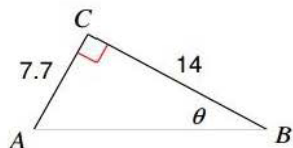


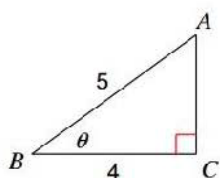
**Part I: Right Triangles**

Directions: Find the measure of the angle or side indicated. Please show all of your work.

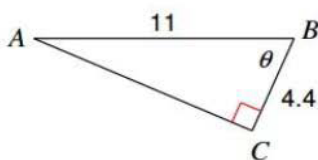
1) Find  $\theta$



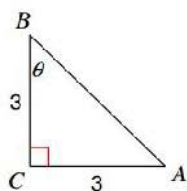
2) Find  $\theta$



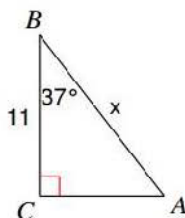
3) Find  $\theta$



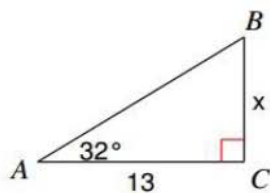
4) Find  $\theta$



5) Find  $x$



6) Find  $x$



## Lab Skills Review – Data Analysis Practice

### Skills to Review over the Summer: Linearizing/Graphing

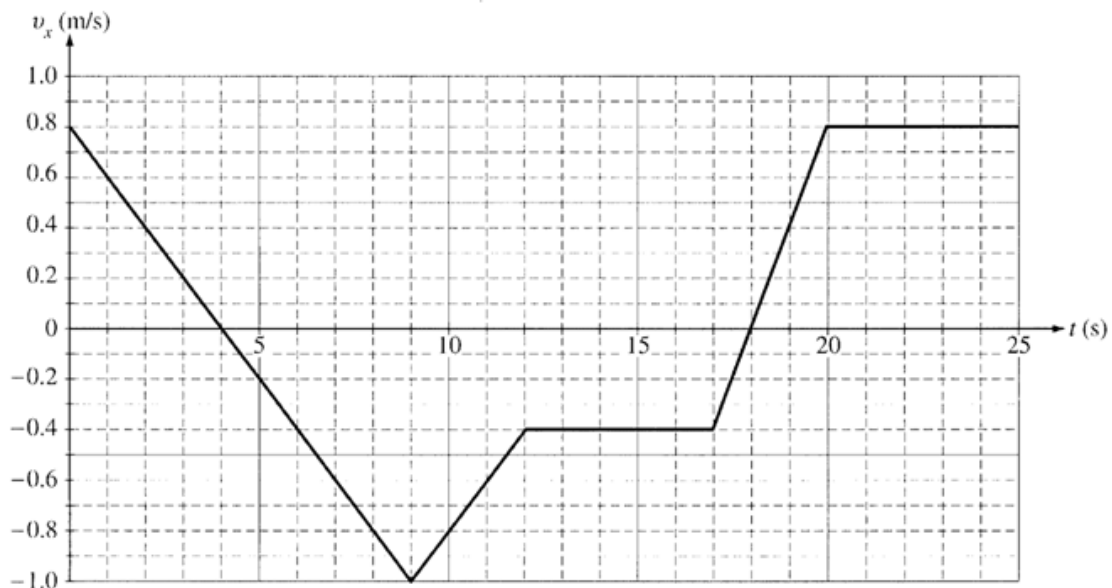
Graphical construction & analysis are very important skills to have in physics. You must be able to interpret graphs and gather information from them. Throughout the year you may be asked to:

- correctly graph data
- determine the type of relationship shown by a graph
- draw best-fit lines for your data
- linearize data
- calculate the slope, area under the curve, or intercept values

**Complete the problems below to practice using some of these skills.**

Please try your best on the two problems that follow – they can be tricky if you have not done this in a while (or ever). Don't worry if you don't get it completely, we will go over this the first week of school.

**Problem #1:** The graph below shows the velocity vs. time of a cart moving along a straight horizontal track.

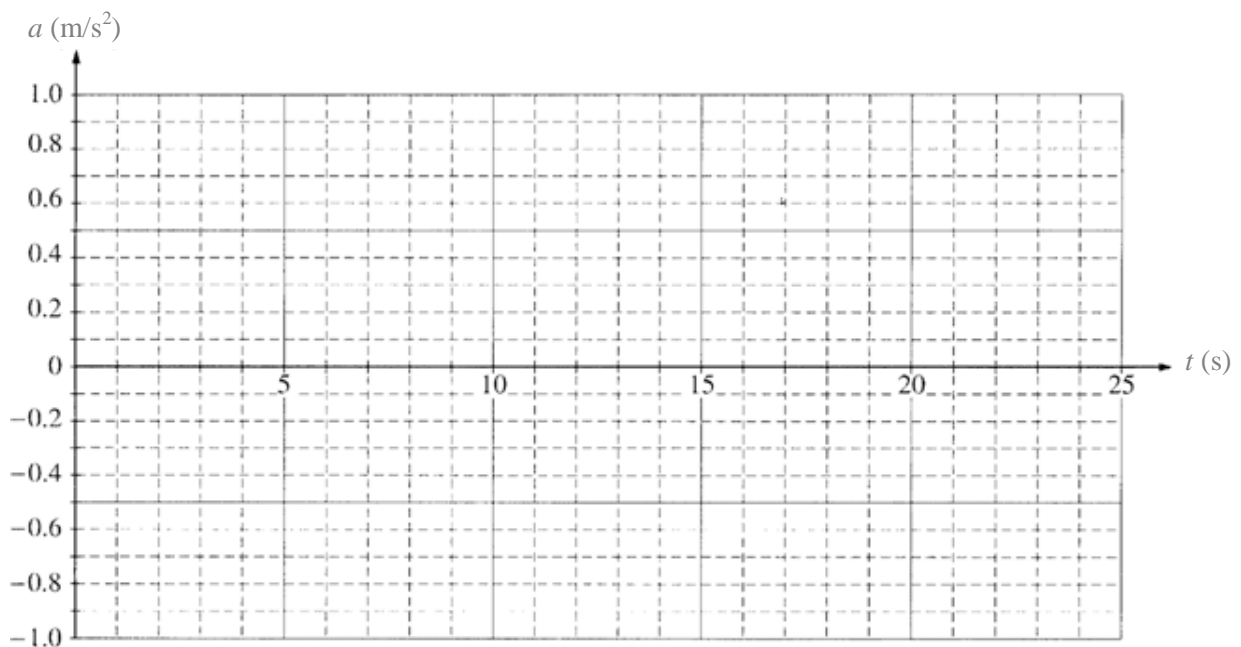


- Indicate the times when the cart is at rest
- Determine the slope for the cart from time  $t = 0$  s to time  $t = 9$  s

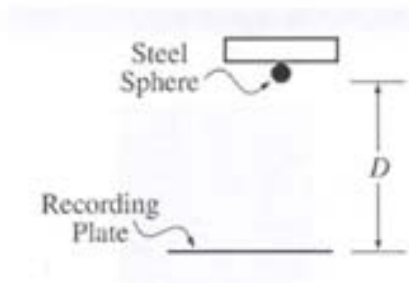
- c. What do you think the negative sign in your answer to part b signifies?
- d. The slope of each segment of the graph on the previous page is equal to the average acceleration of the cart over that time frame. Using the labels on the axes from the original graph, determine the formula for finding the average acceleration.

*\*Hint: If **average acceleration = slope**, then **average acceleration =** (must have  $v$  and  $t$  in the answer)*

- e. Using the graph on the previous page, graph the acceleration vs. time for the cart below.



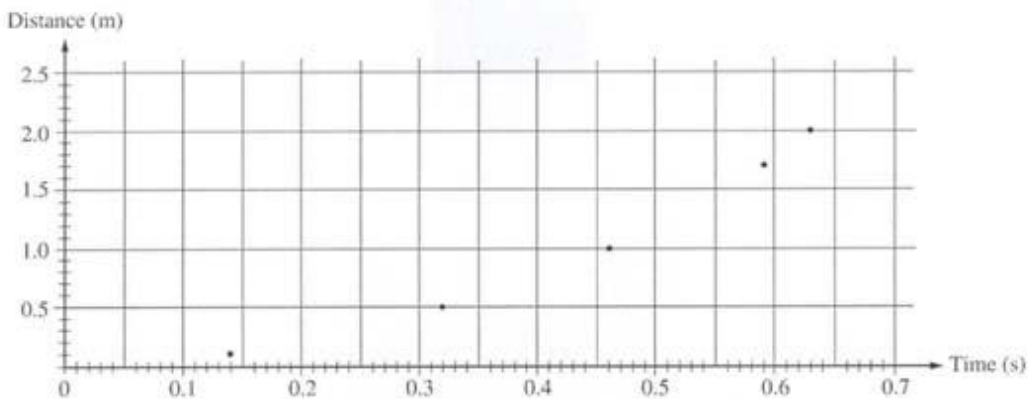
## Problem #2



A student wishing to experimentally determine the acceleration due to gravity ( $g$ ) has an apparatus that holds a small steel sphere above a recording plate as shown above. When the sphere is released, a timer automatically begins recording the time of the fall. The timer automatically stops when the sphere strikes the recording plate. The student measures the time for the fall for different values of the distance  $D$  and records the data in the table below. These data points are also plotted on the graph.

**Data Table**

Distance of Fall (m)	0.10	0.50	1.00	1.70	2.00
Time of Fall (s)	0.14	0.32	0.46	0.59	0.63



- a. On the graph above, sketch a smooth curve through the data.

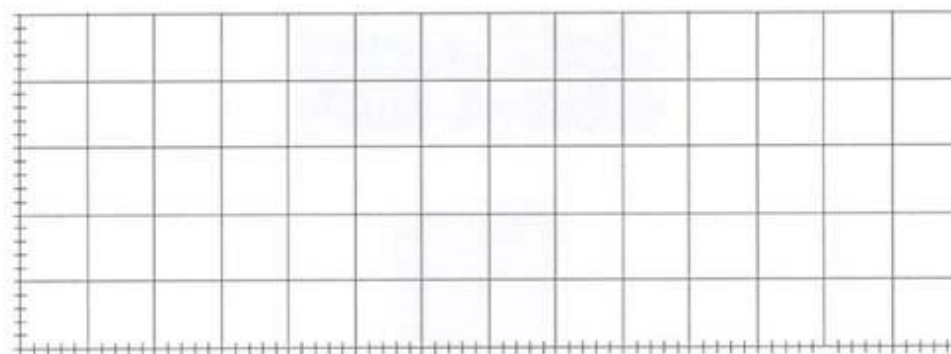
The student can use the data for the distance  $D$  and time  $t$  to produce a second graph from which the acceleration due to gravity,  $g$ , can be determined. The relationship between  $D$ ,  $t$  and  $g$  is as follows:

$$D = -$$


- b. What quantities should the student graph in order to produce a linear relationship between  $D$  and  $t$ ?

- c. On the graph below, plot data points for the quantities that you outlined in (b) and sketch a best-fit straight-line to fit your points. Be sure to label your axes and show the scale that you have chosen for the graph.

**Data Table**

- d. Calculate the slope of your data from part (c).
- e. Based on your slope in part (d), determine the acceleration due to gravity,  $g$  in this experiment.

7. Displacement is a quantity that has a direction and a magnitude. What are these types of quantities called and how are they represented in diagrams?
8. How can you show direction in calculations?
9. What is the formula for change in position (displacement)?
10. What is this  $\Delta$ ? What does it mean?  

11. Problem: Sally starts at 60.0 m, walks east and ends up at 100.0 m. What is her displacement?
12. Problem: Joe jumps off of a wall that is 10.0 feet high and lands on the ground. What is his displacement?

- **2-3: Instantaneous Velocity (p.23)**

1. What is instantaneous velocity and how does it differ from average velocity?
2. If a school bus moves with an average speed of 30 mph, does this mean its instantaneous velocity at any instant is also 30 mph? Explain.
3. When an object moves with constant velocity, does its average velocity during any time interval differ from its instantaneous velocity at any instant?

- **2-4: Acceleration (p.23-25)**

1. What is acceleration and what formula can you use to calculate average acceleration?
2. Is acceleration a vector quantity or scalar quantity? How do you know?
3. What is instantaneous acceleration?
4. Look at Example 2-3 then complete Problem #17 on p.39

**Part II: Factor-Label Method for Converting Units (Dimensional Analysis)**

A very useful method of converting one unit to an equivalent unit is called the factor-label method of unit conversion. You may be given the speed of an object as 25 km/h and wish to express it in m/s. To make this conversion, you must change **km** to **m** and **h** to **s** by multiplying by a series of factors so that the units you do not want will cancel out and the units you want will remain. Conversion factors: 1000 **m** = 1 **km** and 3600 **seconds** = 1 **hour**

**Do the following conversions using the factor-label method. Include units in each step and box in your answer. Show all of your work!**

7. How many meters are in 100 feet? (1 ft = 0.3048 m)
  
  
  
  
  
  
  
  
  
  
8. How many square feet are in 100 m<sup>2</sup> ?
  
  
  
  
  
  
  
  
  
  
9. How many kilograms are in 2000 grams?
  
  
  
  
  
  
  
  
  
  
10. If there are 745 Watts for every horsepower how many horses would it take to power a single hundred-watt light bulb?
  
  
  
  
  
  
  
  
  
  
11. If a woodchuck can chuck 2 cubic meters of wood per minute, how many cubic centimeters per second is that equivalent to?
  
  
  
  
  
  
  
  
  
  
12. I want to know how far I just traveled on my super sweet 21-speed bike. I know the speed I went (2.5 m/s) and I know that my bike ride was 45 minutes long.

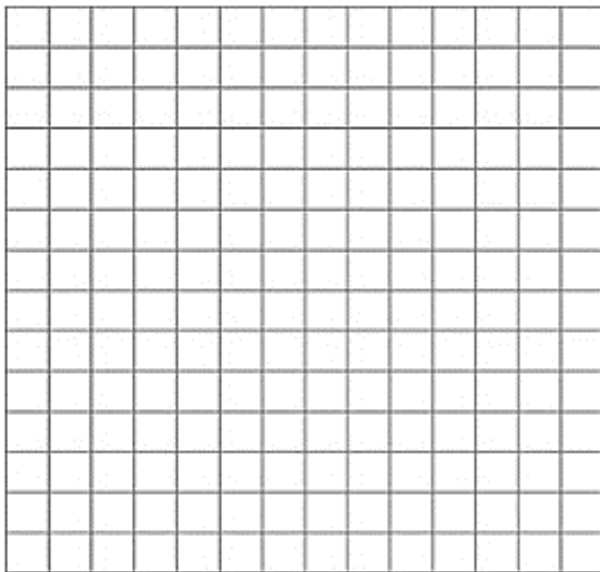


### Part III: Graphing

You have been asked by your teacher to measure the diameter, radius and circumference of some round objects, such as tin cans, lids, CD's, coins, etc. You have collected the measurements and recorded them in the table below:

Radius (cm)	Circumference (cm)
1.1	3.5
3.2	10.0
4.8	15.1
8.8	27.5
9.6	29.9
12	37.6

13. You are to graph the data in the graph below. The radius is the independent variable here and the circumference is the dependent variable. What does this mean for how you graph the data?
14. Label the axis and with the name of the quantity, appropriate scaling of numbers and units. Then plot the points and draw the best straight line through as many points as possible, known as best-fit-curve (DO NOT JUST CONNECT THE DOTS!)



15. Find the slope of the graph. Does it have a name or a physical meaning?

16. Is the slope constant? How do you know this?

17. Does your graph have a y-intercept, if it does, what is it and does it have any significance?

18. Using the fact that the equation for a straight line is  $y = mx + b$  write the specific equation for this graph using the appropriate symbols for radius and circumference in place of the  $x$  and  $y$  symbols.

#### Part IV: Scientific Notation:

Examples:  $200,000 = 2 \times 10^5$      $0.00000123 = 1.23 \times 10^{-6}$

Express the following numbers in scientific notation:

13.  $86,400 \text{ s} =$

15.  $300,000,000 \text{ m/s} =$

14.  $0.000564 \text{ m} =$

16.  $0.0000000000667 =$

Convert from scientific notation to normal notation:

17.  $9 \times 10^9 =$

19.  $1.93 \times 10^4 \text{ kg/m}^3 =$

18.  $1 \times 10^{-3} \text{ m} =$

20.  $4.5 \times 10^{-7} \text{ m} =$

#### Multiplying Numbers in Scientific Notation

21. In your own words, explain how you multiply numbers in scientific notation.

22.  $(2.5 \times 10^8) \times (1.2 \times 10^1)$

24.  $(6.0 \times 10^{-2})(6.1 \times 10^{-2})$

23.  $(1.8 \times 10^3)(7.3 \times 10^{-8})$

25.  $(5.5 \times 10^9) \times (4.0 \times 10^{11})$

### Adding Numbers in Scientific Notation

26. In your own words, explain how you add numbers in scientific notation.

27.  $(2.5 \times 10^8) + (1.2 \times 10^8)$

29.  $(6.0 \times 10^{-2}) + (6.1 \times 10^{-2})$

28.  $(1.8 \times 10^3) + (7.3 \times 10^2)$

30.  $(5.5 \times 10^9) + (4.0 \times 10^{11})$

31. Why do scientists use scientific notation?

32. Which of the following is written in proper scientific notation?

(A)  $0.25 \times 10^3$     (B)  $2.5 \times 10^2$     (C)  $25 \times 10^1$     (D) 250

### PART V: Algebraic Relationships

Consider the following:  $z = x/y$      $c = ab$      $l = m\sqrt{n}$      $r = s^2/t^2$

33. As  $x$  increases and  $y$  stays constant,  $z$  \_\_\_\_\_.

34. As  $y$  increases and  $x$  stays constant,  $z$  \_\_\_\_\_.

35. As  $x$  increases and  $z$  stays constant,  $y$  \_\_\_\_\_.

36. As  $a$  increases and  $c$  stays constant,  $b$  \_\_\_\_\_.

37. As  $c$  increases and  $b$  stays constant,  $a$  \_\_\_\_\_.

38. As  $b$  increases and  $a$  stays constant,  $c$  \_\_\_\_\_.

39. As  $n$  increases and  $m$  stays constant,  $l$  \_\_\_\_\_.

40. As  $l$  increases and  $n$  stays constant,  $m$  \_\_\_\_\_.

41. If  $s$  is tripled and  $t$  stays constant,  $r$  is multiplied by \_\_\_\_\_.

42. If  $t$  is doubled and  $s$  stays constant,  $r$  is multiplied by \_\_\_\_\_.

**PART VI: SOLVING EQUATIONS**

Often problems on the AP exam are done with variables only. Below are various physics formulas. Don't worry about what the variables mean for now; we will learn that later. Just solve for the variable indicated. Don't let the different letters confuse you. Manipulate them algebraically as though they were numbers. Remember, there is a video tutorial on the website if you need some help.

Directions: Use algebra to solve for the indicated variable. Please show all work.

43.  $\Delta V = IR$ , solve for  $I$

44.  $v_f = v_o + at$ , solve for  $a$

45.  $mgh = \frac{1}{2}mv^2$ , solve for  $v$

46.  $\Delta x = v_o t$ , solve for  $t$

47.  $v_f^2 = v_o^2 + 2a(x_f - x_o)$ , solve for  $a$

48.  $T = 2\pi\sqrt{\frac{L}{g}}$  solve for  $g$

49.  $U_s = \frac{1}{2}kx^2$ , solve for  $x$

### PART VII: Significant Figures

For each number given below, identify how many significant digits are in the number.

50. 0.56 \_\_\_\_\_

55. 5 \_\_\_\_\_

51. 5,984 \_\_\_\_\_

56. 5.0 \_\_\_\_\_

52. 5.9873 \_\_\_\_\_

57. 5.08 \_\_\_\_\_

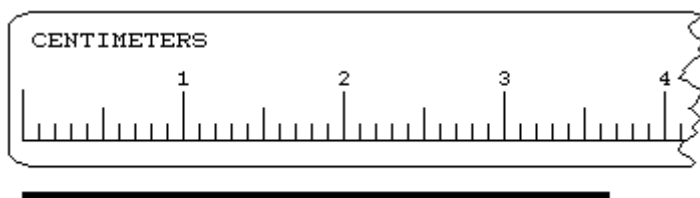
53. 100,000 \_\_\_\_\_

58. 1870 \_\_\_\_\_

54. 0.098 \_\_\_\_\_

59. 1.400 \_\_\_\_\_

60. Measure the line with the ruler shown below



a) Your Measurement: \_\_\_\_\_

b) How many significant digits are there? \_\_\_\_\_

c) How do you know how many significant digits are necessary here?

61. In math operations involving significant figures, the answer is reported in such a way that it reflects the reliability of the least precise operation. In your own words, what are the "rules" for:

a) multiplication & division of significant figures:

b) addition & subtraction of significant figures:

Directions: Solve each problem. Show all steps of your process and circle your answer. Be sure your answer has the correct amount of significant figures.

62.  $1.3 \text{ m} \times 71.5 \text{ m} =$

63.  $4.2 \text{ ft} + 8.15 \text{ ft} =$

64.  $38.520 \text{ L} - 11.4 \text{ L} =$

65.  $\frac{8.00 \text{ ml}}{4.00 \text{ m}} =$

66.  $\frac{0.82 \text{ g} \times 25.4 \text{ g}}{0.116 \text{ g} \times 3.4 \text{ g}} =$

67. **Test Yourself....**An engineering student is trying to calculate the permeation rate of water across a polymer membrane of a fuel cell. The student's measurements are provided in the table below. Determine how many significant figures each measurement has.

Student's Data	Student's Measurements	# of Significant Figures
the mass of water that crossed the membrane	3.7520 g	
the area of the membrane used	1.00 cm <sup>2</sup>	
elapsed	3600 seconds	

68. Explain why all of the measurements are given in different numbers of significant figures.

69. In order to calculate the permeation rate of water across the polymer membrane, she must divide the mass of the water collected by the area of the membrane and then divide that by the elapsed time. So in other words:

**Permeation rate = the mass of the collected methanol/ area of the membrane /elapsed time**

- How many significant digits should her answer be? \_\_\_\_\_
- Explain how you figured out the answer to part a.

70. What is the connection between the number of significant digits provided in a problem and the way in which these quantities were initially measured?