Name: _____ AP Physics 1/2

Summer Assignment – Math Review

Scientific Notation – a method for writing large or small numbers using powers of 10.

ex.

$2005 = 2.005 \times 10^3$ OR 2.005E3

$0.00012 = 1.2 \times 10^{-4}$ OR 1.2E-4

Note that the letter capital "E" can be substituted for "x 10" and is considered to have the same value.

Write each of the following using scientific notation.

1) 43126 _____

2) 0.0042 _____

3) -700000 _____

4) -0.0000150 _____

Rounding – a method for truncating numbers into a shorter form; often used in conjunction with significant digit rules.

Round off each of the following numbers to the number of digits shown AND rewrite it using scientific notation.

5) round 634000 to 2 digits _____

6) round 0.0345 to 2 digits _____

7) round 8.655 to 3 digits _____

SI Prefixes – a set of symbols used to abbreviate large or small numbers – can be used in conjunction with scientific notation.

Prefix	Symbol	Meaning
tera	T	10^{12}
giga	G	10^{9}
mega	M	10^{6}
**** kilo***	***k***	***10^{3}***
deci	d	10^{-1}
**** centi***	***c***	***10^{-2}***
**** milli***	***m***	***10^{-3}***
micro	μ	10^{-6}
nano	n	10^{-9}
pico	p	10^{-12}

**** you should MEMORIZE the italicized prefixes***

ex.

To remove SI prefix sub power of 10 for symbol

$3.0 \text{ mm} = 3.0 \times 10^{-3} \text{ m} = 0.003 \text{ m}$

$2.0 \text{ kW} = 2.0 \times 10^{3} \text{ W} = 2000 \text{ W}$

To add SI prefix sub symbol in for power of 10

$240 \text{ m} = 0.240 \times 10^{3} \text{ m} = 0.240 \text{ km}$

$0.00562 \text{ s} = 5.62 \times 10 \times 10^{-3} \text{ s} = 5.62 \text{ ms}$

Note that SI prefixes are simply placeholders for powers of 10 – it is essential to understand this!

Come up with at least TWO ways to rewrite 0.024 meter using SI prefixes.

8) _____

9) _____

Write an equivalent expression for 5000 kJ using a different SI prefix.

10)

Significant Digits – a set of rules used to determine how many digits in a given measurement are meaningful/desirable for reporting.

Rules

- If the number contains a decimal point then all digits except for leading zeroes are significant.

ex.

2.450 contains 4 sig. digits
0.0032 contains 2 sig. digits
4.00510 contains 6 sig. digits
50. contains 2 sig. digits

- If the number does not contain a decimal point then all digits except for leading AND trailing zeroes are significant.

ex.

30,000 contains 1 sig. digit
23050 contains 4 sig. digits

Indicate the number of significant digits in each number.

11) 32100.0 _____

12) 0.00123 _____

13) 0.20040 _____

14) 7330.0 _____

15) 3200 km _____

16) 125 students _____

17) 0.0300 _____

Adding/Subtracting with Significant Digits

Line up all of the numbers on the decimal point. Perform the operation and then truncate the final answer using the left-most digit as a guide.

ex.

```
  13.005
   22.4
+ 145.23
  180.635
```

Final answer - 180.6

Multiplying/Dividing with Significant Digits

Determine number of significant digits in operands. The answer should be rounded to the same number of significant digits as the operand with the LEAST number of significant digits.

ex.

456.2 x 23.2 x 0.0056 = 59.269504
(4) (3) (2)

We can't have more than TWO significant digits in our answer. So the final answer is 59.

Evaluate each expression, showing the correct number of significant digits in your answer.

18) 22 + 45.5 + 0.36 _____

19) 0.0023 x 953 _____

20) 2005.4 – 4.82 _____

21) $2.4 \times 10^3 / 1.2 \times 10^4$ _____

Unit Conversions – a method for turning one set of units into a different set of units to arrive at an equivalent expression of the same value. The factor-label method uses a series of ratios that are arranged to cancel out existing units and introduce desired ones.

Examples:

Convert 3.0 minutes into seconds.

$$\frac{3.0\,\text{min}}{1}\left(\frac{60s}{1\,\text{min}}\right)=\frac{180\,\text{min}\cdot s}{1\,\text{min}}=180s$$

**Note that we can cross out units that cancel BEFORE rewriting the numbers at the end.*

Convert 5.0 km into miles (note that 1 mi = 1.61 km)

$$\frac{5.0km}{1}\left(\frac{1mi}{1.61km}\right)=\frac{5mi}{1.61}=3.1mi$$

Convert 21km into mm

$$\frac{21km}{1}\left(\frac{10^3 m}{1km}\right)\left(\frac{1mm}{10^{-3}m}\right)=\frac{21(10^3)(1)mm}{(1)(1)(10^{-3})}=21x10^6\,mm$$

Convert 45 mi/hr into km/min

$$\frac{45mi}{1hr}\left(\frac{1.61km}{1mi}\right)\left(\frac{1hr}{60\,\text{min}}\right)=\frac{45(1.61)(1)mi}{(1)(1)(60)\,\text{min}}=1.2mi/\text{min}$$

Convert the following

22) 24 hours into minutes

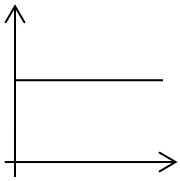
23) 3500 mm into km

24) 22.3 meter/second into kilometers /hour

25) 257 m^3 into km^3

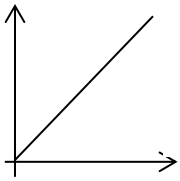
Graphing – there are TWO skills that you need in dealing with graphs in physics.

1. Be able to identify a graph that shows the relationship between two values in an equation.



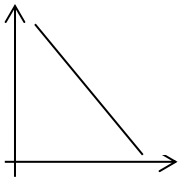
Constant value graph

y = constant



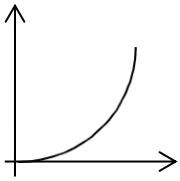
Direct Relationship (positive slope)

y = x ; y = 2x ; y = 0.7x



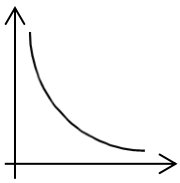
Direct Relationship (negative slope)

y = -x ; y = -5x



Polynomial Relationship

$y = x^2$; $y = 4x^3$



Inverse Relationship

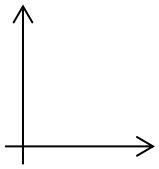
$y = 1/x$; $y = 1/x^2$

Given the set of expressions below, determine the type of graph that would relate the stated variables. (Note that you must assume that all variables not involved in the graph must remain constant)

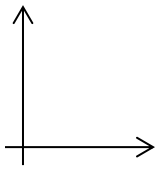
$$F_{net} = ma \qquad a_c = \frac{v^2}{r} \qquad R = \frac{\rho L}{A}$$

$$F_g = \frac{Gm_1m_2}{r^2} \qquad b = \frac{-Ad}{x} \qquad hd^2 = rU$$

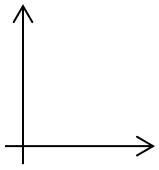
26) Sketch the relationship between F_{net} and a.



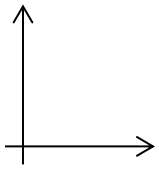
27) Sketch the relationship between F_g and r.



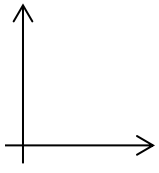
28) Sketch the relationship between a_c and v.



29) Sketch the relationship between R and A.

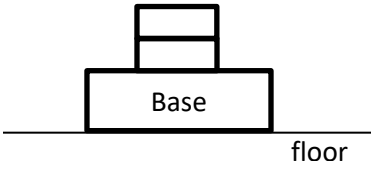


30) Sketch the relationship between b and A.



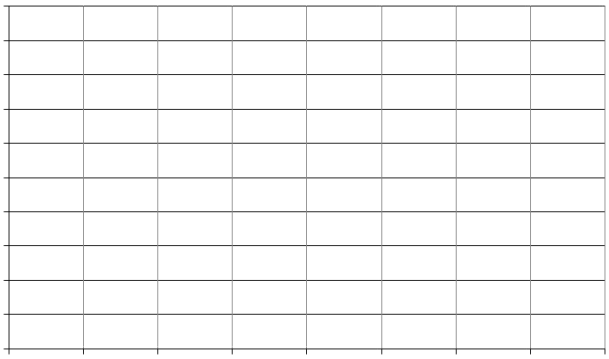
2. Be able to graph data and determine slope of a graph and its meaning.

   A tower of increasing height was built upward from a base using a set of blocks. Two blocks were added each time and the height of the tower was measured. The following is a data table representing the height of the tower (from the floor) at each two block interval.



Blocks	Height (cm)
2	2.2
4	3.3
6	4.0
8	5.5
10	6.2
12	7.8
14	8.1

31) Using the grid below, mark an appropriate scale, label the axes with units, plot the data, and draw a best-fit line (using a straightedge!)



32) Calculate the slope of the line.

33) Estimate the y-intercept of the line: _____

34) Formulate the equation for this line using the expression: y = mx+ b.

35) What physical measurement does the slope of this line represent?

36) What physical measurement does the y-intercept of this line represent?

Algebra – in order to do physics on the advanced placement level your algebra skills must be perfect BEFORE the year begins.

Evaluate/simplify each expression.

37) $3 = 5 + x$

38) $6 = -2x + 4$

39) $4 - 5x = 14$

40) $5 = \frac{x}{2}$

41) $9 = \frac{18}{x}$

42) $4 = \frac{16}{x+2}$

43) $E_p = mgh$

Given: E_p = 1225, g = 9.8, h =305 find m.

44) $d = \left(\frac{v_i + v_f}{2}\right)t$

Given: d = 10.0, v_i = 5.0, t = 2.0 find v_f

45) $v = \frac{d_f - d_i}{t_f - t_i}$

Given: v = 2.0, d_f = 25, d_i = 10, t_f = 12.5 find t_i

46) $d = v_i t + \frac{1}{2}at^2$

Given: d = 12, t = 2.1, a = -4.3 find v_i

47) $v_f^2 = v_i^2 + 2ad$

Given: $v_f = 13.7$, $a = -2.25$, $d = 254$ find v_i

48) $E_k = \frac{1}{2}mv^2$

Given: $E_k = 126$, $v = 22.35$ find m

49) $E_k = \frac{1}{2}mv^2$

Given: $E_k = 1012$, $m = 12$ find v

50) $F_g = \frac{Gm_1m_2}{r^2}$

Given: $G = 6.67 \times 10^{-11}$, $m_1 = 3.45 \times 10^{16}$, $m_2 = 1.34 \times 10^7$, $F_g = 1.26 \times 10^4$ find r

51) $L = L_0\sqrt{1-\frac{v^2}{c^2}}$

Given: $L = 13.0$, $v = 2.1 \times 10^8$, $c = 3.0 \times 10^8$ find L_0

52) $m = \frac{m_0}{\sqrt{1-\frac{v^2}{c^2}}}$

Given: $m = 2.5 \times 10^6$, $m0 = 2.2 \times 10^6$, $c = 3.0 \times 10^8$, find v

53) $n_1\sin\theta_1 = n_2\sin\theta_2$

Given: $n_1 = 1.35$, $n_2 = 1.04$, $\theta_1 = 24°$, find θ_2

Trigonometry – the use of the relationship between sides and angles of triangles to determine unknown characteristics of those triangles. Relies on the following set of rules:

$$\sin\theta = \frac{opp}{hyp}$$

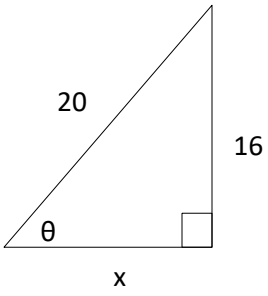
$$\cos\theta = \frac{adj}{hyp}$$

$$\tan\theta = \frac{opp}{adj}$$

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

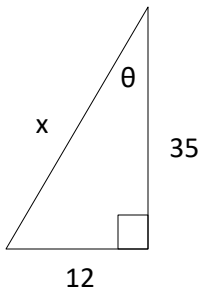
$$a^2 + b^2 = c^2$$

Use the rules above to determine the unknowns in each triangle.



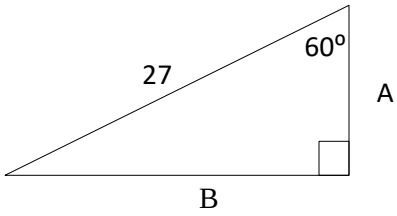
54) x = _____

55) θ = _____



56) x = _____

57) θ = _____



58) A = _____

59) B = _____

Name: _____ Date: _____

Lab #1 – Graphing (40 minutes)
AP Physics 1/2

Purpose: To review graphing methods and techniques for using graphs to produce meaningful results.

Equipment: round objects (glasses, bowls, tubes, pots, pans, etc.); string; metric ruler; graph paper or a computer graphing program

Procedure: Wrap a piece of string around the circumference of a round object. Mark the length of the string and unwrap it. Measure the string's length in millimeters and record the number in the data table below. Use the ruler to measure the diameter of the object as accurately as possible in millimeters. Record this measurement in your data table. Repeat this procedure for as many different objects as you can (up to 8).

Object	Circumference (mm)	Diameter (mm)
1		
2		
3		
4		
5		
6		
7		
8		

Graph: using graph paper (or a graphing program if you know how) produce a graph of circumference vs. diameter. Be sure to make your graph with circumference on the y-axis and diameter on the x-axis. Use an appropriate scale that will fill up nearly an entire sheet of graph paper; include a title on your graph as well as labels on your axes with units. Carefully plot your data points and draw a best-fit line for the data (use a ruler to draw your line!) The best-fit line for this experiment should be very close to straight. Attach your graph to this sheet when you submit your lab.

Results: select and circle two points on the best-fit line that you produced. Note that these do not have to be data points from your table, but must be on the line.

Use the formula $\frac{y_2 - y_1}{x_2 - x_1}$ to determine the slope of the graph (include the equation and units in your calculation.)

Analysis: The slope that you calculated is considered your "measured value" for this experiment. The "expected value" for this experiment is 3.14.

Use the percent error formula: $\%error = \frac{|measured - \exp ected|}{\exp ected} x100$ to compare these two values.

Summary: in the space below, write a summary of important details for this activity. In writing your summary you should at a minimum consider… "What type of relationship exists between circumference and diameter?" "What does the slope of a graph of these two values represent?" "What equation can you write that relates circumference to diameter?" "What was the quality of your result and how do you know?" "What were the main factors that limited the precision of your results?"