2 Estimations & Unit Analysis

1)

(a) $v = \frac{x}{t} = \frac{500m}{1.5s} =$ **333.33 m/s**
↳ The speed of sound

(b) $x = 0.5km$
$t = 1.5s$
↳ convert $1.5s \times \frac{1min}{60s} = 0.025 \times \frac{1hr}{60min} = 0.0004167$

$v = \frac{x}{t} = \frac{0.5km}{0.004167} =$ **1,199.9 km/hr**

2)

(a) $0.25m^3$ to cm^3 Note: $1cm^3 = 1000000$

$0.25m^3 \times \frac{1000000cm^3}{1m}$

$= 25,000,000\ cm^3$

(b) 100 km/hr in m/s?

$\frac{100km}{1hr} \times \frac{1000m}{1km} \times \frac{1hr}{3600s} = \frac{100,000m}{3600s}$

$= 27.78\ m/s$

(c) $2\ kgms^{-2}$ in $gm\ cm\ ms^{-2}$ $kg = 10^{-3}g$
$1\ kg\ m/s^2 = 10\ gm\ cm\ ms^{-1}$ $m = 10^{-2}$
$2\ Kg\ m/s^{-2} = 20\ gm\ cm\ ms^{-2}$ $s = 10^{-3}$

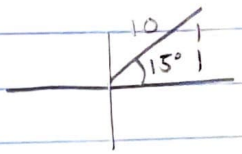
$\frac{(1 \times 10^{-3}) \times 10^{-2}}{(10^{-3})^2} \rightarrow \frac{.001 \times 10^{-2}}{10^{-6}}\ \frac{gm\ cm}{ms^2}$

$= 10 \cdot 2$

$= 20\ gm\ cm\ ms^{-2}$

3 Vectors

1)



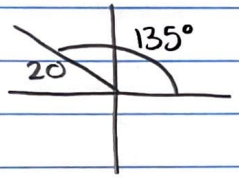
(a) mag = 10m, angle = 15°

$10\cos 15° = \frac{5\sqrt{6}+5\sqrt{2}}{2} = 9.66\hat{\imath}$

$10\sin 15° = \frac{5\sqrt{6}-5\sqrt{2}}{2} = 2.585\hat{\jmath}$

$\vec{X}_1 = (9.66\hat{\imath} + 2.585\hat{\jmath})\,m$

(b) mag = 20m, angle = 15°



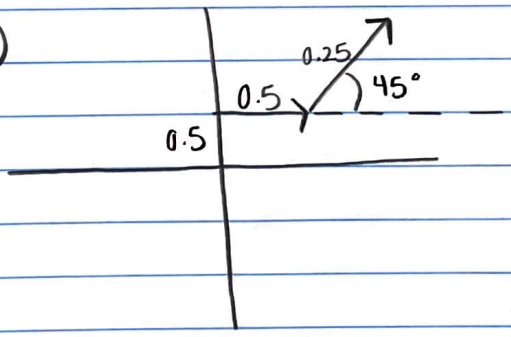
$20\cos 135° = -7.07\hat{\imath}$

$20\sin 135° = 7.07\hat{\jmath}$

$\vec{X}_2 = (-7.07\hat{\imath} + 7.07\hat{\jmath})\,m$

2)

(a)



(b) 0.5N↑, 0.5E→, 0.25↗

$0.25\sin(45°) = 0.177\,km$

$0.25\cos(45°) = 0.177\,km$

$0.177\,km + 0.5 = 0.677\,km\hat{\jmath}$

$0.177\,km + 0.5 = 0.677\,km\hat{\imath}$

Final: $(0.68\hat{\imath} + 0.68\hat{\jmath})\,km$

(c) $a^2 + b^2 = c^2$

↳ $(0.68)^2 + (0.68)^2 = c^2$

$c = 0.68\sqrt{2}$

$c = 0.96\,km$ = distance

4 Motion Along a Straight Line

1)

(a) $v = \frac{x_f - x_i}{t_f - t_i} = \frac{\Delta x}{\Delta t}$

$\Delta x = -9 - 7 = -16\,m$

$v = \frac{x(-2)\,m - x(2)\,m}{-2s - 2s}$

$x(2) = -1.0 - 4.0(2)\,m$
$= -1.0 - 8\,m$
$= -9m$

$x(-2) = -1.0 - 4.0(-2)\,m$
$= -1.0 + 8m$
$= 7m$

(b) $v = \frac{\Delta x}{\Delta t} = \frac{-16m}{-4s} = 4\,m/s$

2)

(a) $v = \frac{x_f - x_i}{t_f - t_i} = \frac{\Delta x}{\Delta t}$

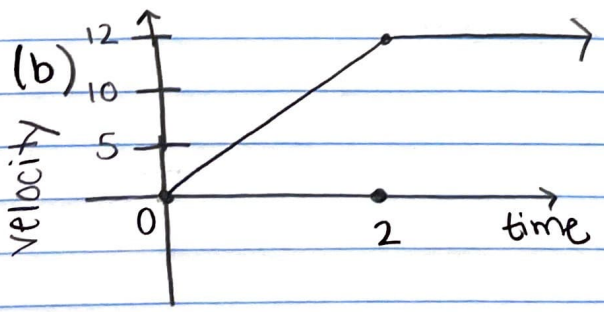
$v = \frac{x(2) - x(0)}{2 - 0s}$

$x(2) = -2(2) + 7(2)^2$
$-4 + 7(4)$
$-4 + 28$
$x(2) = 24$

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

$v = \frac{24 - 0m}{2s} = \frac{24}{2} = 12\ m/s$

(b)



(c) instantaneous velocity?

$x(1) = -2(1) + 7(1)^2$
$-2 + 7$
$x(1) = 5\,m/s$

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

3)

(a) time for top speed = 10 m/s

$V_f = 10\ m/s$

$V_i = 0\ m/s$

$t = ?$

$V = V_i + at$

$10\ m/s = 0 + 5\ m/s^2 (t)$

$$\frac{10\ m/s}{5\ s} = \frac{5\ m/s^2 (t)}{5}$$

$\boxed{t = 2\ sec}$

(b) displacement?

$V_f = 10\ m/s$

$x(t) = 1/2\ at^2 + V_i(t) + x_i$

$V(t) = V + at$

$x(t) = 1/2\ (V_f + V_i)\ t)$

$= 1/2\ (10 + 0)(2)$

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

(c) $speed = \frac{d}{t} \rightarrow t = \frac{d}{s}$

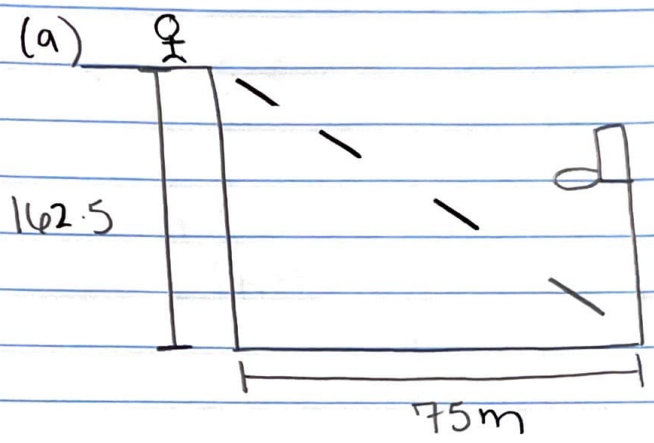
$\Delta x = 100 - 10 = 90m$

$t = \frac{90m}{10 m/s} = 9s$ → $9s + 2s = \boxed{11 sec \text{ total } t}$

5 Motion in Two & Three Dimensions

1) height = 162.5
horiz. = 75 m

(a)



(b) $\text{angle} = \tan^{-1}\left(\frac{162.5}{75}\right) \approx 65°$
↳ tan

$$R = \frac{V_0^2 \sin(2\theta_0)}{g} = V_0^2 = \frac{Rg}{\sin(2\theta)}$$

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

$$V_0 = \frac{75(9.81)}{\sin(2(65))}$$

$V_0 = 31$

$V_0 = 31$

$31\cos(65°)$

$\boxed{V_{xi} = 12.7 \text{ m/s} \approx 13 \text{ m/s}}$

2)

(a) $R = \frac{v^2 \sin(2\theta)}{g} = \frac{40 \text{m/s}^2 \sin(2(45))}{9.81}$

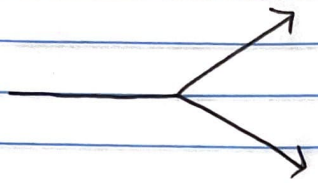
$= \frac{40^2 \cdot 1}{9.81} = \boxed{163.1 \text{ m}}$ ↳ lands

(b) $T = \frac{2V_0 \sin(\theta)}{g} = \frac{2(40)\sin(45)}{9.81} = \frac{40\sqrt{2}}{9.81} = 5.76 \text{ sec}$

$\boxed{\text{time in air} = 5.76 \text{ sec}}$

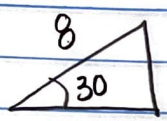
6 Forces

1)



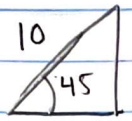
$\vec{a} = \frac{F_{Net}}{m} = \frac{6.86}{49}$

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



$x = \cos(30°)8$

$x = 6.93\uparrow, -4\int$



$x = \cos(45°)10$

$x = 7.07\uparrow, 7.07\int$

$F_{Net} = 14.3\ N$

$7.07 + 6.93 = 14\uparrow$

$7.07 - 4 = 3\int$

] 14.3 N

$14.3 - 7.5 = 6.86$