Sophie Frizzell

Score: 19/25

Physics Midterm

10-8-22

Technically, there is a factor of 2 for sounding going "there and back."

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

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

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

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

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

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

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

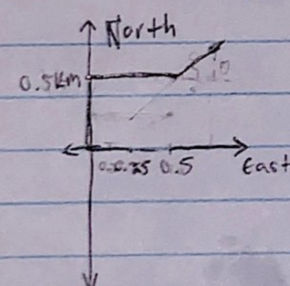
$a = -8$ $b = 7$

(-1) The formulas are correct, but I think you may have confused degrees and radians

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

$a = -20.0$ $b = 2.0$

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

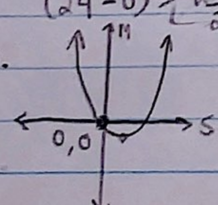
$x(2.0) = -1.0 - (4.0 \times 2.0)m = -1.0 - 8.0\ m = -9.0m$ $(-9.0 - (7.0)) = \boxed{-16\ m}$

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

2.) a. $x(t) = -2t + 7t^2 \rightarrow x(0) = -2(0) + 7(0)^2 = 0$, $x(2) = -2(2) + 7(2)^2 = 24$

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

b.



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

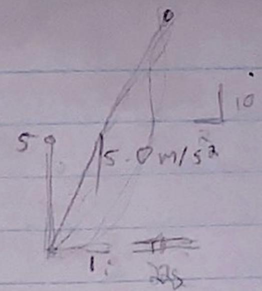
$= -2 + 7$

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

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

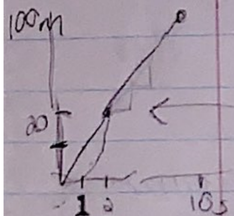
(-2) The graph is of the position but we wanted the v(t). (c) is 12 m/s, and (d) is 14 m/s^2

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



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

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



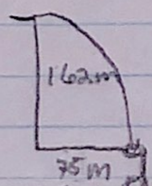
b. $\boxed{20m}$

(-1) Part (b) is 10 meters, from equations of constant acceleration vs. time with no initial velocity. This would have given you the correct part (c), or 11 s.

c. $\boxed{10s}$

5. Motion in Two and Three Dimensions

1.) a.



(-1) This equation is either applied to x-velocity or y-velocity and associated displacement

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

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

$\boxed{R = 163.10\,m}$

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

$\boxed{t_{tof} = 5.77s}$

6. Forces

1.) $F_x = 10\cos(45°) + 8\cos(30°)$

$= 14.0\,N$

$F_y = 10\sin(45°) - 8\sin(30°)$

$= 3.1\,N$

$F_f = -7.5\,N$

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

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

$= 0.73\,m/s^2$

(-1) Almost! The 7.5 N should be subtracted from the magnitude of the total pulling force (because they are in opposite directions).