Chp 3 Review Packet Solutions (Conceptual Physics)

Sample Calculations (Use Unit Conversions and Show Your Work)

1. How many seconds are in a year?

$$\frac{1 \text{ year}}{1} \times \frac{365 \text{ days}}{1 \text{ yr}} \times \frac{24 \text{ hrs}}{1 \text{ day}} \times \frac{60 \text{ min}}{1 \text{ hr}} \times \frac{60 \text{ s}}{1 \text{ min}} = \boxed{31536000 \text{ s}}$$

2. How many days are in a century?

$$\frac{1 \text{ century}}{1} \times \frac{100 \text{ yrs}}{1 \text{ century}} \times \frac{365 \text{ days}}{1 \text{ yr}} = \boxed{36500 \text{ days}}$$

3. How many millimeters are in a kilometer?

$$\frac{1 \text{ mm}}{1} \times \frac{10^{-3} \text{ m}}{1 \text{ mm}} \times \frac{1 \text{ km}}{10^{3} \text{ m}} = \boxed{1 \times 10^{-6} \text{ km}}$$

4. How many inches are in a mile?

$$\frac{1 \text{ mile}}{1} \times \frac{5280 \text{ feet}}{1 \text{ mile}} \times \frac{12 \text{ inches}}{1 \text{ ft}} = \boxed{63360 \text{ inches}}$$

5. How many Gm are there in 2.56×10^{19} pm?

$$\frac{2.56 \times 10^{19} \text{ pm}}{1} \times \frac{10^{-12} \text{ m}}{1 \text{ pm}} \times \frac{1 \text{ Gm}}{10^{9} \text{ m}} = \boxed{0.0256 \text{ Gm}}$$

6. How many Mg are there in 3.7×10^{5} kg?

$$\frac{3.7 \times 10^{5} \text{ kg}}{1} \times \frac{10^{3} \text{ g}}{1 \text{ kg}} \times \frac{1 \text{ Mg}}{10^{6} \text{ g}} = \boxed{370 \text{ Mg}}$$

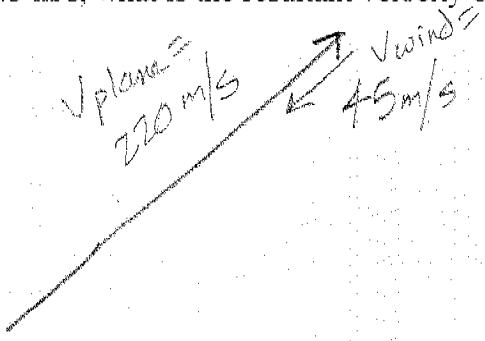
7. How many nm are there in 8.64×10^{9} μm?

$$\frac{8.64 \times 10^{9} \text{ μm}}{1} \times \frac{10^{-6} \text{ m}}{1 \text{ μm}} \times \frac{1 \text{ nm}}{10^{-9} \text{ m}} = \boxed{8.64 \times 10^{12} \text{ nm}}$$

8. How many mg are there in 2.89 cg?

$$\frac{2.89 \text{ cg}}{1} \times \frac{10^{-2} \text{ g}}{1 \text{ cg}} \times \frac{1 \text{ mg}}{10^{-3} \text{ g}} = \boxed{28.9 \text{ mg}}$$

9. Rochelle is flying to New York for her big Broadway debut. If the plane heads out of Los Angeles with a velocity of 220.0 m/s in a northeast direction, relative to the ground, and encounters a wind blowing head-on at 45 m/s, what is the resultant velocity of the plane, relative to the ground?

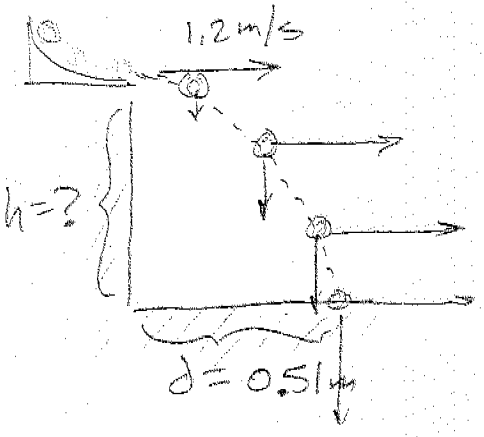


$V_{resultant} = V_{plane} + V_{wind}$

$= 220 - 45$

$V_{resultant} =$ **175 m/s, Northeast**

10. In her physics lab, Melanie rolls a 10-g marble down a ramp and off the table with a horizontal velocity of 1.2 m/s. The marble falls into a cup placed on the floor 0.51 m from the bottom of the table. How high is the table? Draw a picture of the situation.



Horizontally: How long does marble take to go 0.51 m? Horizontal velocity is constant, so...

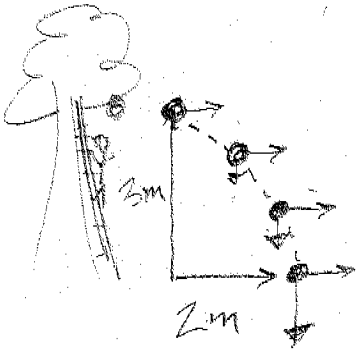
$x = vt$, or $t = \frac{x}{v} = \frac{0.51\text{ m}}{1.2\text{ m/s}} =$ **0.425 s**

Vertically: How high is the table if the ball takes 0.425 s to drop?

$d = \frac{1}{2}at^2$, so $d = \frac{1}{2}(-9.8\text{ m/s}^2)(0.425\text{ s})^2$

$d =$ **−0.885 m** (Negative because it's falling down)

11. Bert is standing on a ladder picking apples in his grandfather's orchard. As he pulls each apple off the tree, he tosses it into a basket that sits on the ground 3.0 m below at a horizontal distance of 2.0 m from Bert. How fast must Bert throw the apples (horizontally) in order for them to land in the basket? Draw a picture of the situation.



Vertically: How long will it take the apple to fall 3.0 m?

$d = -3\text{ m}$, $a = -10\text{ m/s}^2$, $t = ?$

$d = \frac{1}{2}at^2$, rearrange equation to get $t = \sqrt{\frac{2d}{g}}$

$t = \sqrt{\frac{2(-3\text{ m})}{-9.8}} =$ **0.782 s**

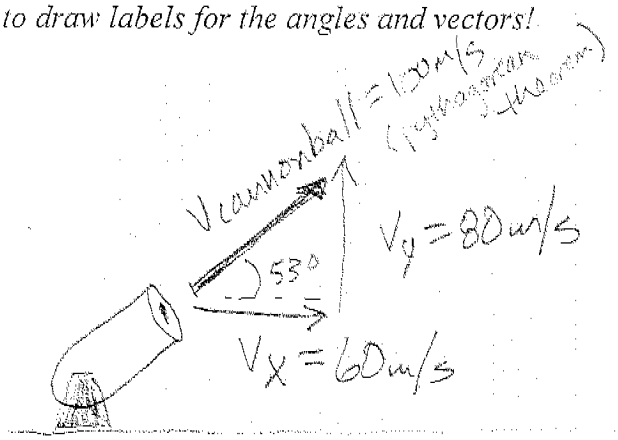
Horizontally: Apple needs to travel 2 m in 0.782 s, so velocity is...

$v = \frac{x}{t} = \frac{2\text{ m}}{0.782\text{ s}} =$ **2.56 m/s**

12. A cannon is fired up from the ground at an angle of 53° from the horizontal, with a horizontal velocity of 60 m/s and a vertical velocity of 80 m/s.

a. Draw a labeled picture of the cannon, including:
- the angle of launch,
- the velocity vector in the direction the cannonball will be fired,
- component vectors (horizontal and vertical) for the initial velocity of a cannonball to be fired from the cannon.

Be sure to draw labels for the angles and vectors!



b. How long will it take the cannonball, after it is fired, to reach its highest point?

At highest point vertically, $V_f = 0$, so

$V_f = V_i + at \rightarrow t = \frac{V_f - V_i}{a} = \frac{(0 - 80 m/s)}{-10 m/s^2} = \boxed{8 s}$

c. How long after being fired will the cannonball hit the ground?

Problem is symmetrical, so it will hit the ground $2 \times 8 s = \boxed{16 s}$ after the cannonball is fired.

d. How high above the ground is the cannonball at its highest point?

In 8 s, how far would cannonball fall from that highest point?

$y = \frac{1}{2}at^2 = \frac{1}{2}(-10 m/s^2)(8 s)^2 = \boxed{320 m}$

e. How far away from the cannon does the cannonball land (horizontal distance)?

$x = vt$ (v = horizontal velocity, t = total time)

$x = (60 m/s)(16 s) = \boxed{960 m}$

f. On your diagram, draw the cannonball at one-second intervals and draw the horizontal and vertical components of its velocity (vectors) at each one-second interval.