{1hr}{60min} \cdot \frac{1min}{60s} \cdot \frac{1000m}{1\ Km}$

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

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

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

3 Vectors

1a) 

$x = \cos(15) \cdot 10 = 9.66\uparrow$

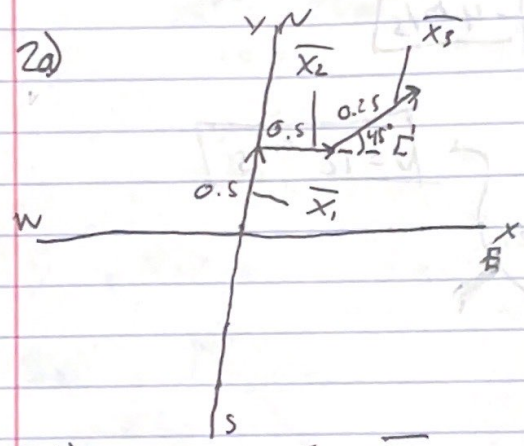
$y = \sin(15) \cdot 10 = 2.59\uparrow$

$\vec{x}_1 = (9.66\uparrow + 2.59\uparrow)\,m$

1b) $x = \cos(135) \cdot 20m = -14.1\uparrow$

$y = \sin(135) \cdot 20m = 14.1\uparrow$

$\vec{x}_2 = (-14.1\uparrow + 14.1\uparrow)\,m$

2a) 

2b) $\vec{x}_3 = \cos(45) \cdot 0.25$

$= 0.18\uparrow$

$y = \sin(45) \cdot 0.25 = 0.18\uparrow$

$0.5\,km\uparrow + 0.5\,km\uparrow + (0.18\uparrow + 0.18\uparrow)$

$0.18\,km\uparrow + 0.18\,km\uparrow$

$\Delta\vec{x} = 0.68\uparrow km + 0.68\uparrow km$

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

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

$c = 0.96\,km$

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

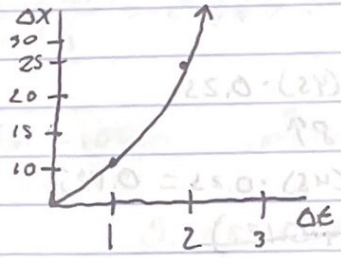
$v = -2(2) + 7(2)^2$

$= -4 + 28$

$= 24$

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

2b)



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

$v = -2 + 7$

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

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

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

$\vec{a} = 5.0\ m/s^2$

$v_i = 0\ m/s$

$v_p = 10\ m/s$

$\Delta t = ?$

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

3b) ~~$\Delta x = x_f - x_i$~~

~~$= 10m - 0m$~~

~~$= 10m$~~

$x(t) = \frac{1}{2} a t^2 + v_i t + x_i$

$= \frac{1}{2}(5.0)(2)^2 + 0.2s + 0m$

$= \boxed{10.2m}$

3c) $100m - 10m = 90m$

$10\ m/s = 90m$

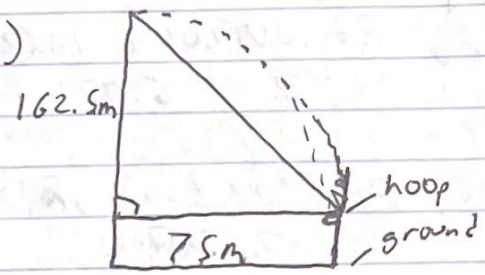
$= 9s$

$+ 2s$

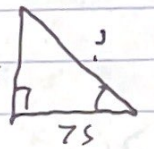
$= \boxed{11s}$

5 Motion in Two & Three Dimensions

1a)



1b)



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

$\theta = 65.2°$

$162.5^2 + 75^2 = c^2$

$\sqrt{32031.25} = \sqrt{c^2}$

~~$c = 178.$~~

$c = 178.97m$

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

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

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

$\sqrt{V^2} = \sqrt{966.1}$

$\boxed{V = 31.1\ m/s}$

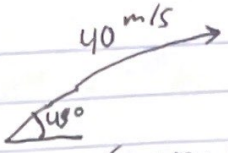
$R = 75m$

$V_0^2 = ?$

$\theta = 65.2°$

$g = 9.81$

2a)



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

$$R = 163.1\ m$$

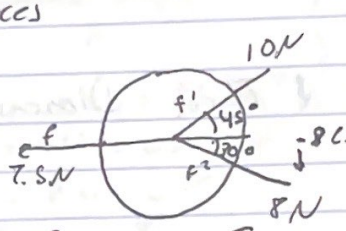
2b) $$T = \frac{2 V_0 \sin(\theta)}{g}$$

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

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

6 Forces

1)



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

$m = 49\ kg$

$F_x = 10N(\cos 45°) + (8N)(\cos 30)$

$= 7.07 + 6.93$

$= 14N$

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

$= 7.07 - 4$

$= 3.07N$

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

$c = 14.3N$

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

$= 12.4°$

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

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

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