

# POSNACK

S C H O O L

AP Physics 1 Summer Assignment Packet

2017-18

Welcome to AP Physics 1 at David Posnack Jewish Day School. The concepts of physics are the most fundamental found in the sciences. By the end of the year, you will have had the opportunity to make and test many hypotheses about the behavior of everyday objects and to design and build some interesting contraptions that will demonstrate the laws of mechanics.

This course will require a serious commitment and independent work on the part of every student in order to ensure a pace by which we can master the material before the AP testing in May 2017. This preparation packet (summer assignment) should assist all of us in achieving that goal.

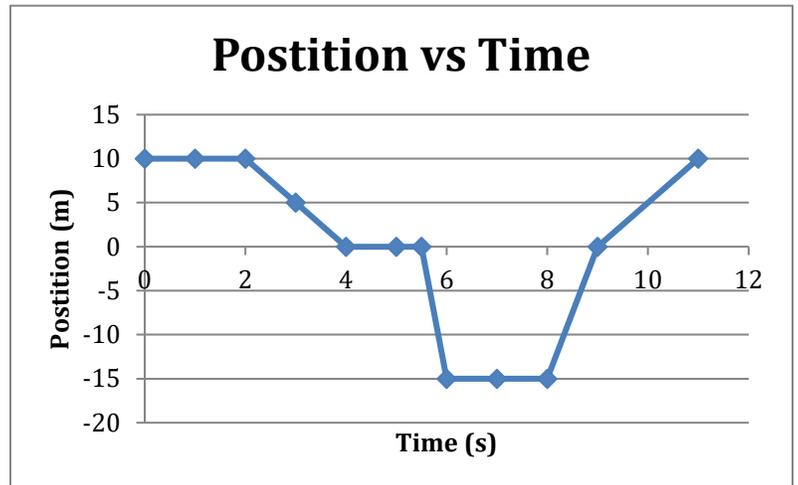
1. Go to Khan Academy and find the AP Physics 1 series of videos, specifically the one dimensional motion section(<https://www.khanacademy.org/science/physics/one-dimensional-motion>). Watch the lessons from the intro to physics through the last part of the acceleration section, and read the associated text pages to become familiar with the terms and concepts involved in one-dimensional motion. The content in Part 1 of this packet is covered in those videos (you won't see the same problems or questions, but the concepts are the same, so you should be able to do the work. For more help, try some of the supplemental links at the summer assignment webpage.)
2. Using the information on the next, download Vernier Logger Pro 3 from [www.vernier.com](http://www.vernier.com). Be sure to select the correct computer system option before downloading the program. It is free and safe to use. You will need to do this right away so that you are able to complete the lab portion (Part 2) of this packet. If you have any problems with it, please contact [kchajin@posnackschool.org](mailto:kchajin@posnackschool.org) immediately. There are two other files attached that you can open ONCE you have downloaded Vernier.
3. Part 3 of this packet is an assessment/review of your algebra and geometry skills, which are fundamental to your success in this course. Should you need to review any of these skills, Khan Academy, APlus Physics, and several other websites have terrific review videos.
4. Part 4 of this packet is a review accuracy and precision and an introduction to calculating uncertainty, random error, and systematic error. You will need to view the video on the summer assignment page to answer the questions.
5. *All parts of this assignment are to be received ON the first day of school during class.*

***The summer assignment is to be one's own work. That does not mean that you cannot help one another when you run into problems, but it DOES mean that copying work is not acceptable and, if discovered, will result in a zero for the assignment.***



4. Examine the graph below. It represents the motion of a particle over a period of 12 seconds. Determine the answers to items A through G.

- average velocity between points A and B
- average velocity between points B and C
- average velocity between points G and H
- total displacement from time 0 to time 11 s



- What is the particle doing between points B and C?
- What is it doing between F and G?
- When is the particle's speed the greatest?

### 1 Dimensional Kinematics- Non-uniform (Accelerated) Motion (Acceleration → What Are Acceleration Time Graphs)

- Calculate the average acceleration:
  - A rocket has a starting velocity of 5 m/s and a velocity of 200 m/s after 40 s.
  - A train, traveling at 40 m/s south changes its velocity to 12 m/s north over a period of 15 s.
- A runner is initially moving at +2.5 m/s and accelerates at the rate of  $-0.9 \text{ m/s}^2$  for 2 s. What is the velocity of the runner after the 2 s?
- A car traveling with a velocity of +7 m/s accelerates at  $+2 \text{ m/s}^2$  for 10 s. How far does the car travel in the 10 s?
- What happens to the *speed* of a car which, having an initial negative velocity, undergoes a positive acceleration? (Will it increase, decrease, or stay the same?)
- Explain why it is that your car has 3 accelerators. What/where are they?

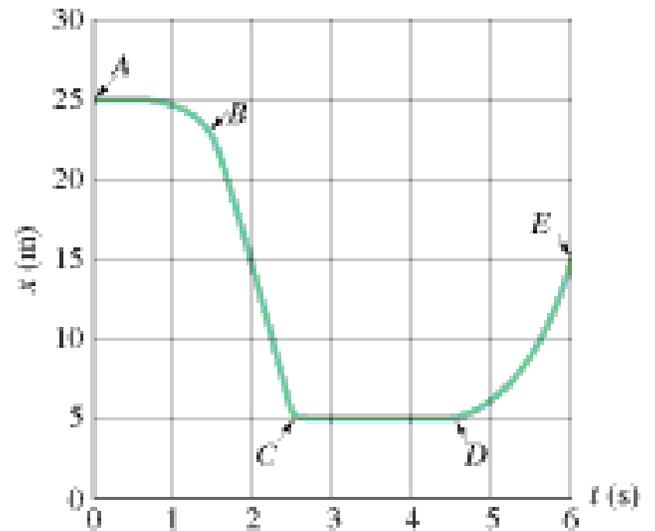
6. Examine the graph below, which represents the motion of a particle over six seconds. (Note that this is a position vs. time graph.)

a. Calculate the average velocity between points A and C.

b. How could you calculate the instantaneous velocity at point B?

c. What is the particle doing between  $t=3\text{s}$  and  $t=4\text{s}$ ?

d. What does the particle do between 5 s and 6 s? How can you tell?



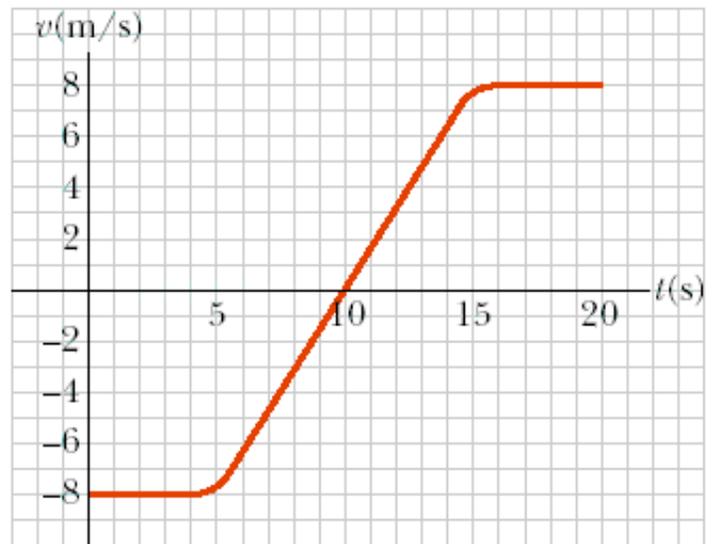
7. Examine the graph below, which represents the motion of a particle. (Note that this is a velocity vs. time graph.)

a. What is the velocity of the particle between  $t=0$  and 4 s?

b. What is the average acceleration between  $t=5\text{ s}$  and  $t=15\text{ s}$ ?

c. What does the particle do at  $t=10\text{ s}$ ?

d. What is the total displacement of the particle (from  $t=0\text{s}$  to  $t=20\text{s}$ )? Explain.



## AP Physics Summer Assignment-Part 2

### Toy Car (Use Lab Files in the Summer Assignment page.)

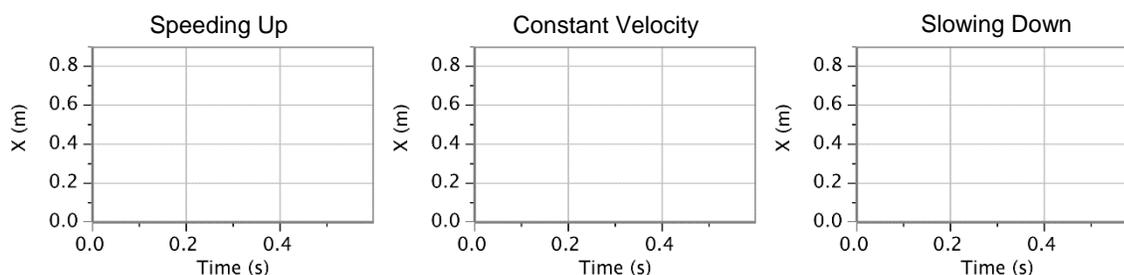
Imagine a motorized toy car moving along on a flat, level track for a distance of less than a meter. Your goal in this activity is (1) to predict what a graph of the car's position vs. time (or  $x$  vs.  $t$ ) will look like and (2) to use *Logger Pro* software to analyze a digital video clip of a toy car to test your prediction and find the speed of the car as a function of time.



#### 1. Preliminary Questions

**Note:** You will receive **full credit for each prediction** made in this preliminary section whether or not it matches conclusions you reach in the next section. As part of the learning process it is important to compare your predictions with your results. **Do not change your predictions!**

- (a) Imagine a motorized toy car moving forward and back along on a flat, level surface that is about one meter long. Would you expect to see it speeding up, moving at a constant speed, or slowing down? Explain your reasoning.
- (b) If you were to play a movie of the car described in (a) and/or replay it on a frame-by-frame basis, how could you test your prediction about its motion? Explain.
- (c) Sketch graphs of the location of the toy car along an  $x$ -axis when it is speeding up, moving at a constant velocity, and slowing down. Assume timing starts when the car's leading edge is at the origin.



## 2. Activity-Based Questions

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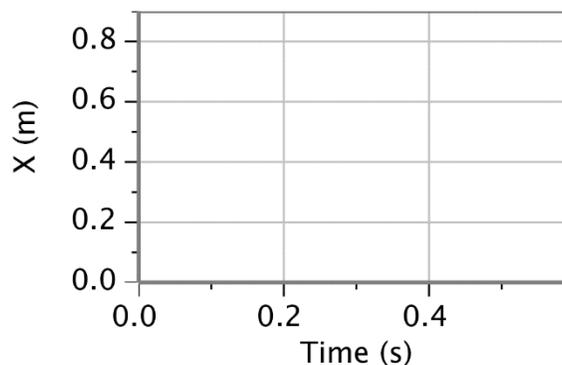
- (a) Open the file < 8.20.04.remotecar1-2> in *QuickTime Player*. Play the movie or advance it frame-by-frame using the right arrow key ( $\rightarrow$ ) on your keyboard. If you are unable to play it in QuickTime Player, go to the next step and insert the movie file into the experiment file, if it isn't already there. You can insert it using the "Insert $\rightarrow$ Movie" option from the menu bar at the top of the Logger Pro screen. Once the video is in the experiment file, you should be able to play it.

Can you tell whether it is speeding up, slowing down or moving at a constant speed? If so explain how you know.

- (b) Open the Logger *Pro* experiment file <ToyCarMotion.cmbl> to open a video analysis file with the movie inserted. Click the **Add Point** tool ( $\oplus$ ) near the top right side of the movie window. Then click on the front of the car in each frame to record the position in picture elements or *pixels* for short. **Note:** If you mess up, just close and re-open the movie and start over. (You'll learn how to fix bad point markers later on.)

What does the graph's shape tell you about the nature of the car's motion?

- (c) Your next task is to scale the movie using the 1-meter calibration stick shown in the movie. This allows you to determine the car's location in meters, rather than pixels, in each frame. To scale, click on the **Set Scale** tool () that looks like a little ruler. Then place the cursor at one end of the calibration stick and hold down the mouse button as you drag it to the other end of the stick and release it. Your scale object is 1 m, so click on the OK button in the dialog box. Carefully draw the data points on the graph shown on the right.



- (d) Figure out a good way to find the speed of the car in meters/second to three significant figures. **Hint:** Though other methods are acceptable, you might want to use the "**Tangent**" feature in the Logger *Pro* **Analyze** menu. Report your result and show or describe your method.
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### ***3. Reflections on Your Findings***

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(a) Comment on the nature of the motion and what evidence was most convincing in arriving at your conclusion.

(b) How did your prediction in question 1(a) compare with your final conclusion?

## AP Physics Summer Assignment-Part 3

### Significant Figures and Scientific Notation Review

1.) How many significant figures do the following numbers have?

- a.) 3.01      Answer: \_\_\_\_\_      d.) 89.000      Answer: \_\_\_\_\_  
b.) 0.0910      Answer: \_\_\_\_\_      e.)  $\pi/2$       Answer: \_\_\_\_\_  
c.) 315,000      Answer: \_\_\_\_\_

Directions: Solve the following. Final answers should be in scientific notation with the correct number of significant figures.

2.)  $(6.28 \times 10^{17} - 3.14 \times 10^{17})$       3.)  $(6.28 \times 10^3 + 3.9 \times 10^8)$

4.)  $6.00 \times 10^{-7} \frac{3.00 \times 10^{26}}{2.00 \times 10^9}$

5.)  $\frac{8.4 \times 10^8}{4.1 \times 10^7}$

### Unit Conversions Review

6.) Finish the SI prefix table below. Follow the example of the shown. You will need to memorize these.

Symbol	Name	Numerical Equivalent
n		
$\mu$		
m		
c	centi	$10^{-2}$
k		
M		
G		

7.) 21.35 kilograms = \_\_\_\_\_ many grams?

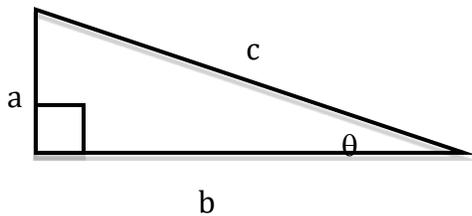
8.) 760 nm = \_\_\_\_\_ meters?

9.) 25 years = \_\_\_\_\_ seconds?

10.)  $2.998 \times 10^8$  m/s = \_\_\_\_\_ miles per hour?

## Trigonometry Review

Directions: Use the figure below to answer problems 12-21. Simplify as much as you can.



12.) Find  $c$  if given  $a$  and  $b$ .

13.) Find  $a$  if given  $b$  and  $c$ .

14.) Find  $\theta$  if given  $a$  and  $b$ .

15.) If  $a = 6.0$  and  $c = 10.0$ , what is  $b$ ?

16.) If  $c = 20.0$  and  $\theta = 80^\circ$ , what is  $b$ ?

17.) If  $a = 15.0$  and  $\theta = 30^\circ$ , what is  $b$ ?

## Algebra Review

Directions: Solve the following equations for the given variable and conditions. Simplify if needed.

Example:  $2x + xy = z$ . Solve for  $x$ .

$$x(2 + y) = z$$

$$x = \frac{z}{2 + y}$$

18.)  $v_1 + v_2 = 0$ . Solve for  $v_1$ .

19.)  $a = \frac{v}{t}$ . Solve for  $t$ .

20.)  $v_f^2 = v_i^2 + 2ad$  solve for  $v_i$ .

21.)  $a_c = \frac{v^2}{r}$ . Solve for  $v$ .

22.)  $Ft = mv_f - mv_i$ . Solve for  $m$ .

23.)  $m_1v_{i1} + m_2v_{i2} = (m_1 + m_2)v_f$ . Solve for  $v_{i,2}$ .

24.)  $-kx + m(-g) = 0$ . Solve for  $m$ .

25.)  $F_g = G \frac{m_1m_2}{r^2}$ . Solve for  $r$ .

## Relationships from equations

26.) Consider  $z = \frac{y}{x}$  and  $a = bc$ ,

- a.) As  $x$  increases and  $y$  stays constant,  $z$  \_\_\_\_\_.
- b.) As  $y$  increases and  $x$  stays constant,  $z$  \_\_\_\_\_.
- c.) As  $x$  increases and  $z$  stays constant,  $y$  \_\_\_\_\_.
- d.) As  $a$  increases and  $c$  stays constant,  $b$  \_\_\_\_\_.
- e.) As  $c$  increases and  $b$  stays constant,  $a$  \_\_\_\_\_.
- f.) As  $b$  increases and  $a$  stays constant,  $c$  \_\_\_\_\_.

## Systems of equations

Use the equations in each problem to solve for the specified variable in the given terms. Simplify.

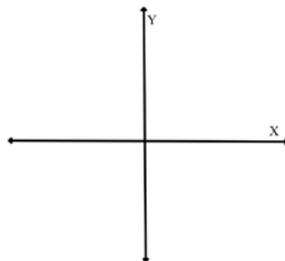
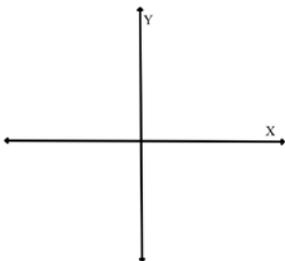
27.)  $F_f = \mu F_N$  and  $F_N = mg \cos \theta$ . Solve for  $\mu$  in terms of  $F_f$ ,  $m$ ,  $g$ , and  $\theta$ .

28.)  $F_1 + F_2 = F_T$  and  $F_1 \cdot d_1 = F_2 \cdot d_2$ . Solve for  $F_1$  in terms of  $F_T$ ,  $d_1$ , and  $d_2$ .

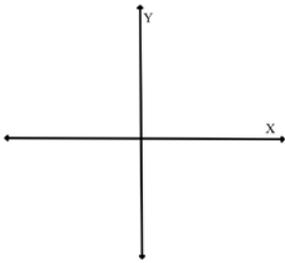
## Graphing Equations

29.) On the  $y$  vs.  $x$  graphs below, sketch the relationships given.

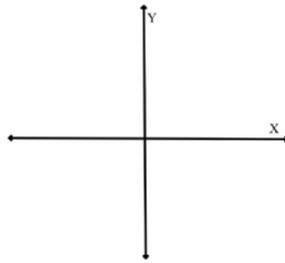
- a.)  $y = mx + b$ , if  $m > 0$  and  $b = 0$ .
- b.)  $y = x^2$



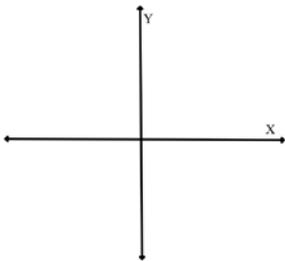
c.)  $y = \sqrt{x}$



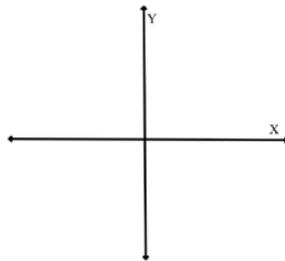
d.)  $y = 1/x$



e.)  $y = 1/x^2$



f.)  $y = \sqrt{\frac{1}{x}}$



### AP Physics Summer Assignment-Part 4

1. What is meant by "uncertainty" in a measurement? Why do you think it is important to include an indication of uncertainty when you report experimental results?
2. What is systematic (or systemic) error in an experiment? In what ways would it affect the data? Give one example.
3. How are analog measuring devices different from digital devices?
4. What is random error in an experiment? In what ways would it affect the data? Give one example.
5. How is uncertainty represented on a graph?
6. Suppose you are measuring the length and the width of a piece of paper with a metric ruler, on which the smallest division is the millimeter (0.001 m). You measure the length to be 0.0130 m and the length to be 0.085 m.
  - a. What would be the appropriate way to report each measurement, including the uncertainty?
  - b. What would be the area of the piece of paper, with the correct uncertainty value included in your answer?
7. Briefly describe an acceptable method for determining the uncertainty when using multiple repeated measurements.
8. In your own words, compare and contrast precision and accuracy.