Name_____ **A.P. Assignment 2020-2021**

Welcome to A.P.Physics 1! We are going see and represent the world in new ways. You will see how physics applies to everything.

Expectations:

- Read and listen carefully.
- Ask questions shamelessly.
- Manipulate equations fearlessly.
- Complete homework diligently
- Supplement your learning creatively

Instructions: Due: Aug. 28th (Fall Semester) Jan. 25th (Spring Semester)

Go to the following website https://openstax.org/subjects/science and download the College Physics for AP courses book. This will serve as a resource that is available to you on-line and will also be utilized for reading assignments, etc. (homework, quizzes, simulation labs)

(.5 pts / each)

Part 1: Scientific Notation and Dimensional Analysis

Many numbers in physics will be provided in scientific notation. You need to be able read and simplify scientific notation. (**This section is to be completed without calculators…all work should be done by hand.)** Get used to no calculator! All multiple choice portions of tests will be completed without a calculator.

Express the following the numbers in scientific notation. Keep the same unit as provided. ALL answers in physics need their appropriate unit to be correct.

1. 7,640,000 kg

2. 8327.2 s

3. 0.000000003 m

4. 0.0093 km/s

Often times multiple numbers in a problem contain scientific notation and will need to be reduced by hand. Before you practice, remember the rules for exponents.

When numbers are multiplied together, you *(add / subtract)* the exponents and *(multiply / divide)* the bases.

When numbers are divided, you *(add / subtract)* the exponents and *(multiply / divide)* the bases.

When an exponent is raised to another exponent, you *(add / subtract / multiply / divide)* the exponent.

Using the three rules from above, simplify the following numbers in proper scientific notation:

5. $(3x10^{6})\cdot(2x10^{4}) =$

6. $(1.2x10^{4}) / (6x10^{-2}) =$

7. $(4x10^{8})\cdot(5x10^{-3}) =$

8. $(7x10^{3})^{2} =$

9. $(8x10^{3}) / (2x10^{5}) =$

10. $(2x10^{-3})^{3} =$

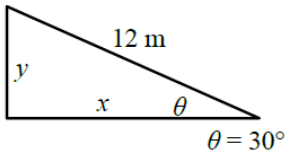
Trigonometry Review (2pts / each)

Write the formulas for each one of the following trigonometric functions. Remember SOHCAHTOA!

$\sin\theta =$ $\cos\theta =$ $\tan\theta =$

Calculate the following unknowns using trigonometry. Use a calculator, but show all of your work. Please include appropriate units with all answers. (Watch the unit prefixes!)

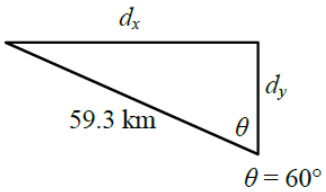
1.



$y =$ _____

$x =$ _____

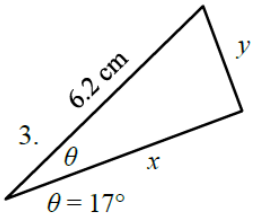
2.



$d_x =$ _____

$d_y =$ _____

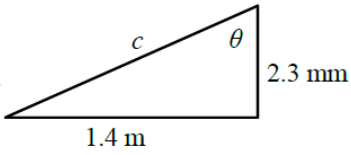
3.



$x =$ _____

$y =$ _____

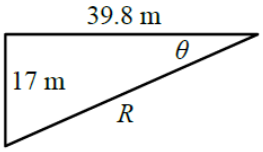
4.



$c =$ _____

$\theta =$ _____

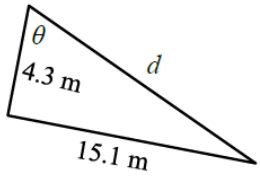
5.



$R =$ _____

$\theta =$ _____

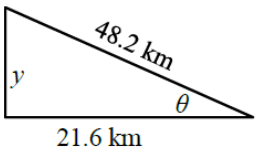
6.



$d =$ _____

$\theta =$ _____

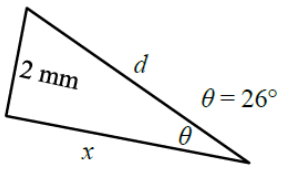
7.



$y =$ _____

$\theta =$ _____

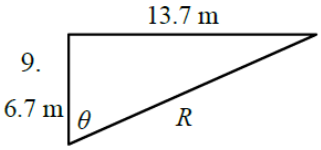
8.



$x =$ _____

$d =$ _____

9.



$R =$ _____

$\theta =$ _____

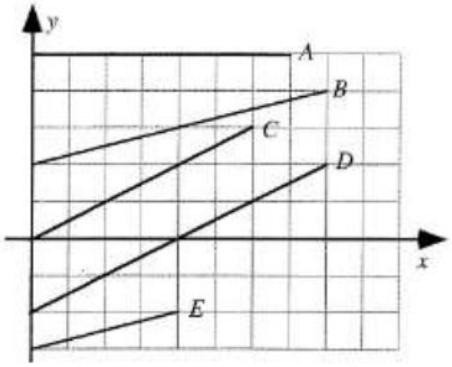
Key Graphing Skills to remember:

1. Always label your axes with appropriate units.
2. Sketching a graph calls for an estimated line or curve while plotting a graph requires individual data points AND a line or curve of best fit.
3. Provide a clear legend if multiple data sets are used to make your graph understandable.
4. Never include the origin as a data point unless it is provided as a data point.
5. Never connect the data points individually, but draw a single smooth line or curve of best fit
6. When calculating the slope of the best fit line you must use points from your line. You may only use given data points IF your line of best fit goes directly through them.

Graphing Skills (3pts / each)

Conceptual Review of Graphs

Shown are several lines on a graph.

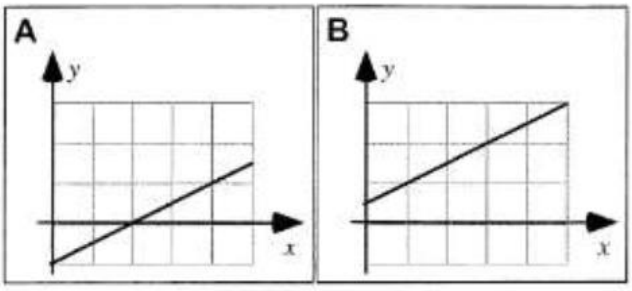


Rank the slopes of the lines in this graph.

					OR			
1 Greatest	2	3	4	5 Least		All the same	All zero	Cannot determine

Explain your reasoning.

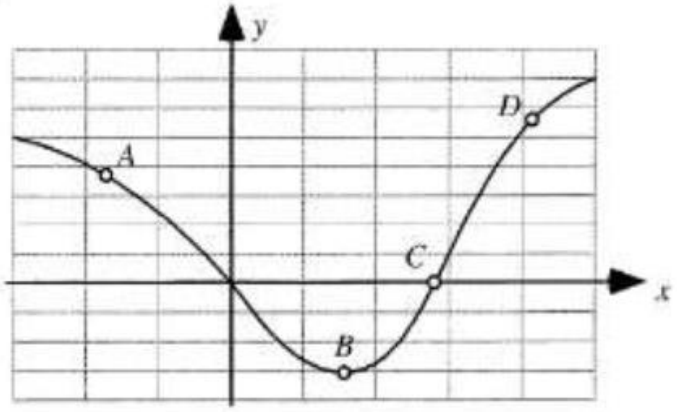
Shown are two graphs.



Is the slope of the graph (i) *greater in Case A*, (ii) *greater in Case B*, or (iii) *the same in both cases?* _____

Explain your reasoning.

Four points are labeled on a graph.



Rank the slopes of the graph at the labeled points.

				OR			
1 Greatest	2	3	4 Least		All the same	All zero	Cannot determine

Explain your reasoning.

Linearizing Data (1 pt / each)

Linear and Non-Linear Functions

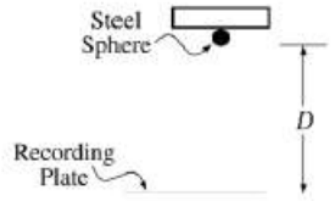
You must understand functions to be able linearize. First let's review what graphs of certain functions looks like. Sketch the shape of each type of *y vs. x* function below. *k* is listed as a generic constant of proportionality.

Linear $y = kx$ Inverse $y = {}^{k}/_{x}$ Inverse Square $y = {}^{k}/_{x^2}$ Power $y = kx^2$

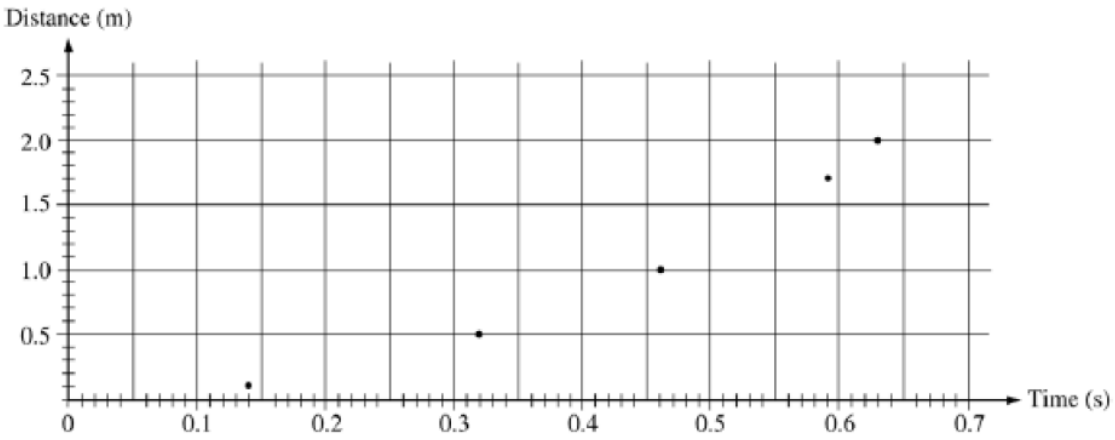
Watch and take notes on the following video: https://www.youtube.com/watch?v=LqKmjMRtxkA

Sample AP Graphing Exercise

A steel sphere is dropped from rest and the distance of the fall is given by the equation $D = \frac{1}{2}gt^2$. D is the distance fallen and t is the time of the fall. The acceleration due to gravity is the constant known as g. Below is a table showing information on the first two meters of the sphere's descent.



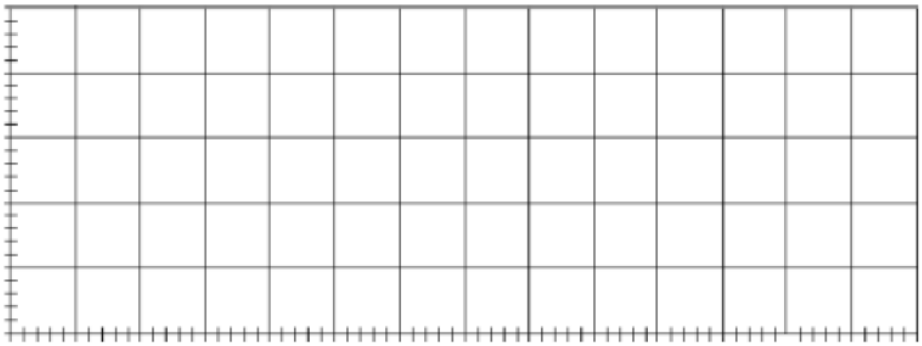
Distance of Fall (m)	0.10	0.50	1.00	1.70	2.00
Time of Fall (s)	0.14	0.32	0.46	0.59	0.63



a) Draw a line of best fit for the distance vs. time graph above.

b) If only the variables D and t are used, what quantities should the student graph in order to produce a linear relationship between the two quantities?

c) On the grid below, plot the data points for the quantities you have identified in part (b), and sketch the straight-line fit to the points. Label your axes and show the scale that you have chosen for the graph.



d) Calculate the value of g by using the slope of the graph.

Algebra Review (1 pt / each)

Solve the following (almost all of these are extremely **easy** – it is *important* for you to work *independently*). Units on the numbers are included because they are essential to the concepts, however they do not have any *effect* on the actual numbers you are putting into the equations. In other words, the units do not change how you do the algebra. Show every step for every problem, including writing the original equation, all algebraic manipulations, and substitution! You should practice doing all algebra *before* substituting numbers in for variables.

Section I:

$v_f = v_0 + at$ $\qquad$ $x_f = x_0 + v_0 t + \frac{1}{2}at^2$ $\qquad$ $v_f^2 = v_0^2 + 2a(x_f - x_0)$

1. Using equation (1) solve for t given that $v_0 = 5$ m/s, $v_f = 25$ m/s, and $a = 10$ m/s^2.

2. $a = 10$ m/s^2, $x_0 = 0$ m, $x_f = 120$ m, and $v_0 = 20$ m/s. Use the second equation to find t.

3. $v_f = -\, v_0$ and $a = 2$ m/s^2. Use the first equation to find t / 2.

4. How does each equation simplify when $a = 0$ m/s^2 and $x_0 = 0$ m?

Section II:

$\Sigma F = ma$ $\qquad f_s \leq \mu_s N$

$f_k = \mu_k N$ $\qquad F_s = -kx$

5. If ΣF = 10 N and a = 1 m/s^2, find m using the first equation.

6. Given $\Sigma F = f_k$, m = 250 kg, μ_k= 0.2, and $N = 10m$, find a.

7. $\Sigma F = T - 10m$, but a = 0 m/s^2. Use the first equation to find m in terms of T.

8. Given the following values, determine if the third equation is valid. $\Sigma F = f_s$, m = 90 kg, and a = 2 m/s^2. Also, μ_s= 0.1, and N = 5 N.

9. Use the first equation in Section I, the first equation in Section II and the givens below, find ΣF. m = 12 kg, v_0 = 15 m/s, v_f = 5 m/s, and t = 12 s.

10. Use the last equation to solve for F_s if k = 900 N/m and x = 0.15 m.

Section III:

$a = \dfrac{v^2}{r}$ $\qquad \tau = rF\sin\theta$

11. Given that v is 5 m/s and r is 2 meters, find a.

12. Originally, a = 12 m/s^2, then r is doubled. Find the new value for a.

13. Use the second equation to find θ when τ = 4 Nm, r = 2 m, and F = 10 N.

Section IV:

$K = \dfrac{1}{2}mv^2$ $\qquad W = F(\Delta x)\cos\theta$ $\qquad P = \dfrac{W}{t}$

$\Delta U_g = mgh$ $\qquad U_s = \dfrac{1}{2}kx^2$ $\qquad P = Fv_{avg}\cos\theta$

14. Use the first equation to solve for K if m = 12 kg and v = 2 m/s.

15. If $\Delta U_g = 10$ J, $m = 10$ kg, and $g = 9.8$ m/s^2, find h using the second equation.

16. $K = \Delta U_g$, $g = 9.8$ m/s^2, and $h = 10$ m. Find v.

17. The third equation can be used to find W if you know that F is 10 N, Δx is 12 m, and θ is 180°.

18. Given $U_s = 12$ joules, and $x = 0.5$ m, find k using the fourth equation.

19. For $P = 2100$ W, $F = 30$ N, and $\theta = 0°$, find v_{avg} using the last equation in this section.

Section V:

$$p = mv \qquad F\Delta t = \Delta p \qquad \Delta p = m\Delta v$$

20. p is 12 kgm/s and m is 25 kg. Find v using the first equation.

21. "Δ" means "final state minus initial state". So, Δv means $v_f - v_i$ and Δp means $p_f - p_i$. Find v_f using the third equation if $p_f = 50$ kgm/s, $m = 12$ kg, and v_i and p_i are both zero.

22. Use the second and third equation together to find v_i if $v_f = 0$ m/s, $m = 95$ kg, $F = 6000$ N, and $\Delta t = 0.2$ s.

Section VI:

$$T_s = 2\pi\sqrt{\frac{m}{k}} \qquad T_p = 2\pi\sqrt{\frac{l}{g}} \qquad T = \frac{1}{f}$$

23. T_p is 1 second and g is 9.8 m/s^2. Find l using the second equation.

24. $m = 8$ kg and $T_s = 0.75$ s. Solve for k.

25. Given that $T_p = T$, $g = 9.8$ m/s^2, and that $l = 2$ m, find f (the units for f are Hertz).

Section VII:

$$F_g = -\frac{GMm}{r^2} \qquad U_g = -\frac{GMm}{r}$$

26. Find F_g if $G = 6.67 \times 10^{-11}$ m^3 kg^{-1} s^{-2}, $M = 2.6 \times 10^{23}$ kg, $m = 1200$ kg, and $r = 2000$ m.

27. What is r if $U_g = -7200$ J, $G = 6.67 \times 10^{-11}$ m^3 kg^{-1} s^{-2}, $M = 2.6 \times 10^{23}$ kg, and $m = 1200$ kg?

28. Use the first equation in Section IV for this problem. $K = -U_g$, $G = 6.67 \times 10^{-11}$ m^3 kg^{-1} s^{-2}, and $M = 3.2 \times 10^{23}$ kg. Find v in terms of r.

29. Using the first equation above, describe how F_g changes if r doubles.

Section VIII:

$$V = IR \qquad R = \frac{\rho l}{A}$$

$$I = \frac{\Delta Q}{t}$$

$$P = IV$$

$$R_S = (R_1 + R_2 + R_3 + \cdots + R_i) = \Sigma R_i$$

$$\frac{1}{R_P} = \left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \cdots + \frac{1}{R_i}\right) = \sum_i \frac{1}{R_i}$$

30. Given $V = 220$ volts, and $I = 0.2$ amps, find R (the units are ohms, Ω).

31. If $\Delta Q = 0.2$ C, $t = 1$s, and $R = 100$ Ω, find V using the first two equations.

32. $R = 60$ Ω and $I = 0.1$ A. Use these values to find P using the first and third equations.

33. Let $R_S = R$. If $R_1 = 50$ Ω and $R_2 = 25$ Ω and $I = 0.15$ A, find V.

34. Let $R_P = R$. If $R_1 = 50$ Ω and $R_2 = 25$ Ω and $I = 0.15$ A, find V.

35. Given $R = 110$ Ω, $l = 1.0$ m, and $A = 22 \times 10^{-6}$ m^2, find ρ.

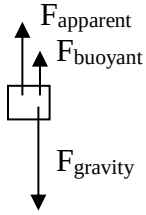
Read below the **Goals** (#1-6), then, do the **Assignments** in the sections that follows, which are keyed to the **Goal** items (#1-6). Model **Assignment** answers to the corresponding **Goals**.

Goals: (48 points total)

1. Know what units things are measured in. Ex: frequency in 1/s = Hz
2. Know how to justify units in any calculation. Ex: P = I^2 R = (20^2~~C^2~~/s^2)(15J~~s~~/~~C^2~~) = J/s
3. Be able to set up and execute a proper conversion. Sometimes it's not just moving the decimal (and which way do I move it?) Ex1: Convert 75 km/h to m/s… $75\frac{\cancel{km}}{\cancel{h}} X \frac{1000m}{1\cancel{km}} X \frac{1\cancel{h}}{3600s} = 20.8\frac{m}{s}$

   Ex 2: Convert 375 cm to m… $375\ \cancel{cm}\ X \frac{1m}{100\cancel{cm}} = 3.75m$

   Note that the three conversion factors used in these two examples each equal one and could be written upside down if the conversion was reversed.
4. Analyze equations to predict what happens to certain variables when another variable in the equation changes. Ex: In the equation $I = \frac{V}{R}$, I and R are inversely proportional because increasing R decreases I (assuming V remains constant) and vice-versa.
5. Know the meaning of the symbols. Ex: I = current in amps and is the rate of flow of electrons in coulombs per second.
6. Make sure you can competently draw sketches. Ex: (No artistic talent required-it's just boxes and arrows)



A rock being weighed underwater

1. (___ /12) Look up "kinematics" on Wikipedia, define it, and list quantities used (there are 4), define them, and write the units for those quantities. Repeat for "dynamics" (there are at least 2)
2. (___ /6) Find and write one equation for kinematics and one for dynamics, then substitute the units for the quantities contained in the equation and justify the final units. Choose equations (or rearrange them if you need to) where some cancelling is required.
3. (___ /7) Convert any speed in miles per hour to meters per second, and a distance in miles to km.

4. (___ /2) In the equation $g = \frac{Gm}{r^2}$, what would happen to g if r were doubled? (note that r is squared in the equation)
5. (___ /12) Look up the quantities f (lower case), T (upper case), v (lower case), and P (upper case). What do they stand for, what units are they measured in, and what is the definition of the quantity? (Note: some letters are used for more than one quantity; you may pick one)
6. (___ /9) Forces act on us all day every day. Represent yourself with a box and draw labeled arrows that represent all the forces acting on you (longer arrows = stronger forces) in three distinct situations for a given day. Do one for you not moving, one moving at constant speed, and one accelerating. Give each drawing a title.

Take the time to watch and take notes on these videos:
How to solve problems in Physics:
https://www.youtube.com/watch?v=4lzQ9XfSU58&feature=youtu.be (7 minutes)

Introduction to the Kinematics Unit of study
https://www.youtube.com/watch?v=Po7li9JbEsQ&t=158s (30 minutes)

Acceleration: https://www.youtube.com/watch?v=P0UYC8S4kUI (20 minutes)

Introduction to Free Fall and Acceleration Due to Gravity:
https://www.youtube.com/watch?v=vyvDzI22sOE (12 minutes)

Common Free fall Pitfalls:
https://www.youtube.com/watch?v=vyvDzI22sOE (12 minutes)

How to solve problems in Physics:
https://www.youtube.com/watch?v=4lzQ9XfSU58&feature=youtu.be (7 minutes)