Key

General Physics Chapter 1 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 k 10^{3}

c) centi c 10^{-2}

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

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

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?

$$V \cdot D = \frac{M}{V} \cdot V$$

$$M = VD = (78.5\ mL)(14.1\ g/mL) = 1106.85$$

$$= \boxed{1110\ g}$$

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.

$$R = \frac{atm \cdot L}{mol \cdot K} \qquad nT(R) = \left(\frac{PV}{nT}\right) nT$$

$$R = \frac{PV}{nT} \qquad \frac{nRT}{V} = \frac{PV}{V}$$

$$\boxed{P = \frac{nRT}{V}}$$

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?

since these are definitions, ∞ sig figs.

$$2105\ \text{yds} * \frac{3\ \text{ft}}{1\ \text{yd}} * \frac{12\ \text{in}}{1\ \text{ft}}$$

75,780 in

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?

$$8\ \text{hr} * \frac{60\ \text{min}}{1\ \text{hr}} = 480.\ \text{min} + 1\ \text{min} \quad 481\ \text{min}$$

$$481\ \text{min} * \frac{60\ \text{s}}{1\ \text{min}} = 28860\ \text{s} = \boxed{\approx 28{,}900\ \text{s}}$$

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?

$$36{,}200\ \text{ft} * \frac{12\ \text{in}}{1\ \text{ft}} * \frac{2.54\ \text{cm}}{1\ \text{in}} = 1{,}103{,}376\ \text{cm}$$

6 5 4 3 2 1

$$1.10 * 10^{6}\ \text{cm}$$

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?

$$25{,}000\ \text{pumpkins} * \frac{85\ \text{cal}}{1\ \text{pumpkin}} * \frac{1\ \text{lb}}{3500\ \text{cal}} = 607\ \text{lb} \approx \boxed{610\ \text{lb}}$$

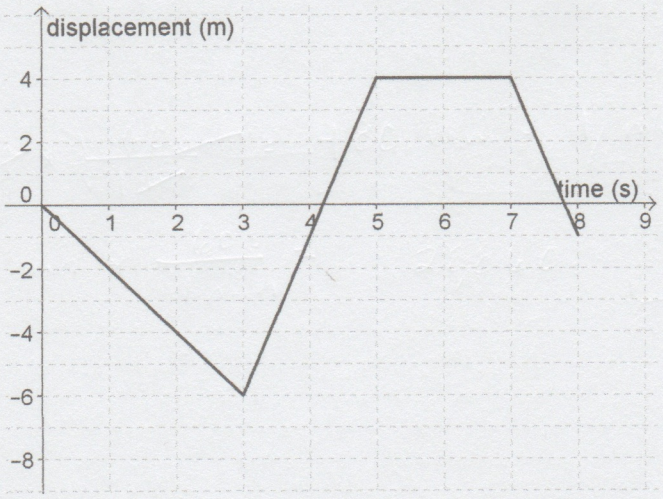
Bonus: World record is 75 Reese's Cup in one sitting. This seems so beatable. Go!

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: $200 \text{ laps} * \frac{2.5 \text{ mi}}{1 \text{ lap}} = 500 \text{ miles}$

Displacement: 0 miles – since you begin and end in the same place!

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?

4m or 4.00m

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

$t = 0 \to 3$ is 6m

$t = 3 \to 5$ is $(4-(-6))\text{m} = 10\text{m}$

total: 16m

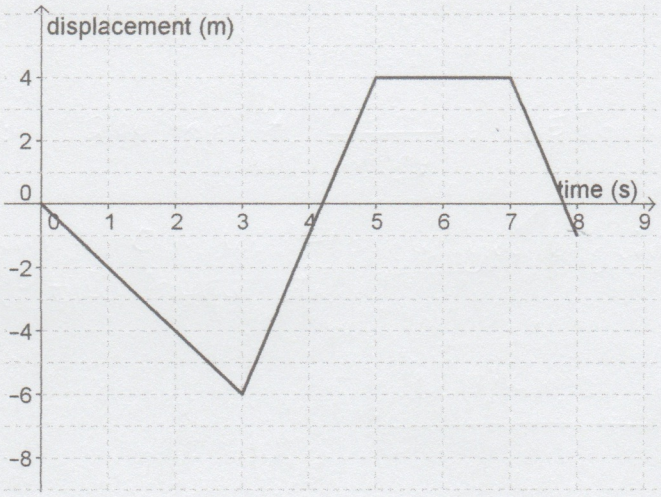
6.00m + 10.0m

16.0m

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

$$\bar{v} = \frac{x_f - x_i}{t_f - t_i} = \frac{(4-0)\text{m}}{(6-0)\text{s}} = \frac{4}{6}\frac{\text{m}}{\text{s}} = \frac{2}{3}\text{ m/s}$$

or 0.667 m/s



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

$0 \to 3$: distance 6 m

$3 \to 6$: 10 m

total: 16 m

$$\text{Speed} = \frac{\text{distance}}{\text{time}} = \frac{16\text{ m}}{6} = \frac{8}{3}\text{ m/s}$$

or

2.67 m/s

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

0 m/s plateau

f) What occurred at time = 3.00 s?

when slope changes from positive to negative it indicates a change in direction.

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

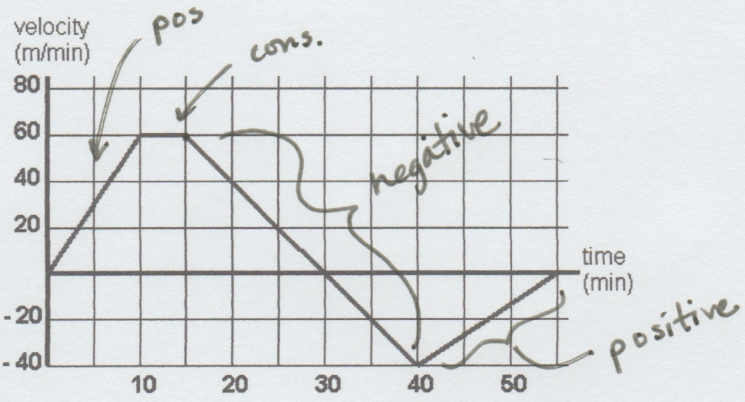
$$\bar{v} = \frac{x_f - x_i}{t_f - t_i} = \frac{-6-0}{3-0} = \frac{-6}{3} = \boxed{-2.00\text{ m/s}}$$

h) What is the instantaneous velocity at 2.00 s?

since velocity is constant between 0 and 3 seconds, it will be the same as the above velocity.

-2.00 m/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.

see graph

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

$$\bar{a} = \frac{v_f - v_i}{t_f - t_i} = \frac{60 - 0 \text{ m/min}}{15 - 0 \text{ min}} = \boxed{4.0 \text{ m/min}^2}$$

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

going to be the same as the slope of the line from t = 15 to t = 40

$$\frac{-40 \text{ m/min} - 60 \text{ m/min}}{40 \text{ min} - 15 \text{ min}}$$

d) Find the instantaneous acceleration at t = 40~~s~~. min $\quad \frac{-100}{25} = \boxed{-4.0 \text{ m/min}^2}$

at a peak, relative minimum,

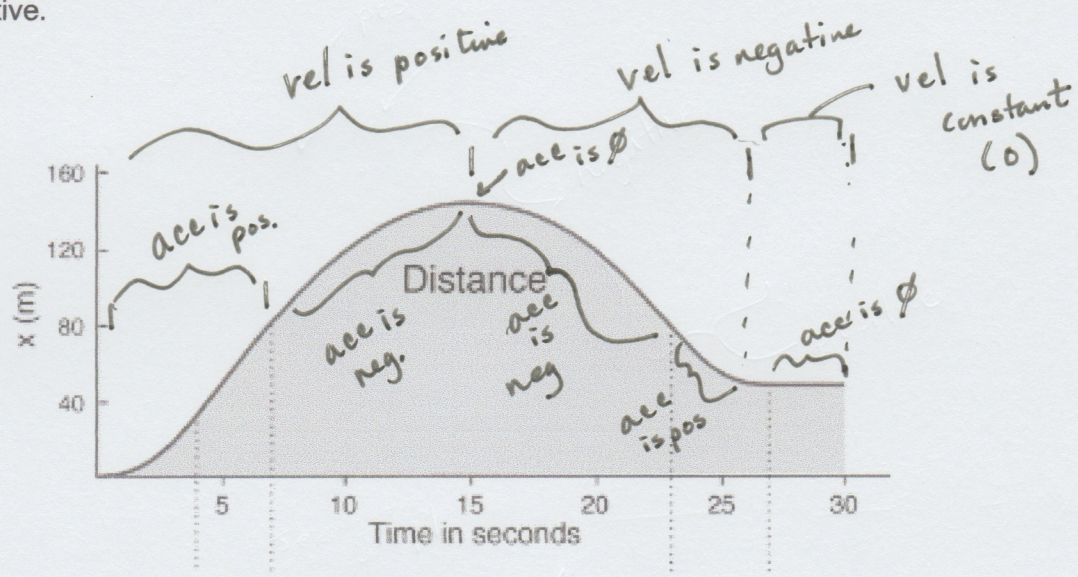
so $\boxed{0 \text{ m/min}^2}$

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

$$\bar{a} = \frac{v_f - v_i}{t_f - t_i} = \frac{(20 - 0) \text{ m/min}}{(25 - 0) \text{ min}} = \frac{20}{25} = \frac{4}{5} \text{ m/min}^2$$

$$\boxed{0.80 \text{ m/min}^2}$$

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?

$x_i = 40.0\ m \quad v_i = 3.50\ m/s \quad a = 2.80\ m/s^2 \quad t = 55.0\ s$ ← this will not appear on test!

$$X_f = X_i + V_i t + \tfrac{1}{2} a t^2$$

$$= 40.0\text{m} + (3.50\text{m/s})(55\text{s}) + \tfrac{1}{2}(2.80\text{m/s}^2)(55.0\text{s})^2$$

$$= 40.0\text{m} + 192.5\text{m} + 4,235\text{m}$$

$$4467.5\text{m} \approx 4.47 * 10^3\text{m} \text{ or } 4.47\text{km}$$

ambulance may be airborne...

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?

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

$V_f^2 = V_i^2 + 2a(x_f - x_i)$

$V_f^2 = (6.60\ m/s)^2 + 2(1.35\ m/s^2)(795\ m - 125\ m)$

$V_f^2 = 43.56\ m^2/s^2 + 1809\ m^2/s^2$

$\sqrt{V_f^2} = \sqrt{1852.56\ m^2/s^2}$

$V_f = \boxed{43.0\ m/s}$

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?

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

$V_f = V_i + at$

$= 32.0\ m/s + (1.50\ m/s^2)(24.0\ s)$

$= 32.0\ m/s + 36.0\ m/s$

$= \boxed{68.0\ m/s}$

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?

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

$x_f = x_i + \frac{1}{2}(V_i + V_f)t$

$= 300\ m + \frac{1}{2}(85.0\ m/s + 112\ m/s)(38.0\ s)$

$300\ m + 3743\ m = 4043\ m = \boxed{4040\ m}$

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?

$$v_i = 65.0\ mi/hr \quad v_f = 83.0\ ~~m/s~~\ mi/hr$$

$\bar{V} = \frac{V_i + V_f}{2} = \frac{65.0\ mi/hr + 83.0\ mi/hr}{2}$

$= \boxed{74.0\ mi/hr}$

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.)

a) What is the maximum height?

Several ways to do this

1.) Find time until penny is at same height and half it. Then use that time to find max height (see part b)

$X_f = X_i + V_i t + \frac{1}{2}at^2$

$264 + 16t + \frac{1}{2}(-9.8)t^2$ ← negative since gravity

$264 + 16t - 4.9t^2$

$t = \frac{3.27s}{2}$

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

$= 264 + 26.08 - 13.019$

$= 277\text{ m}$

or 2.) Use derivative and equal it to 0

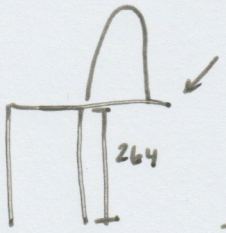
$264 + 16t - 4.9t^2 = 0$

$16 - 9.8t = 0$

$-16 \quad -16$

$\frac{-9.8t}{-9.8} = \frac{-16}{-9.8} = 1.63s$ then plug it in like in #1.

b) At what time does the penny reach its maximum height?



change our height → zero it out

$X_f = X_i + V_i t + \frac{1}{2}at^2$

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

$-264 \quad -264$

$0 = 16t - 4.9t^2$

$0 = t(-4.9t + 16)$

$t(-4.9t + 16) = 0$

$t = 0 \quad -4.9t + 16 = 0$

$-16 \quad -16$

$\frac{-4.9t}{-4.9} = \frac{-16}{-4.9}$

$t = 3.27s$

now take half

$\frac{3.27s}{2} = 1.63s$

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

see part b

$3.27s$

Two ways: Find time to impact from apex. Then use drop

$V_f = V_i + at$

at apex $V_i = 0$

$V_f = at$

$= (-9.8\frac{m}{s})(7.52s)$

$-73.7\frac{m}{s}$

From top ($t = 1.63$) to bottom $9.15 - 7.52s$

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

Quadratic time! (or just graph :))

when penny hits the ground $X_f = 0m$

$X_f = X_i + V_i t + \frac{1}{2}at^2$

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

the negative is irrelevant

$\frac{-16 \pm 73.7}{-9.8}$

$\frac{-16 - 73.7}{-9.8} = 9.15s$

$-b \pm \frac{\sqrt{b^2 - 4ac}}{2a}$

$\frac{-16 \pm \sqrt{(16)^2 - 4(-4.9)(264)}}{2(-4.9)}$

$\frac{-16 \pm \sqrt{256 + 5174.4}}{-9.8}$

$\frac{-16 \pm \sqrt{5430.4}}{-9.8}$

or derivate

$-9.8t + 16$

$-9.8(9.15) + 16$

$= -73.7\frac{m}{s}$

$a = -4.9$

$b = 16$

$c = 264$

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

position: $x_f = x_i + v_i t + \frac{1}{2}at^2$

$= 264 + 16(3) + \frac{1}{2}(-9.8)(3)^2$

$= 264 + 48 - 44.1 = 267.9\text{m} = \boxed{268\text{m}}$

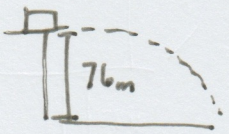
$v_f = v_i + at$

$= 16 + (-9.8)(3)$

$\boxed{= -13.4\ \text{m/s}}$

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.)



The car will act like its in free fall

impact means $x_f = 0$

$x_f = x_i + v_i t + \frac{1}{2}at^2 \quad v_i = 0$

$= 76 + (0)t + \frac{1}{2}(-9.8)t^2$

$0 = 76 - 4.9t^2$

$-76 \quad -76$

$\frac{-76}{-4.9} = \frac{-4.9t^2}{-4.9}$

$\sqrt{15.5} = \sqrt{t^2}$

$\boxed{t = 3.94\text{s}}$

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

$v_f = v_i + at \qquad v_i = 0$

$v_f = (-9.8)(2.5)$

$\boxed{-24.5\ \text{m/s}}$

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

$x_f = x_i + vt + \frac{1}{2}at^{\to 0}$ there is no acceleration in the x direction!

$x_f = x_i + vt \qquad x_i = 0$

use 3.94s as time to impact.

$x_f = (7.50\ \text{m/s})(3.94\text{s})$

$= \boxed{29.6\text{m}}$