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Physics Midterm

10-8-22

2. Estimations + Unit Analysis

1.) a. $0.5\ km \cdot \frac{1000m}{1\ km} = 500m \rightarrow v = \frac{x}{t} = \frac{500m}{1.5s} = \boxed{333.3\ m/s}$

b. $333.3\ m/s$ to $km/hr \rightarrow \frac{333.3\ m}{1\ s} \cdot \frac{1\ km}{1000\ m} \cdot \frac{3600\ s}{1\ hr} = \boxed{1,199.9\ km/hr}$

2.) a. $0.25 m^3$ in $cm^3 \rightarrow 0.25 m^3 \cdot \frac{(100)^3\ cm^3}{1\ m^3} = \boxed{250000\ cm^3}$

b. $100\ km/hr$ in $m/s \rightarrow \frac{100\ km}{1\ hr} \cdot \frac{1000\ m}{1\ km} \cdot \frac{1\ hr}{60\ min} \cdot \frac{1\ min}{60\ sec} = \frac{100,000\ m}{3,600\ s} = \boxed{27.8\ m/s}$

c. $2\ kg\ m\ s^{-2}$ in $gm\ cm\ ms^{-2} \rightarrow \frac{2\ kg\ m}{s^2} \cdot \frac{1000\ gm}{1\ kg} \cdot \frac{100\ cm}{1\ m} \cdot \frac{1\ s^2}{1,000,000\ ms^2} =$

$\boxed{0.2\ gm\ cm\ ms^{-2}}$

3. Vectors ($\vec{x} = a\hat{i} + b\hat{j}$)

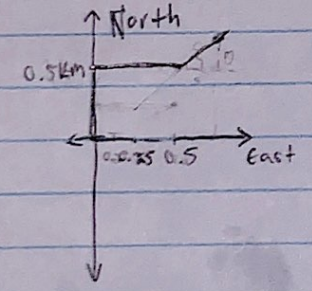
1.) a. $a = 10\cos(15°)$, $b = 10\sin(15°)$ $\vec{x}_1 = -8\hat{i} + 7\hat{j}$

$a = -8$ $b = 7$

b. $a = 20\cos(155.0)$ $b = 20\sin(135.0)$ $\vec{x}_2 = -20\hat{i} + 2\hat{j}$

$a = -20.0$ $b = 2.0$

2.) a.



b. $x = 0.5\ km + (0.25\cos(45°)) = 0.63\ km$

$y = 0.5\ km + (0.25\sin(45°)) = 0.71\ km$

final location = $\boxed{(0.63km, 0.71km)}$

c. $a^2 + b^2 = c^2 \rightarrow 0.5^2 + 0.5^2 = c^2 \rightarrow 0.71$

$0.71km + 0.25km \approx \boxed{1\ km}$

4. Motion Along a Straight Line

1.) a. $x(t) = -1.0 - 4.0t\ m \rightarrow x(-2.0) = -1.0 - (4.0 \times -2.0)_m = -1.0 + 8.0_m = 7.0\ m$

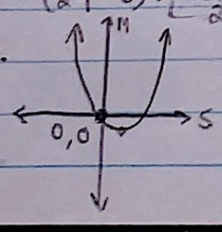
$x(2.0) = -1.0 - (4.0 \times 2.0)m = -1.0 - 8.0\ m = -9.0m$ $(-9.0 - (7.0)) = \boxed{-16\ m}$

b. $\frac{-16\ m}{4s} = \boxed{-4\ m/s}$

2.) a. $x(t) = -2t + 7t^2 \rightarrow x(0) = -2(0) + 7(0)^2$ $x(2) = -2(2) + 7(2)^2$

$(24 - 0) = \frac{24m}{2s} = \boxed{12\ m/s} = 0$ $= 24$

b.



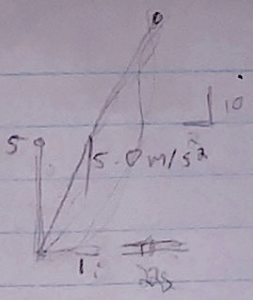
c. $x(1) = -2(1) + 7(1)^2$

$= -2 + 7$

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

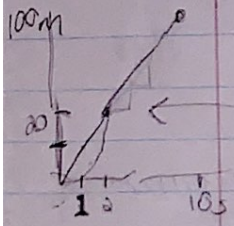
d.) $\frac{24 - 0\ m/s}{2} = \boxed{12\ m/s^2}$

$a = 5.0\ m/s^2$ $\quad v_i = 0\ m/s$ $\quad v_F = 10.0\ m/s$



$10\ m/s \cdot 2\ s = 20m$

3.) a. $t = \frac{v_F - v_i}{a} = \frac{10.0 - 0\ m/s}{5.0\ m/s^2} = \boxed{2.0\ s}$

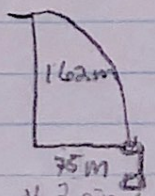


b. $\boxed{20\ m}$

c. $\boxed{10s}$

5. Motion in Two and Three Dimensions

1.) a.



b. $v^2 = v_i^2 + 2a\Delta y$

$v^2 = (0)^2 + 2(9.81\ m/s^2)(75m)$

$\sqrt{v^2} = \sqrt{1471.5\ m^2/s^2}$

$\boxed{v = 38.36\ m/s}$

2.) a. $R = \frac{v_0^2 \sin(2\theta_0)}{g}$

$R = \frac{40^2 \sin(2(45))}{9.81}$

$\boxed{R = 165.10\ m}$

b. $t_{t.o.f} = \frac{2(v_0)\sin(\theta_0)}{g} \rightarrow t_{t.o.f} = \frac{2(40\ m/s)\sin(45)}{9.81\ m/s^2}$

$\boxed{t_{t.o.f} = 5.77\ s}$

6. Forces

1.) $F_x = 10\cos(45^\circ) + 8\cos(30^\circ)$

$= 14.0\ N$

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

$= 3.1\ N$

$F_F = -7.5\ N$

$F_{net} = (14N - 7.5N) + 3.1N = 6.5N + 3.1N$

$a = \frac{F_{net}}{m} \rightarrow \frac{6.5N + 3.1N}{49\ kg} = (0.13 + 0.06)\ m/s^2$

$= 0.73\ m/s^2$