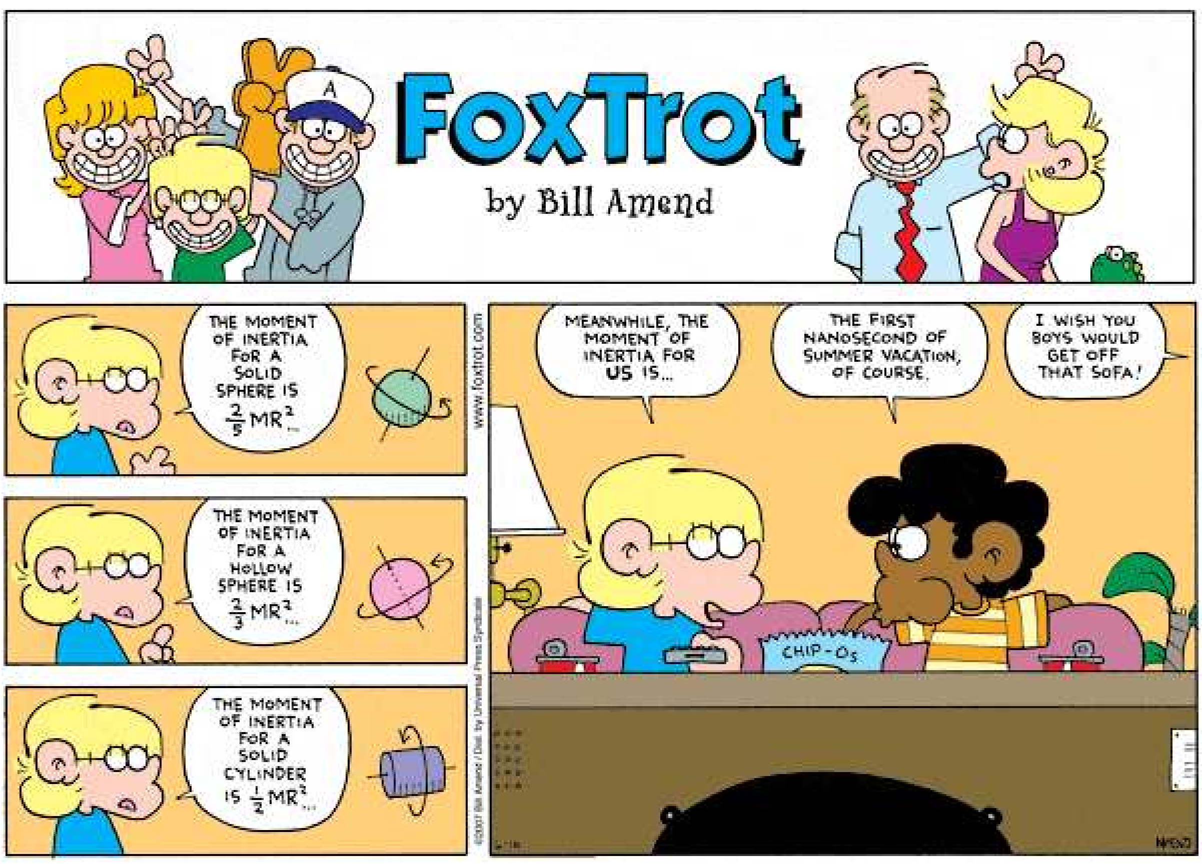
SC12 Summer Assignment Packet

Physics **Mr. Gregory**

Name:________________________________

Welcome to Physics! It is a course that is fun, interesting, and challenging on a level you've not yet experienced. This assignment will review all of the prerequisite knowledge expected of you. There are 6 parts to this assignment. It is the quantity - not the difficulty - of the problems that has the potential to overwhelm, so do it over an extended period of time. By taking the time to review and understand all parts of this assignment, you will help yourself acclimate to the rigor and pacing of Physics. This is all stuff you already know how to do – it's all basic math skills. It is VERY important that this assignment be completed individually. It will be a total waste of your time to copy the assignment from a friend. Good luck!

The completed packet is due the first day of class in September.



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.

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 this, remember the rules for exponents you learned in algebra- fill in the following blanks:

I. When numbers with exponents are multiplied together, you __________ the exponents and _______________ the bases.

II. When numbers are divided, you _____________ the exponents and ______________ the bases.

III. When an exponent is raised to another exponent, you ______________ the exponents and _______________ the base.

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

5. $(3 \times 10^{6}) \cdot (2 \times 10^{4}) =$

6. $(1.2 \times 10^{4}) / (6 \times 10^{-2}) =$

7. $(4 \times 10^{8}) \cdot (5 \times 10^{-3}) =$

8. $(7 \times 10^{3})^{2} =$

9. $(8 \times 10^{3}) / (2 \times 10^{5}) =$

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

Fill in the power and the symbol for the following unit prefixes. Look them up as necessary. These should be **memorized** for next year. *Kilo*- has been completed as an example.

Prefix	Power	Symbol
Giga-		
Mega-		
Kilo-	10^3	k
Centi-		
Milli-		
Micro-		
Pico-		

Not only is it important to know what the prefixes mean, it is also vital that you can convert between metric units. If there is no prefix in front of a unit, it is the base unit which has 10^0 for its power, or just simply "1". Remember, if there is an exponent on the original unit, the converted unit should be raised to the same exponent.

Convert the following numbers into the specified unit. Use scientific notation when appropriate.

11. 24 g = _______________ kg

12. 94.1 MHz = _______________ Hz

13. 6 GW = _______________ kW

14. 640 nm = _______________ m

15. 3.2 m^2 = _______________ cm^2

16. 40 mm^3 = _______________ m^3

17. 1 g/cm^3 = _______________ kg/m^3

18. 20 m/s = _______________ km/hr

For the remaining scientific notation problems you may use your calculator. It is important that you know how to use your calculator for scientific notation. The easiest method is to use the "EE" button. An example is included below to show you how to use the "EE" button.

<u>Example</u>: 7.8×10^{-6} would be entered as "7.8 E -6"

19. $(3.67 \times 10^{3})(8.91 \times 10^{-6})$ =

20. $(5.32 \times 10^{-2})(4.87 \times 10^{-4})$ =

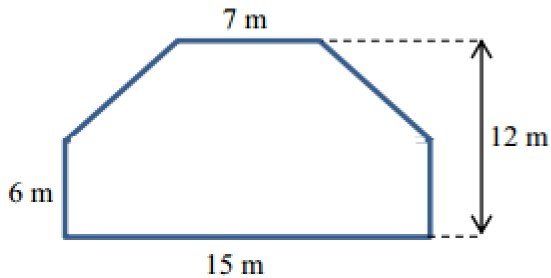
21. $(9.2 \times 10^{6}) / (3.6 \times 10^{12})$ =

22. $(6.12 \times 10^{-3})^3$ =

Part 2: Geometry

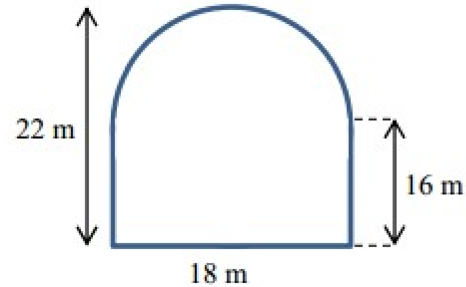
Calculate the area of the following shapes. It may be necessary to break up the figure into common shapes.

1.



Area = ______________

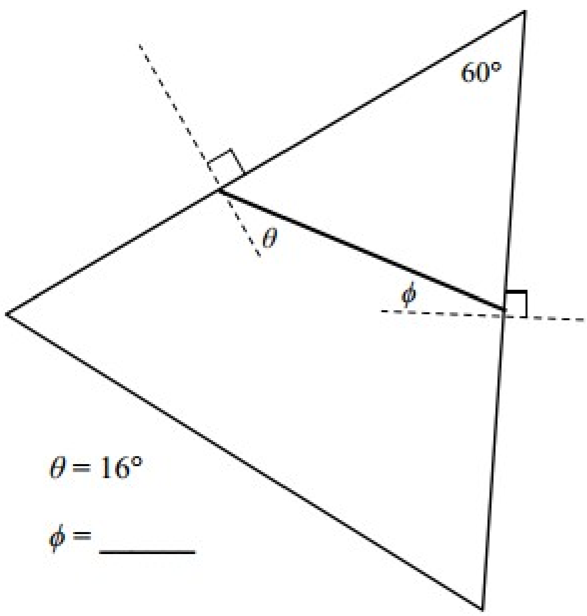
2.



Area = ______________

Calculate the unknown angle values for questions 3 - 6.

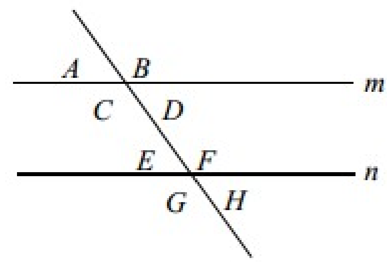
3.



$\theta = 16°$

$\phi =$ ______

4.

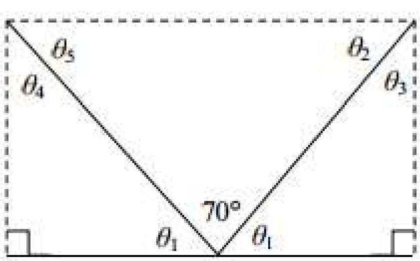


Lines *m* and *n* are parallel.

A = 75° B = _____ C = _____ D = _____

E = _____ F = _____ G = _____ H = _____

5.



$\theta_1 =$ _____

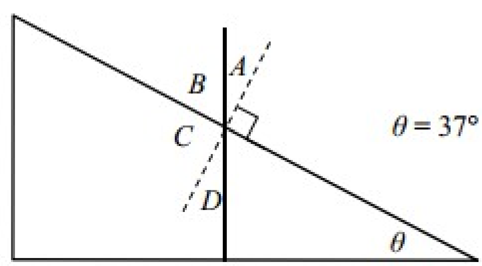
$\theta_2 =$ _____

$\theta_3 =$ _____

$\theta_4 =$ _____

$\theta_5 =$ _____

6.



$\theta = 37°$

A = _____ B = _____

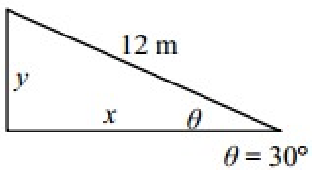
C = _____ D = _____

Part 4: Trigonometry

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

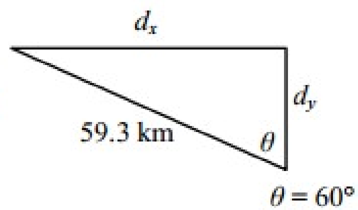
$\sin\theta$ = $\cos\theta$ = $\tan\theta$ =

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.


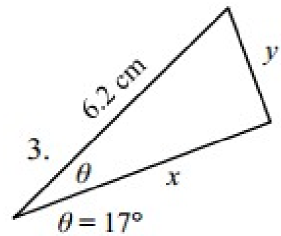
y = ______

x = ______

2.


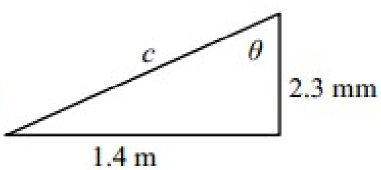
d_x = ______

d_y = ______

3.


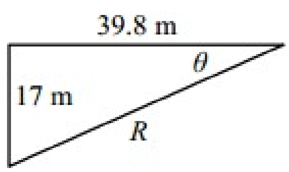
x = ______

y = ______

4.


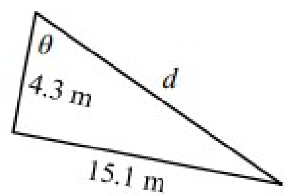
c = ______

θ = ______

5.


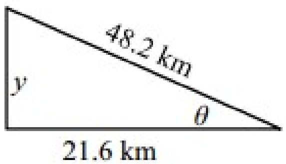
R = ______

θ = ______

6.


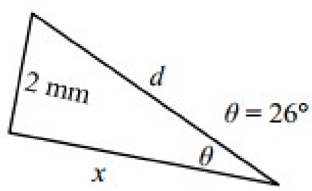
d = ______

θ = ______

7.


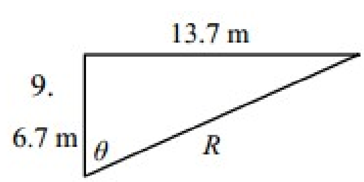
y = ______

θ = ______

8.


x = ______

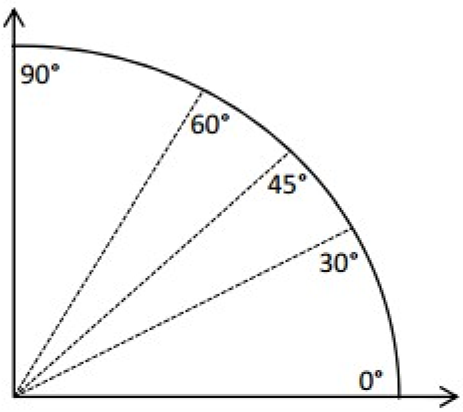
d = ______

9.


R = ______

θ = ______

You will need to be familiar with trigonometric values for a few common angles. Memorizing this diagram in degrees or the chart below will be very beneficial for next year (in math and physics!). In the diagram, the cosine of the angle is the x-coordinate and the sine of the angle is the y-coordinate (in other words, each radius of the circle shown is the hypotenuse of a right triangle). Write the ordered pair (in fraction form) in the table below for each of the angles shown on the quarter-circle.



θ	$\cos\theta$	$\sin\theta$
0°		
15°		
30°		
45°		
60°		
90°		

Refer to your completed chart to answer the following questions.

10. At what angle is sine at a maximum?

11. At what angle is sine at a minimum?

12. At what angle is cosine at a minimum?

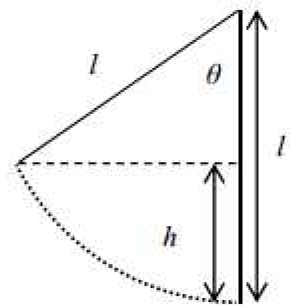
13. At what angle is cosine at a maximum?

14. At what angle are the sine and cosine equivalent?

15. As the angle increases in the first quadrant, what happens to the cosine of the angle?

16. As the angle increases in the first quadrant, what happens to the sine of the angle?

Use the figure at right to answer problems 17 and 18.



17. Find an expression for h in terms of l and θ.

18. What is the value of h if l = 6 m and θ = 40°?

Part 5: Algebra

Solve the following. Units on the numbers are included because they are essential to the concepts, however, 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. Do all algebra before substituting numbers in for variables.

Section I: *For problems 1-5, use the three equations below:*

$$v_f = v_0 + at \qquad x_f = x_0 + v_{0t} + \frac{1}{2}at^2 \qquad v_f^2 = v_0^2 + 2a(x_f - x_0)$$

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

2. If v_0 = 0 m/s, x_0 = 0 m and t = 10 s, use the second and third equations together to find x_f .

3. 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.

4. v_f = - v_0 and a = 2 m/s^2. Use the first equation to find t / 2.

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

Section II: *For problems 6 - 11, use the four equations below.*

$$\sum F = ma \qquad f_k = \mu_k N \qquad f_s \leq \mu_s N \qquad F_s = -kx$$

6. If ΣF = 10 kg·m/s^2 and a = 1 m/s^{2,} find m using the first equation.

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

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

9. 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 kg·m/s^2.

10. Using 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.

11. Use the last equation to solve for F_s if k = 900 kg/s^2 and x = 0.15 m.

Section III: *For problems 12 – 14 use the two equations below.*

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

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

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

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

Section IV: *For problems 15 – 23, use the equations below.*

$$K=\frac{1}{2}mv^2 \qquad \Delta U_g=mgh \qquad W=F(\Delta x)\cos\theta$$

$$U_s=\frac{1}{2}kx^2 \qquad P=\frac{W}{t} \qquad P=F(v_{avg})\cos\theta$$

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

16. If ΔU_g = 10 J, *m* = 10 kg, and *g* = 9.8 m/s^2, find *h* using the second equation.

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

18. 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°.

19. Use the value for W you found in the previous question to find P if $t = 2$ s. Which equation do you need?

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

21. For the same value of x as given in problem 20 and the k value you just found, use the last equation in Section II to find F_s.

22. Assuming $\theta = 0°$ and $F = F_s$, use the third equation listed above along with the values found and given in the previous two questions to find W.

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

Section V: *For problems 24 – 26, use the equations below.*

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

24. *p* is 12 kg·m/s and *m* is 25 kg. Find *v* using the first equation.

25. "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 kg·m/s, *m* = 12 kg, and v_i and p_i are both zero.

26. Use the second and third equation together to find v_i if v_f = 0 m/s, *m* = 95 kg, *F* = 6000 N, and Δt = 0.2 s.

Section VI: *For problems 27 – 29 use the three equations below.*

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

27. T_p is 1 second and *g* is 9.8 m/s^2. Find *L* using the second equation.

28. *m* = 8 kg and T_s = 0.75 s. Solve for *k*.

29. 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: *For problems 30 – 33, use the equations below.*

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

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

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

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

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

Section VIII: *For problems 34 – 38, use the equations below.*

$$\rho = \frac{m}{V} \qquad P = P_0 + \rho g h \qquad F_b = \rho V g$$

$$A_1 v_1 = A_2 v_2 \qquad P + \rho g y + \frac{1}{2}\rho v^2 = a\, constant$$

34. If P_0 = 100,000 Pa, ρ = 1.2 kg/m^3, g = 9.8 m/s^2, and h = 75 m, calculate the value of P.

35. If m doubles but V is halved, how does F_b change if g is constant?

36. Using the first equation, third equation, and the first equation from Section II, determine the value of a if $\rho = 1000$ kg/m^3, $V = 2$ m^3, and $g = 9.8$ m/s^2. Assume $F_b = \Sigma F$.

37. If y is constant, how does P change if v is tripled (use the fifth equation)?

38. Find v_2 if v_1 =300 m/s and A_2 equals 2.5A_1.

Section IX: *For problems 39 – 43, use the equations below.*

$$PV = nRT \qquad Q = mc\Delta T \qquad U = \frac{3}{2}k_B T$$

$$v_{rms} = \sqrt{\frac{3RT}{M}} \qquad W = -P\Delta V \qquad \Delta U = Q + W$$

39. What is T if $V = 2 \times 10^{-3}$ m^3, $n = 1$ mol, $R = 8.31$ J/kg·K, and $P = 7 \times 10^6$ Pa?

40. Assuming *n* and *R* are both held constant, what happens to *T* if *P* is doubled and *V* is tripled?

41. Calculate *m* if *c* = 4000 J/kg°C, *Q* = 6.2 kJ, and *T* = 12 °C. To do this correctly kJ needs to be converted into units of J.

42. If *U* doubles and k_B, *R*, and *M* remain the same values, how does v_{rms} change?

43. If Δ*V* is positive and Δ*U* is zero, what is the sign of *Q*? Justify your answer using the last two equations.

Section X: *For problems 44 – 47, use the equations below.*

$$v=\lambda f \qquad n=\frac{c}{v} \qquad n_1 \sin\theta_1 = n_2 \sin\theta_2$$

44. If *v* is constant, how does *f* change if *λ* quadruples?

45. *c* is equal to 3×10^8 m/s. What is the value of *n* if *v* equals 2.25×10^8 m/s?

46. If n_2 is greater than n_1, is θ_1 greater than, less than, or equal to θ_2? Justify your answer using the third equation.

47. Assuming θ_2 is 90°, write an expression for θ_1 in terms of n_1 and n_2.

Section XI: *For problems 48-52, use the equations below.*

$$\frac{1}{s_o}+\frac{1}{s_i}=\frac{1}{f} \qquad M=-\frac{s_i}{s_o} \qquad f=\frac{R}{2}$$

$$m\lambda=d\sin\theta \qquad x_m=\frac{m\lambda L}{d}$$

48. If s_i = -5 cm and s_o = 2 cm, calculate the value of *f* (units are cm for *f*).

49. *R* is known to be -3.2 cm. Find s_i if s_o = 4 cm.

50. What is the numerical value of *M* if $s_o = 2f$ (*M* has no units)?

51. What is θ if $d = 8.5 \times 10^{-4}$ m, m = 2, and $\lambda = 6.3 \times 10^{-7}$ m?

52. Using the last two equations, calculate x_m if θ is 1.2°, m is 1, λ is 400 nm, and L is 1.4 m. To solve this correctly, λ should be converted from units of nm to m.

Section XII: *For problems 53– 58, use the equations below.*

$$F_E = \frac{kQq}{r^2} \qquad E = \frac{F_E}{q} = \frac{kQ}{r^2} \qquad U_E = \frac{kQq}{r} = qV$$

$$E = -\frac{V}{d} \qquad V = \frac{kQ}{r}$$

53. k is a constant and is always equal to 9.0×10^9 Nm²/C². If $q = 1.2 \times 10^{-13}$ coulombs, $Q = -q$, and $F = -10$ newtons, then find r using the first equation.

54. Another way of writing k is $k = \frac{1}{4\pi\epsilon_0}$ Using $k = 9.0 \times 10^9$ Nm^2/C^2, solve for ε_0.

55. Find E using the fourth equation if $V = 120$ volts and $d = 0.2$ meters.

56. Use the second and fourth equations together to find V if $r = d$, $Q = 1.6 \times 10^{-19}$ C and k is 9.0×10^9 Nm^2/C^2. Can you find the fifth equation in your algebraic steps?

57. If I have a U_E of 12 joules, and I double Q and q, then what is my new value of U_E?

58. If F is 0.2 N, $d = 2.0 \times 10^{-4}$ m, and q is 8.0×10^{-19} C, find V.

Section XIII: *For problems 59 – 64, use the equations below.*

$$C = \frac{Q}{V} \qquad C = \frac{\epsilon_0 A}{d} \qquad U_C = \frac{1}{2} QV = \frac{1}{2} CV^2$$

$$C_p = C_1 + C_2 + \ldots + C_n = \sum_{i=1}^{n} C_i \qquad \frac{1}{C_s} = \frac{1}{C_1} + \frac{1}{C_2} + \ldots + \frac{1}{C_n} = \sum_{i=1}^{n} \frac{1}{C_i}$$

59. If C is 12×10^{-6} farads and V is 12 volts, find Q using the first equation.

60. The relationship between ε_0 and k is described in problem number 54. Use that relationship to re-write the second equation listed in this section in terms of k instead of ε_0.

61. ε_0 is a constant and always equals 8.85×10^{-12} C^2/Nm^2. If $A = 0.3$ m^2 and $d = 0.012$ m, find C.

62. Given $Q = 3.0 \times 10^{-6}$ C, and $C = 7 \times 10^{-6}$ F, find U_C.

63. Use the fourth equation to find C_P if $C_1 = 2 \times 10^{-6}$ F, $C_2 = 4 \times 10^{-6}$ F, and $C_3 = 6 \times 10^{-6}$ F.

64. Use the fifth equation to find C_S if $C_1 = 2 \times 10^{-6}$ F, $C_2 = 4 \times 10^{-6}$ F, and $C_3 = 6 \times 10^{-6}$ F.

Section XIV: *For problems 65 – 70 use the equations below.*

$$V = IR \qquad I = \frac{\Delta Q}{t} \qquad P = IV \qquad R = \frac{\rho L}{A}$$

$$R_s = R_1 + R_2 + \ldots + R_n = \sum_{i=1}^{n} R_i \qquad \frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots + \frac{1}{R_n} = \sum_{i=1}^{n} \frac{1}{R_i}$$

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

66. If ΔQ = 0.2 C, t = 1 s, and R = 100 Ω, find V using the first two equations.

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

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

69. Let R_p = R. If R_1 = 50 Ω and R_2 = 25 Ω and I = 0.15 A, find V.

70. Given R = 110 Ω, L = 1.0 m, and $A = 22 \times 10^{-6}$ m², find ρ.

Section XV: *For problems 71 – 75 use the equations below.*

$$F_B = qvB\sin\theta \qquad F_B = BIL\sin\theta \qquad B = \frac{\mu_o I}{2\pi r}$$

$$\Phi_m = BA\cos\theta \qquad \mathcal{E}_{avg} = \frac{-\Delta\Phi_m}{\Delta t} \qquad \mathcal{E} = BLv$$

71. Find v if $q = -4.8 \times 10^{-19}$ C, B = 3.0 teslas, θ = 90°, and $F_B = -1.0 \times 10^{-9}$ N.

72. μ_0 is a constant and so is always equal to $4\pi \times 10^{-7}$ T·m/A. If I = 0.2 A, r = 0.003 m, θ = 270° and L = 0.15 m, then find F_B.

73. Find Φ_m when B = 1.1 T, A = 2.0 m², and θ = 53°.

74. Remember how "Δ" means "final state minus initial state"? Using that, assume B does not change from 0.3 T and θ = 0°, but A changes from 0.1 m² to 0.4 m². If Δt = 1.1 seconds, use the above information to find Φ_m.

75. $\mathcal{E}$ is 0.12 V, B is 2.0×10^{-3} T, and v is 12,000 m/s. Find L using the last equation in the list.

Section XVI: *For problems 76 – 80, use the equations below.*

$$E = hf \qquad c = \lambda f \qquad K = hf - \varphi$$

$$\lambda = \frac{h}{p} \qquad \Delta E = (\Delta m) c^2$$

76. Find E if $h = 6.63 \times 10^{-34}$ J·s, $\lambda = 450$ nanometers, and $c = 3.00 \times 10^{8}$ m/s. To solve this problem correctly, convert λ into meters before plugging in the number.

77. h is a constant, so it is always equal to the value given in the prior problem. Assuming f is 4.2×10^{14} Hz and φ is 1.3×10^{-19} J, calculate the value of K.

78. Using the first equation from Section V for p, determine the value of λ given that $m = 9.11 \times 10^{-31}$ kg and $v = 2.7 \times 10^{6}$ m/s.

79. c is also a constant, so it always equals 3.00×10^{8} m/s. If the final state of $m = 3.4824 \times 10^{-27}$ kg and the initial state of $m = 3.4829 \times 10^{-27}$ kg, find ΔE.

80. K is not allowed to be negative. Find the minimum value of f that works for the third equation if φ is 4.3×10^{-19} J.

GOOD JOB!

That wasn't so bad was it? Trust me… the blood sweat and tears it took to get through all of those problems will make everything later on a lot easier. Think about it as an investment with a guaranteed return.

Part 6: Scalars and Vectors

Hooray for the Internet! Watch the following two videos:

- http://www.khanacademy.org/science/physics/v/introduction-to-vectors-and-scalars
- http://www.khanacademy.org/science/physics/v/visualizing-vectors-in-2-dimensions

For each video, summarize the content Mr. Khan is presenting in three sentences. Then, write at least one question per video on something you didn't understand or on a possible extension of the elementary concepts he presents here.

If you have issues paying attention or if your Facebook/Twitter/Tumblr is open as you are trying to focus on these videos, you might have to watch them more than once. Trust me, these concepts are some of the building blocks of Physics. Get this down and you are on the fast track to success.

This course is a wonderful opportunity to grow as a critical thinker, problem solver and great communicator. Don't believe the rumors – it is not impossibly hard. It does require hard work, but so does *anything* that is worthwhile. You would never expect to win a race if you didn't train. Similarly, you can't expect to do well if you don't train academically.

Physics is immensely rewarding and exciting, but you do have to take notes, study, and read the book (gasp!). I guarantee that if you do what is asked of you that you will look back to this class with a huge sense of satisfaction! I know I can't wait to get started…

Let's learn some **SCIENCE**!!!