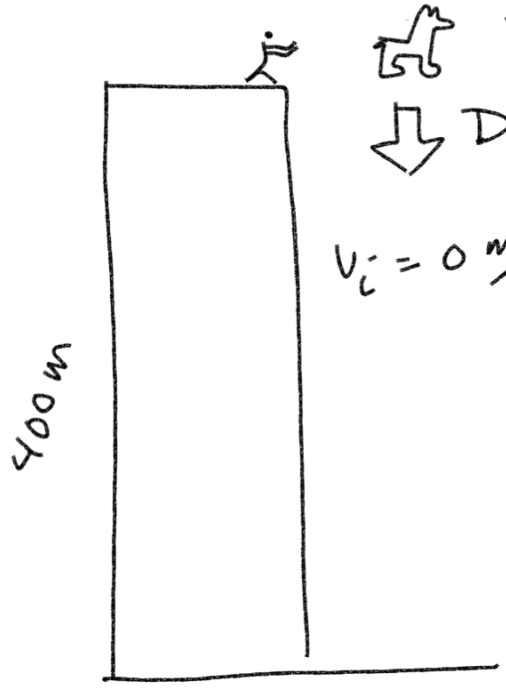
M-GP General Physics Week 10 11/13



1.) time to impact

2.) velocity upon impact.

$$x_f = x_0 + v_i t + \frac{1}{2}at^2$$

$$y_f = y_0 + \cancel{v_i t}^{\,0} + \frac{1}{2}at^2$$

$$0 = 400\text{m} + \frac{1}{2}(-9.8\ \text{m/s}^2)t^2$$

$$0 = 400 - 4.9t^2$$

$$-400 \quad -400$$

$$\frac{-400}{-4.9} = \frac{-4.9t^2}{-4.9}$$

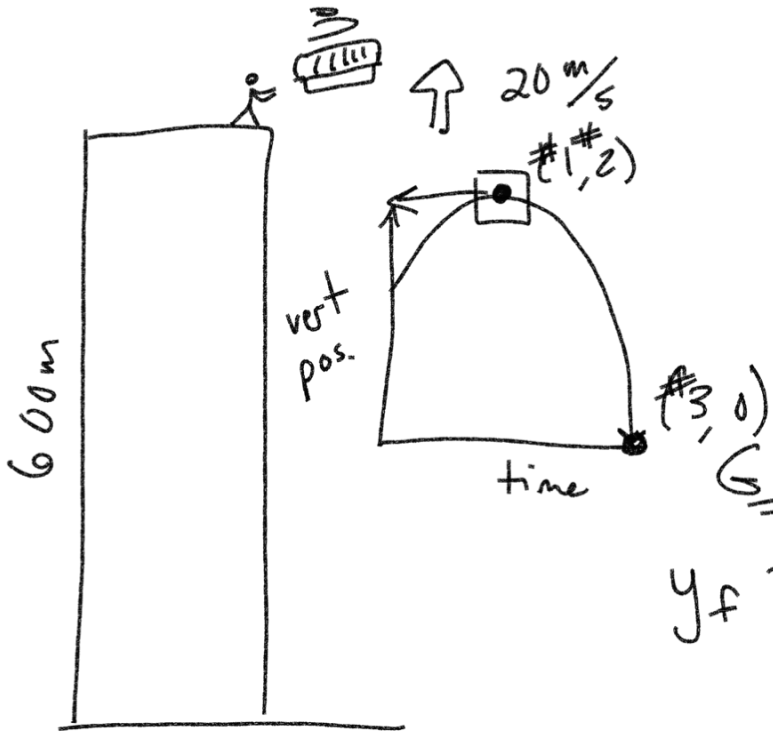
$$\sqrt{\frac{-400}{-4.9}} = \sqrt{t^2}$$

$$t = \sqrt{\frac{-400}{-4.9}}$$

$$= \boxed{9.03\text{ s}}$$

$$v_f = \cancel{v_i}^{\,0} + at = (-9.8\ \text{m/s}^2)(9.03\text{ s})$$

$$= \boxed{-88.5\ \text{m/s}}$$



1.) Time to max height
2.) Max height
3.) Time to impact
4.) Velocity upon impact.

Graph

$$y_f = y_0 + v_i t + \frac{1}{2}at^2$$

$$0 = 600 + 20t - 4.9t^2$$

1.) V_f at max height = 0 m/s

$$V_f = V_i + at \qquad V_i = 20 \text{ m/s}$$

$$0 = 20 + (-9.8)t$$

$$-20 \quad -20$$

$$\frac{-20}{-9.8} = \frac{-9.8t}{-9.8}$$

$$\boxed{t = 2.04 \text{ s}}$$

2.) Find max height

$$y_f = y_0 + v_i t + \frac{1}{2}at^2$$

$$600 + 20(2.04) - 4.9(2.04)^2 = \boxed{620.4 \text{ m}}$$

3.) to find time to impact

optim 1: Use quadratic formula

optim 2: Graph

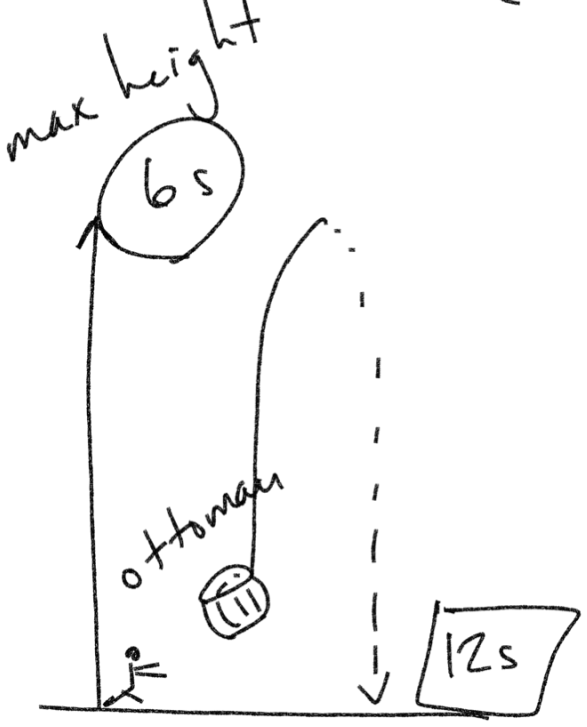
$0 = 6.00 + 20t - 4.9t^2$

$t: 13.3\ s$

4.) Velocity upon impact.

$V_f = V_i + at$

$20 + (-9.8)(13.3) = -110\ m/s$



General Physics Chapter 1 & 2 Pre-Test

Please show work and **include units when available**. **Consider significant figures** when making your final answer. Please use a calculator.

1.) (3 pts total, 1 pt each) Provide the abbreviation and power of each prefix:

a) milli m 10^{-3}

b) kilo

c) centi

2.) (3 pts) What is the density of a metal with a mass of 98.2 g and a volume of 12.4 L?

$D = \frac{M}{V} = \frac{98.2\,g}{12.4\,L} = 7.92\,g/L$

3.) (3 pts) How much of a compound do you have if it has a volume of 78.5 mL and a density of 14.1 g/mL?

4.) (3 pts) Use your knowledge of units to answer the following.

R represents the universal gas constant. Its units are $\frac{atm \cdot L}{mol \cdot K}$. If **P** corresponds to *atm*, **V** measured in *L*, **n** representing *mol*, and **T** corresponds to *K*. Each of these values are utilized within the ideal gas law. With this information, along with some algebra, Find what **P** is equivalent to.

$R = \frac{atm \cdot L}{mol \cdot K} = \frac{PV}{nT}$ $nTR = \frac{PV}{nT} \cdot nT$

$P = \frac{RnT}{V}$ $\frac{RnT}{V} = \frac{PV}{V}$

5.) (12 pts total, 3 pts each) Use your knowledge of dimensional analysis to answer the following.

a) Eric Dickerson holds the NFL record for rushing yards in a season with 2,105 yards. How many inches did he rush for?

b) In 2016, Mao Weidong of China set the world record for longest plank in history. He remained in the plank position for 8 hours and 1 minute. How many seconds to he remain in the plank position?

c) The deepest part of the ocean is called Challenger Deep, located near the end of the Mariana Trench in the Pacific Ocean. If it is 36,200 feet deep, how many centimeters is it to the bottom?

d) It is universally accepted that the Reese's Cup is the world's most perfect food. More specifically, the Reese's Peanut Butter Cup Pumpkin is… no words. Each pumpkin is 85 calories. If one pound of body weight is equivalent to 3500 calories, how much weight would you gain if you ate 25,000 peanut butter pumpkins?

$$25{,}000 \text{ cups} * \frac{85 \text{ cal}}{1 \text{ cup}} * \frac{1 \text{ pound body weight}}{3500 \text{ cal}}$$

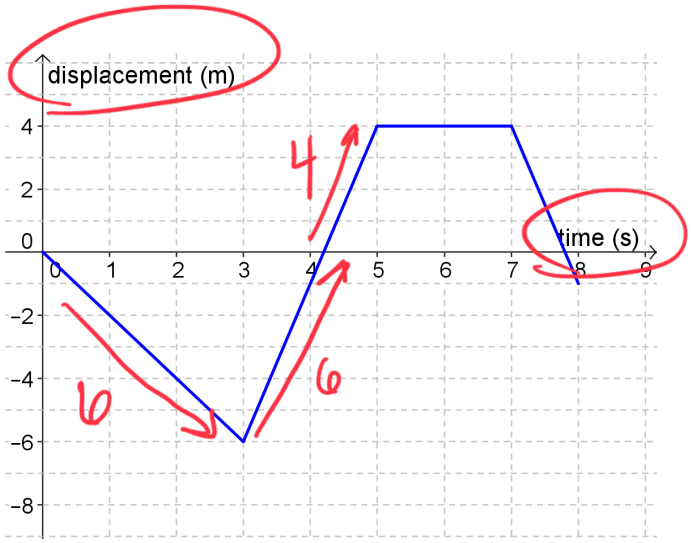
607 pounds

6.) (3 pts) The Daytona 500 is a stock car race in which drivers complete 200 laps around a 2.5 mile oval track. What is the distance travelled by each stock car? What is the displacement? Explain your reasoning.

Distance: $2.5(200) = 500$ miles

Displacement: 0 miles

7.) (16 pts total, 2 pts each) Use the graph to answer the following. Assume three significant figures.



a) What is the displacement at time = 5.00 s?

$\Delta x = x_f - x_i$

$4m - 0m = 4m$

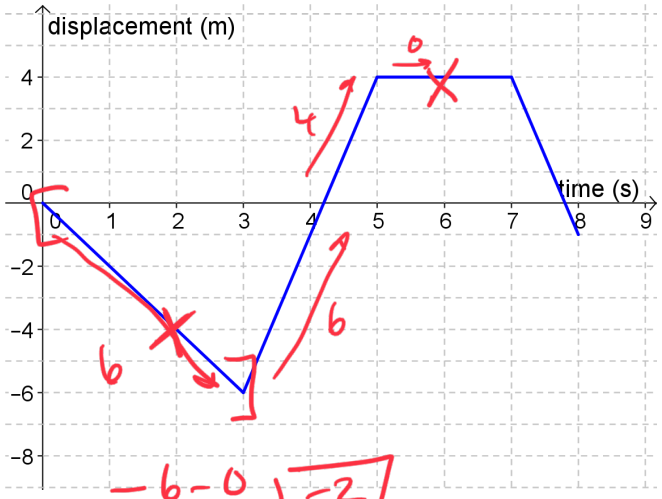
b) What is the distance at time = 5.00 s?

$6 + 6 + 4 = 16m$

c) What is the average velocity at time = 6.00 s?

$\bar{v} = \frac{\Delta x}{\Delta t} = \frac{x_f - x_i}{t_f - t_i}$

$\frac{4m - 0m}{6s - 0s} = \frac{4}{6}\ m/s = \frac{2}{3}\ m/s$



d) What is the average speed at time = 6.00 s?

speed = distance / time = 16 m / 6 s = 8/3 m/s ≈ 2.67 m/s

e) What is the instantaneous velocity at time = 6.00 s?

↳ slope 0 m/s

f) What occurred at time = 3.00 s?

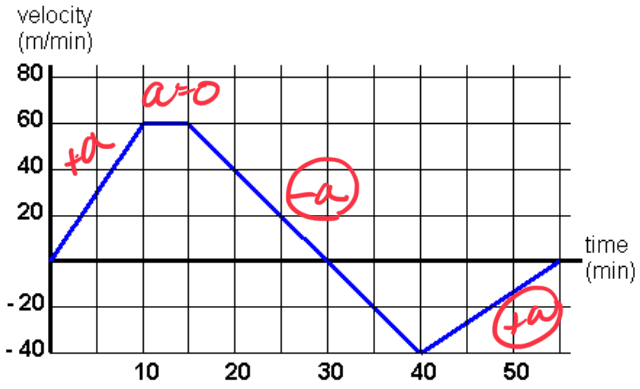
change of direction

g) What is the average velocity at time = 3.00 s?

-2 m/s

h) What is the instantaneous velocity at 2.00 s?

8.) (15 pts total, 3 pts each) Use the graph to answer each of the following. Assume 3 significant digits.



a) Indicate on the graph where acceleration is positive, negative, and constant.

b) Find the average acceleration at t = 15 min.

$$\bar{a} = \frac{v_f - v_i}{t_f - t_i} = \frac{60\ m/min - 0\ m/min}{15\ min - 0\ min} \quad \frac{60\ m/min^2}{15}$$

$$4\ m/min^2$$

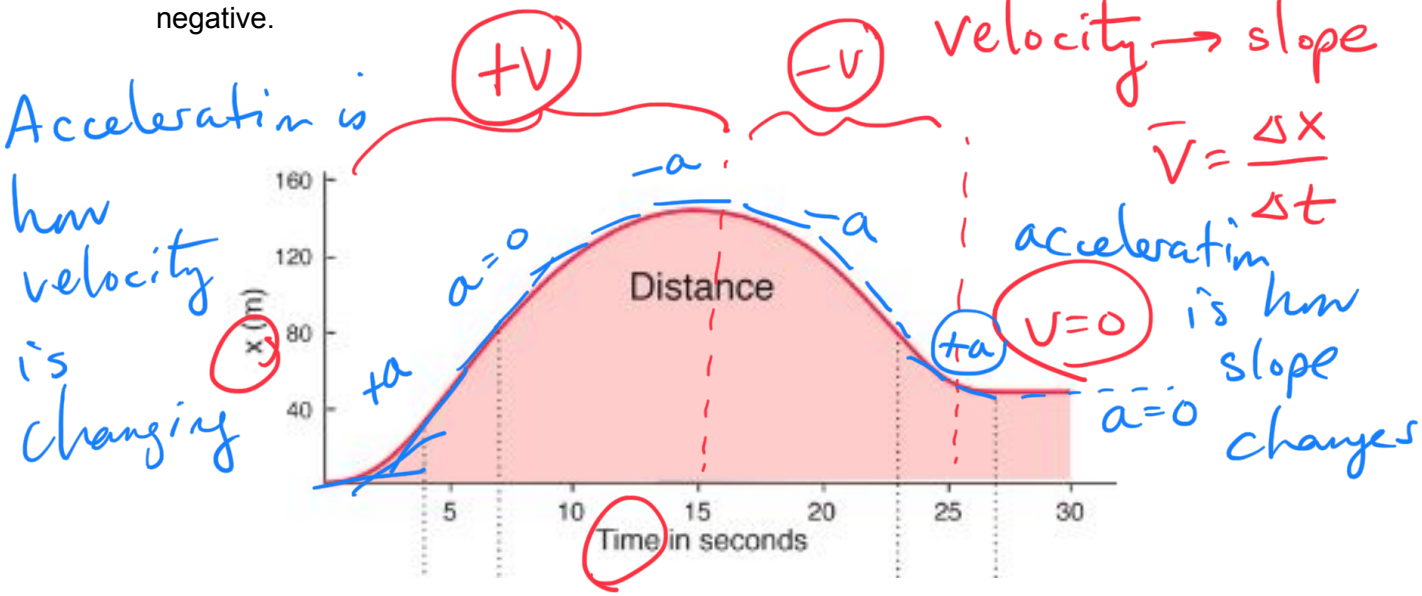
c) Find the instantaneous acceleration at t = 30 min.

d) Find the instantaneous acceleration at t = 40 min.

$$0\ m/min^2$$

e) Find the average acceleration at t = 25 min.

9.) (3 pts) Evaluate the graph. Label where velocity and acceleration are either positive or negative.



10.) (20 pts total, 4 pts each) Solve each. For each scenario, assume acceleration is constant. *Term breakdown will not appear on actual exam!*

a) An ambulance is 40.0 m from the hospital and heading away from it. If it starts at 3.50 m/s and accelerates at a rate of 2.80 m/s^2, how far away from the hospital will it be in 55.0 s?

$x_i = 40.0\ m$	$v_i = 3.50\ m/s$	$a = 2.80\ m/s^2$	$t = 55.0\ s$

$x_f = ?$

$x_f = x_i + v_i t + \frac{1}{2} a t^2$

Sig figs → 3

$40\ m + (3.5\ m/s)(55\ s) + \frac{1}{2}(2.8\ m/s^2)(55\ s)^2$

40

4467.5 m = 4470 m

b) A helicopter starts 125 m away from base at 6.60 m/s. How fast is it traveling when it reaches its destination 795 m away from base if it experienced a constant acceleration of 1.35 m/s^2?

$x_i = 125\ m \quad x_f = 795\ m \quad v_i = 6.60\ m/s \quad a = 1.35\ m/s^2$

x_i

v_i

$v_f = ?$

x_f

a

$(v_f)^2 = (v_i)^2 + 2a(x_f - x_i)$

c) A train is travelling within an initial velocity of 32.0 m/s. If it accelerates at 1.50 m/s^2, what is its final velocity in 24.0 s?

$v_i = 32.0\ m/s \quad a = 1.50\ m/s^2 \quad t = 24.0\ s$

$v_f = ?$

v_i

a

t

$v_f = v_i + at$

$32.0 + (1.50)(24.0)$

units → m/s

sfigs = 3

d) A jet takes off 300. m away from the launch site travelling in the opposite direction at 85.0 m/s. In 38 seconds, the jet is now moving at 112 m/s. How far away from the launch site is it now?

$v_f = 112\ m/s \quad v_i = 85.0\ m/s \quad x_i = 300\ m \quad t = 38.0\ s$

e) A car passes the first check point traveling 65.0 mi/hr. If it passes the second check point at 83.0 mi/hr, what is its average velocity if acceleration is constant?

$v_i = 65.0\ mi/hr \quad v_f = 83.0\ mi/hr$

11.) (20 pts total, 4 pts each) A penny is thrown straight *upward* from the top of a building at a velocity of 16.0 m/s. If the building is 264 m tall, find each of the following. (Use t = 0 as the time the penny leaves the thrower's hand. Also, there is no need to include thrower's height.)

$v_i = 16\ m/s \quad 264m = x_i$

a) What is the maximum height?

$y_f = y_i + v_i t + \frac{1}{2}at^2$

$0 = 264 + 16t - 4.9t^2$

$264 + 16(1.63) - 4.9(1.63)^2$

277 m

b) At what time does the penny reach its maximum height? $v_f = 0\ m/s$

first!

$v_f = v_i + at$

$0 = 16 + (-9.8)t$

$-16 \quad -16$

$\frac{-16}{-9.8} = \frac{-9.8t}{-9.8}$

$t = 1.63s$

c) At what time does the penny return to the height from which it was thrown?

$2(1.63s) = 3.26\ s$

d) What is the velocity of the penny just prior to impact?

velocity at impact

$264 + 16t - 4.9t^2 = 0$

time to impact first

Look on graph

$v_f = v_i + at$

$16 + (-9.8)(9.15)$

$t = 9.15s$

e) What is the velocity and position of the penny at t = 3.00 s.

velocity 3

$v_f = v_i + at$

position

$y_f = y_0 + v_i t + \frac{1}{2}at^2$

$264 + 16t - 4.9t^2$

12.) (12 pts total, 4 pts each) While being chased by the authorities, Jackson drives his car off a 76 m tall cliff. If he is traveling at 7.50 m/s at the time he drives off the cliff, find each of the following. (Assume v_{iy} = 0 m/s and no air resistance.)

a) How long until the car impacts the cushiony ground below? (No Jacksons were harmed in the making of this problem.)

for chapter 3

b) How fast is the car traveling in the y direction after 2.50 s?

c) How far from the base of the cliff will the car land?

With constant acceleration

$$v_{xf} = v_{xi} + a_x t$$

$$Av\ v_x = \frac{v_{xi} + v_{xf}}{2}$$

$$x_f = x_i + \frac{1}{2}(v_{xi} + v_{xf})t$$

$$x_f = x_i + v_{xi}t + \frac{1}{2}a_x t^2$$

$$v_{xf}^2 = v_{xi}^2 + 2a_x(x_f - x_i)$$

1 inch = 2.54 ~~inches~~ cm