Score: 20.5/20. Well done!

Fayze Hindi

2 Estimations & Unit Analysis

1)

(a) $v = \frac{x}{t} = \frac{500m}{1.5s} = \boxed{333.33\ m/s}$

↳ The speed of sound

(b) $x = 0.5km$

$t = 1.5s$

↳ convert $1.5s \times \frac{1\ min}{60s} = 0.025 \times \frac{1hr}{60min} = 0.0004167$

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

2)

This is true, though.

(a) $0.25m^3$ to cm^3

Note: $1cm^3 = 1000000$

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

$\boxed{= 25,000,000\ cm^3}$

(-1) 250,000 cm^3

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

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

$\boxed{= 27.78\ m/s}$

(c) $2kgms^{-2}$ in $gm\ cm\ ms^{-2}$

$Kg = 10^{-3}g$

$1\ kg\ m/s^2 = 10\ gm\ cm\ ms^{-1}$

$m = 10^{-2}$

$2\ Kg\ m/s^{-2} = 20\ gm\ cm\ ms^{-2}$

$S = 10^{-3}$

$\frac{(1\times10^{-3})\times10^{-2}}{(10^{-3})^2} \rightarrow \frac{.001\times10^{-2}}{10^{-6}} \frac{gm\ cm}{ms^2}$

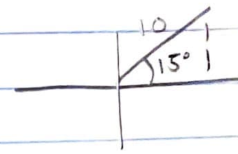
$= 10 \cdot 2$

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

(-1) 0.2 gm cm ms^(-2)

3 Vectors

1)



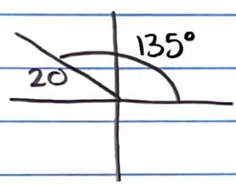
(a) mag $= 10\,m$, angle $= 15°$

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

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

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

(b) mag $= 20\,m$, angle $= 15°$



$$20\cos 135° = -7.07\,\hat{i}$$

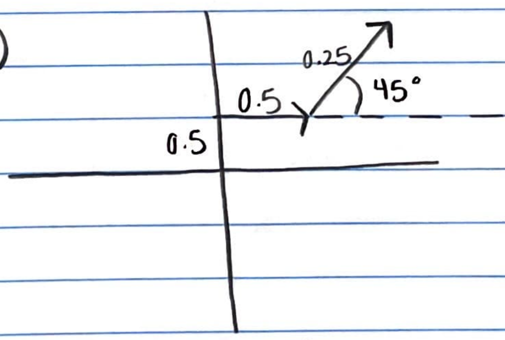
$$20\sin 135° = 7.07\,\hat{j}$$

(-0.5) Some math error, -20/sqrt(2) and 20/sqrt(2)

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

2)

(a)



(b) 0.5N ↑, 0.5E →, 0.25 ↗

$$0.25\sin(45°) = 0.177\,km$$

$$0.25\cos(45°) = 0.177\,km$$

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

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

Final: $(0.68\,\hat{i} + 0.68\,\hat{j})\,km$

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

$\hookrightarrow (0.68)^2 + (0.68)^2 = c^2$

$c = 0.68\sqrt{2}$

$C = 0.96\,km =$ distance

4 Motion Along a Straight Line

1)

(a) $V = \dfrac{x_f - x_i}{t_f - t_i} = \dfrac{\Delta x}{\Delta t}$ $\boxed{\Delta x = -9 - 7 = -16\text{m}}$

$V = \dfrac{x(-2)\text{m} - x(2)\text{m}}{-2\text{s} - 2\text{s}}$

$x(2) = -1.0 - 4.0(2)\text{m}$
$= -1.0 - 8\text{ m}$
$= -9\text{m}$

$x(-2) = -1.0 - 4.0(-2)\text{m}$
$= -1.0 + 8\text{m}$
$= 7\text{m}$

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

2)

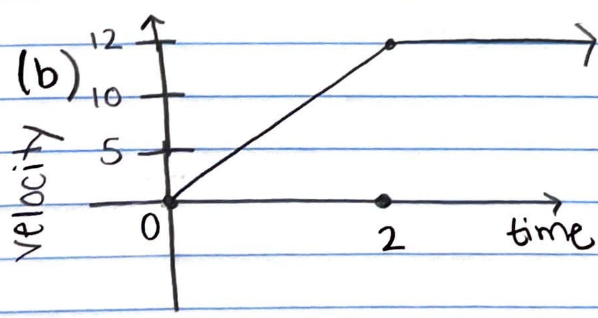
(a) $v = \dfrac{x_f - x_i}{t_f - t_i} = \dfrac{\Delta x}{\Delta t}$

$V = \dfrac{x(2) - x(0)}{2 - 0\text{s}}$

$x(2) = -2(2) + 7(2)^2$
$-4 + 7(4)$
$-4 + 28$
$x(2) = 24$
$x(0) = -2(0) + 7(0)^2$
$x(0) = 0$

$\boxed{V = \dfrac{24 - 0\text{m}}{2\text{s}} = \dfrac{24}{2} = 12 \text{ m/s}}$

(b)



(-1) Velocity should be a linear graph is position is quadratic, and the slope turns out to be 14 m/s^2 which is the slope (part d)

(c) instantaneous velocity?
$x(1) = -2(1) + 7(1)^2$
$-2 + 7$
$\boxed{x(1) = 5\text{ m/s}}$

(-1)

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

3)

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

$V_f = 10\ m/s$

$V_i = 0\ m/s$ $\qquad V = V_i + at$

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

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

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

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

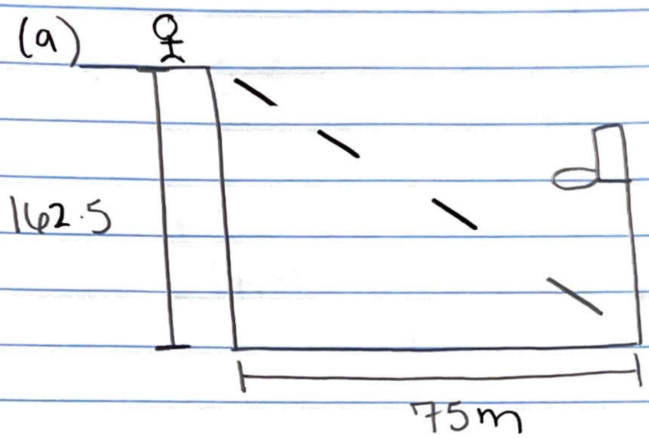
$t = \frac{90m}{10m/s} = 9s \rightarrow 9s + 2s = \boxed{11\,sec \text{ total } t}$

Well done!

5 Motion in Two & Three Dimensions

1) height = 162.5
horiz. = 75 m

(a)



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

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

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

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

$$V_0 = 31$$

$V_0 = 31$
$31\cos(65°)$
$$\boxed{V_{xi} = 12.7\text{m/s} \approx 13\text{ m/s}}$$

Clever, and almost right, though technically this is an approximation

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

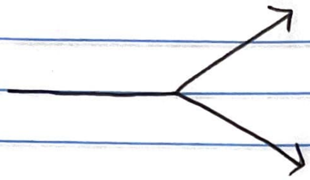
$= \frac{40^2 \cdot 1}{9.81} = \boxed{163.1\text{m}}$
↳ lands

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

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

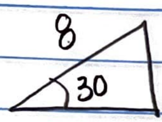
6 Forces

1)



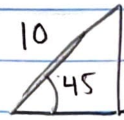
$$\vec{a} = \frac{F_{Net}}{m} = \frac{6.86}{49}$$

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



$x = \cos(30°)8$

$x = 6.93\hat{i}, -4\hat{j}$



$x = \cos(45°)10$

$x = 7.07\hat{i}, 7.07\hat{j}$

$F_{Net} = 14.3N$

$$\left.\begin{array}{l} 7.07 + 6.93 = 14\,\hat{i} \\ 7.07 - 4 = 3\,\hat{j} \end{array}\right] 14.3\ N$$

$14.3 - 7.5 = 6.86$

Well done!