Name: ___________________________

AP Physics Summer Assignment 2010

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Due Date: September1. Summer Assignment Quiz – TBA.

Introduction: The purpose of AP physics is to provide students with the equivalent of a calculus-based college course in physics. This is a demanding course that requires a level of abstract thinking and facility with problem-solving that goes beyond the experience of most students prior to taking the course. Students in academic calculus will need to master some calculus skills before you get to them in calc class. I will do my best to help you in this regard. You will at times be confused and stressed by the pace of the course (we must cover two semesters of physics by May 9th, 2011.) Your head will be swimming with dozens of formulas that each has at its core some basic physics principle. Not surprisingly, then, you cannot afford to fall behind early. If you have waived into this course, know that the pre-requisites are not *capricious* (SAT word – look it up!) <u>Note that you will receive 12 review packets in the last six weeks of school before AP tests that will be graded for accuracy. If you sign up for my course, you are signing up for homework during and after Spring break, when all of your friends are going shopping for their latest summer fashions.</u> However, the reward is typically a number of 4's and 5's in AP physics, with a few 3's and the occasional 2 (by students who give up trying at some point.)

The purpose of this AP Physics Summer Assignment is to prepare you with some of the basic skills that I expect all students to have prior to physics, and to get students who allow students who did not take Honors Physics to become familiar with some basic physics concepts. It does not represent the level or degree of difficulty that AP physics will entail later on.

The Grade:

The Summer assignment is graded as follows:

50 pts for summer work
- 15 – work shown clearly
- 5 – numbers have labels (units)
- 10 – graphs are labeled and best fit lines traced
- 10 – written statements are detailed and clear. (Proofread)
- 10 – A 3-ring binder lab portfolio and lab notebook is in order.

50 pts for a Summer Assignment Quiz

The Content Knowledge:

A modern definition of force – may require some research on your part
The four fundamental forces and their relative strengths
Unit prefixes (Table 1-2), approx. lengths (T1-3), times (T1-4), masses (T1-5)
The Greek alphabet (Back cover) – yes, backwards and forwards
What does *Φισικα* spell?

Definitions:

Mass	Scalar	Position & displacement
Weight	Vector	Instantaneous velocity
Mass Density	Unit Vector	Avg. velocity & speed
	Vector component	Acceleration

Formulas:

Circumference and area of a circle
Surface area and volume of a sphere
Surface area and volume of a cylinder

Trigonometry:

Finding the components of a vector (and $\hat{\boldsymbol{i}},\hat{\boldsymbol{j}},\hat{\boldsymbol{k}}$ notation)
Graphical and component addition and subtraction of vectors

Mathematical modeling

Finding the equations of curves from the following six functions:
linear, quadratic, square root, inverse, constant, inverse square
(See the attached handout for a discussion on linearizing graphs to find equations.) Using r-values is *not* sufficient to prove that data fits the curve.

Assigned problems:

HRW p. 8, Problems 17, 52, 53, 56, 57 (yes, I am having fun @ your expense ☺)
p. 29, Questions 1, 4, 5
p. 30, Problems 1, 3, 5, 9 (bonus 12,) 23, 25, 27
p. 53, Problems 1, 3, 7, 9, 11, 13, 17
Unit I Worksheet I: *Graphing Practice* (In packet)

Lab skills:

Create a lever with a ruler, a pencil and some pennies. Place some pennies on one side of the ruler, and keep their location constant. Then, find as many ways as possible to balance the ruler with the remaining pennies. In the process, identify what variables are the dependent variables, which are independent, and which are being controlled for. Determine how accurately you can make measurements of the relevant variables, then graph your results in some meaningful way, and make a statement of conclusion about what you measured. In your conclusion, use your estimated uncertainty in determining how well your data justifies your conclusion. If you know a theoretically expected result, give an appropriate calculation of % error. Does this fall in the range of your measurement uncertainties?

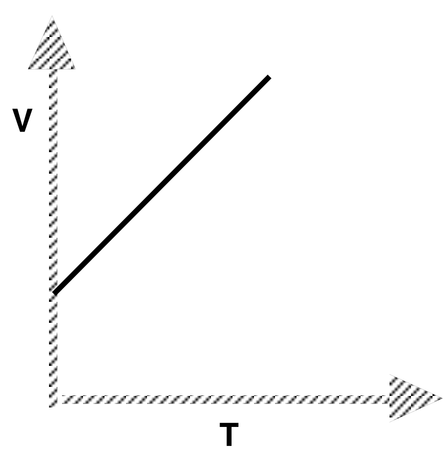
Unit I Reading – Graphical Methods

One of the most effective tools for the visual evaluation of data is a graph. The investigator is usually interested in a quantitative graph that shows the relationship between two variables in the form of a curve.

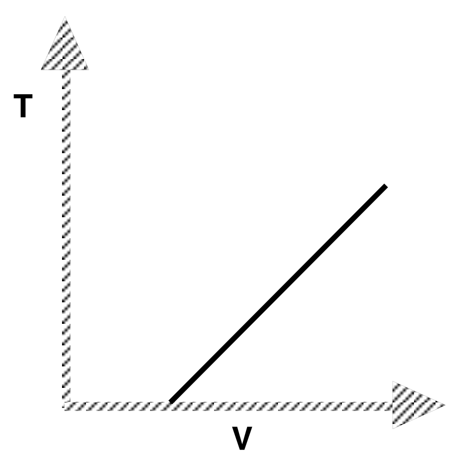
For the relationship y = f(x), **x** is the *independent variable* and **y** is the *dependent variable*. The rectangular coordinate system is convenient for graphing data, with the values of the dependent variable y being plotted along the *vertical axis* and the values of the independent variable x plotted along the *horizontal axis*.

Positive values of the dependent variable are traditionally plotted above the origin and positive values of the independent variables to the right of the origin. This convention is not always adhered to in physics, and thus the positive direction along the axes will be *indicated by the direction the arrow heads point.*

The choice of dependent and independent variables is determined by the experimental approach or the character of the data. Generally, the **independent variable** is the one over which the *experimenter has complete control*; the **dependent variable** is the one that *responds to changes* in the independent variable. An example of this choice might be as follows. In an experiment where a given amount of gas expands when heated at a constant pressure, the relationship between these variables, V and T, may be graphically represented as follows:



Correct



Incorrect

By established convention it is proper to plot V = f (T) rather than T = f (V), since the experimenter can directly control the temperature of the gas, but the volume can only be changed by changing the temperature.

Curve Fitting

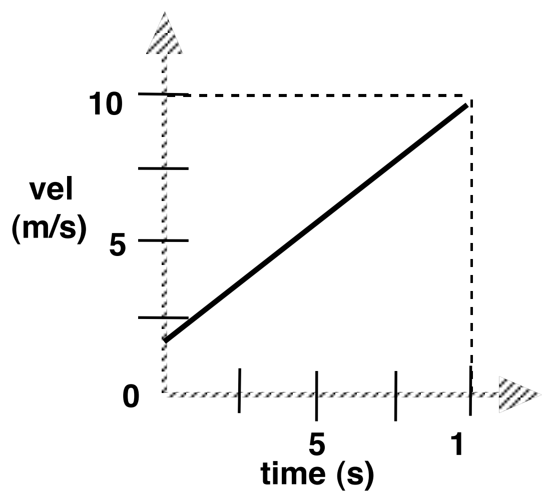
When checking a law or determining a functional relationship, there is good reason to believe that a uniform curve or straight line will result. The process of matching an equation to a curve is called **curve fitting**. The desired empirical formula, assuming good data, can usually be determined by inspection. There are other mathematical methods of curve fitting, however they are very complex and will not be considered here. Curve fitting by inspection requires an assumption that the curve represents a linear or simple power function.

If data plotted on rectangular coordinates yields a straight line, the function y = f(x) is said to be *linear* and the line on the graph could be represented algebraically by the slope-intercept form:

$$y = mx + b,$$

where **m** is the slope and **b** is y-intercept.

Consider the following graph of velocity vs. time:



The curve is a straight line, indicating that v = f(t) is a linear relationship. Therefore,

$$\mathbf{v} = m\mathbf{t} + b,$$

where slope = m = — = ———

From the graph,

$$m = \text{———} = 0.80\ \text{m/s}^2\ .$$

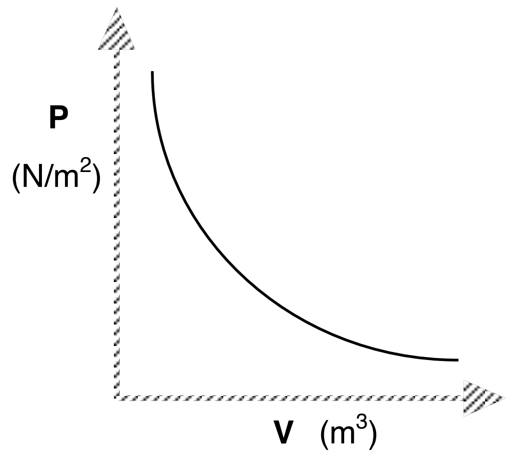
The curve intercepts the v-axis at v = 2.0 m/s. This indicates that the velocity was 2.0 m/s when the first measurement was taken; that is, when t = 0. Thus, $b = v_0 = 2.0$ m/s.

The general equation, **v** = m**t** + b, can then be rewritten as

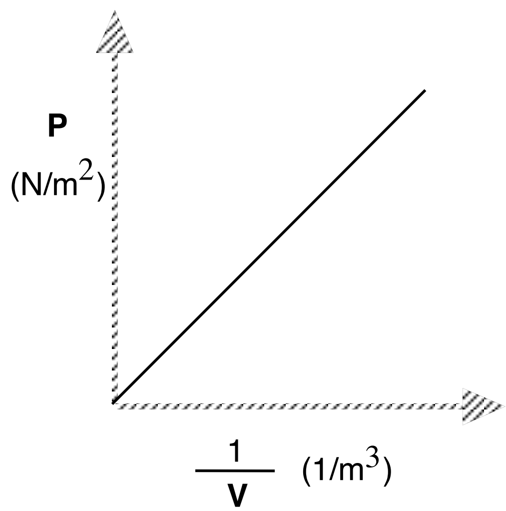
$$\mathbf{v} = (0.80\ \text{m/s}^2\ )\mathbf{t} + 2.0\ \text{m/s}.$$

m

Consider the following graph of pressure vs. volume:



The curve appears to be a hyperbola (inverse function). Hyperbolic or inverse functions suggest a test plot be made of P vs — . The resulting graph is shown below:

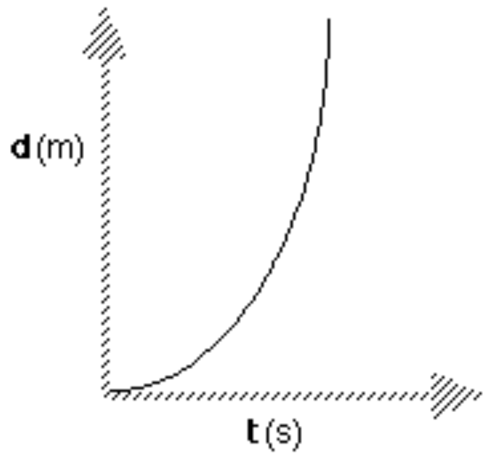


The equation for this straight line is:

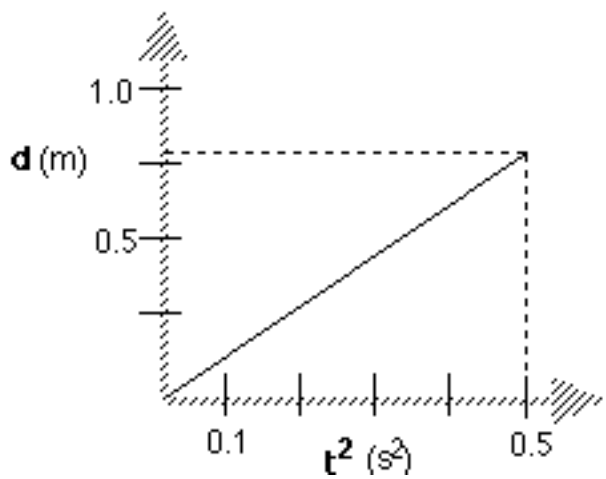
P = m (—) + b,

where b = 0. Therefore; P = — ; when rearranged, this yields PV = constant, which is known as Boyle's law.

Consider the following graph of distance vs. time:



The curve appears to be a top-opening parabola. This function suggests that a test plot be made of d vs. t^2. The resulting graph is shown below:



Since the plot of d vs. t^2 is linear,

$\mathbf{d} = m\mathbf{t^2} + b$.

The slope, m, is calculated by

$$m = \frac{\quad}{\quad}$$

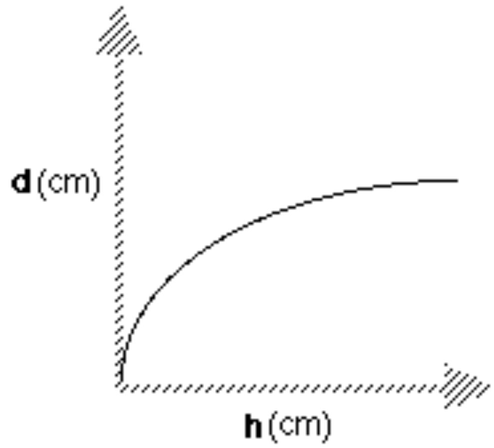
$$= \frac{.80\text{m}}{.50\text{s}^2}$$

$$= 1.6\ \text{m/s}^2$$

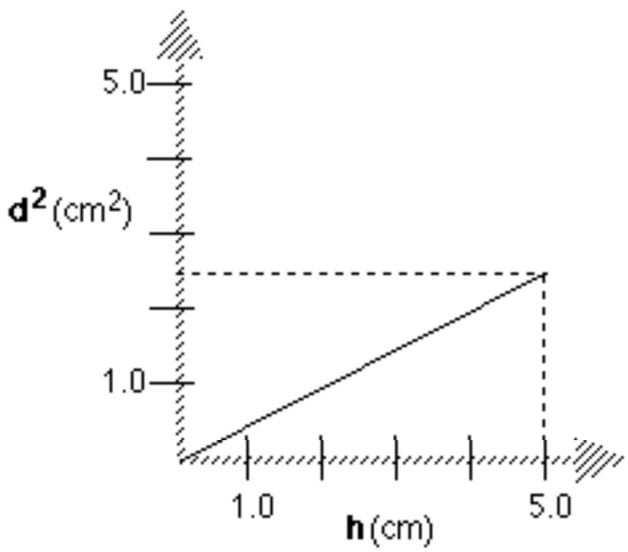
Since the curve passes through the origin, b = 0. The mathematical expression that describes the motion of the object is

$\mathbf{d} = (1.6\ \text{m/s}^2)\mathbf{t^2}$.

Consider the following graph of distance vs. height:



The curve appears to be a side-opening parabola. This function suggests that a test plot be made of d^2 vs. h. The resulting graph is shown on the following page.



Since the graph of d^2 vs. h is linear the expression is

$$\mathbf{d}^2 = m\mathbf{h} + b.$$

The slope, m, is calculated by

m = ——

= ———

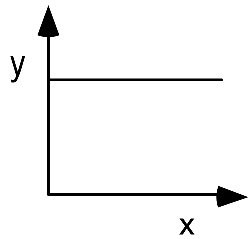
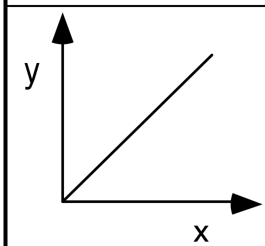
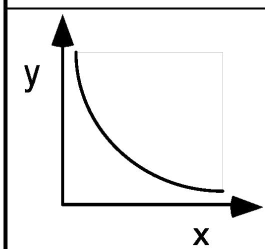
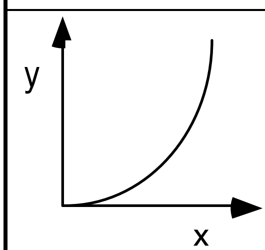
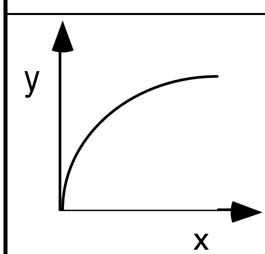
= 0.50 cm.

Since the curve passes through the origin, b = 0. The mathematical expression is then

$$\mathbf{d}^2 = (0.50\ \text{cm})\mathbf{h}.$$

Graphical Methods-Summary

A graph is one of the most effective representations of the relationship between two variables. The independent variable (one controlled by the experimenter) is usually placed on the x-axis. The dependent variable (one that responds to changes in the independent variable) is usually placed on the y-axis. It is important for you to be able interpret a graphical relationship and express it in a written statement and by means of an algebraic expression.

Graph shape	**Written relationship**	**Modification required to linearize graph**	**Algebraic representation**
	As x increases, y remains the same. There is no relationship between the variables.	None	$y = b$, or y is constant
	As x increases, y increases proportionally. Y is directly proportional to x.	None	$y = mx + b$
	As x increases, y decreases. Y is inversely proportional to x.	Graph y vs $\frac{1}{x}$, or y vs x^{-1}	$y = m\left(\frac{1}{x}\right) + b$
	Y is proportional to the square of x.	Graph y vs x^2	$y = mx^2 + b$
	The square of y is proportional to x.	Graph y^2 vs x	$y^2 = mx + b$

When you state the relationship, tell how y depends on x (e.g., as x increases, y ….)

Name____________________________

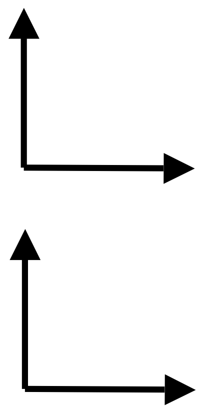
Period____Date____________________

UNIT I Worksheet 1: GRAPHING PRACTICE

For each data set below, determine the mathematical expression. To do this, first graph the original data. Assume the 1st column in each set of values to be the **independent** variable and the 2nd column the **dependent** variable. Then taking clues from the shape of the first graph, modify the data so that the modified data will plot as a straight line. Using the slope and y-intercept from the linear fit, write an appropriate mathematical expression for the relationship between the variables. Be sure to include units!

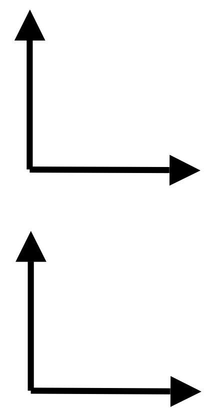
Data set 1

V **(m^3)**	**P** **(pa)**
.1	40
.5	8
1	4
2	2
4	1
5	.8
8	.5
10	.4



Data set 2

t **(s)**	**x** **(m)**
.1	.03
.2	.12
.5	.75
1	3
2	12
3	27
4	48
5	75



Mathematical expression #1

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Mathematical expression #2

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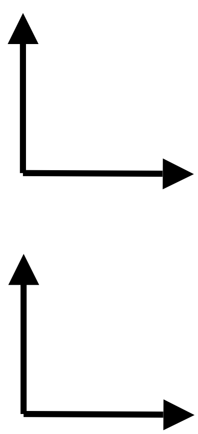
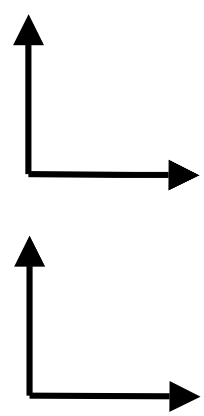
Data set 3

A **(months)**	**W** **(lbs)**
1	7.3
2	9.4
3	10.5
4	12.0
5	13.0
6	14.3
7	15.2
8	16.7



Data set 4

t **(s)**	**v** **(m/s)**
.3	10
1.2	20
2.7	30
4.8	40
7.5	50
10.8	60
14.7	70
19.2	80



Mathematical expression #3

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Mathematical expression #4

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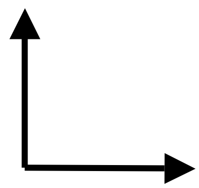
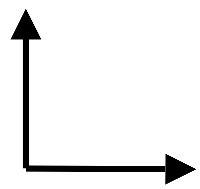
For these graphs, you may need to be more creative in determining a relationship.

Data set 5

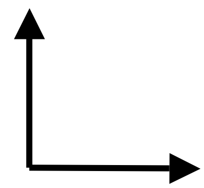
R (a.u.)	T (yr)
.38	.24
.72	.62
1.00	1.00
1.52	1.88
5.19	11.9
9.53	29.5
19.1	84.1
30.0	165
39.4	249

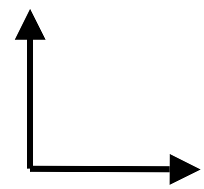




Data set 6

r (m)	F_{el} (N)
.2	425
.5	68.3
1.0	16.5
2.0	4.26
5.0	0.67
10.	0.18
20.	0.042





Mathematical expression #5

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Mathematical expression #6

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AP Physics Textbook Sign-out Waiver.

I understand that I am responsible for this textbook. I will return it to Unionville High School in the Fall, and that if I lose or damage the book, I will be responsible for the replacement cost of the book. I also understand that if I choose not to take the course, I will return the book to the High School office at the time that I drop the course.

Sincerely,

Student name: _________________

Student Signature: __________________ Date: ____________________

Book # ________ Condition ______________

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