***Physics 211/Physics 212** - General Physics I and II (4 credit hours each)*

Course Description (including laboratory, if necessary):

Physics 211 and 212 meet for three one-hour lectures and one two-hour laboratory session each week. The lecture portion of *Physics 211* introduces three major topics: Newton's laws of motion and gravity (causes and descriptions of linear and rotational motion), conservation laws (angular momentum, mechanical energy, and momentum), and thermodynamics, covering topics such as energy, heat and temperature. *Physics 212* addresses the following topics: mechanical waves, electricity, magnetism, simple circuits, and the electromagnetic spectrum. The *Physics 211* laboratory introduces measurement and data analysis and the causes of experimental uncertainties. The *212* laboratory builds on the ideas of energy and force introduced in the first semester and adds the new concepts of electricity and magnetism, with applications to electric circuits.

Students will gain the following skills:

- Ability to solve sophisticated multi-step problems
- Ability to recognize and account for error in measurement (lab)
- Writing lab reports (lab)
- Manage spreadsheets for data analysis (lab)

Who should take this course:

The general audience for these courses consists of engineering and physical science students from areas such as atmospheric science, chemistry, and physics. Biology and pre-med students should consider taking these courses, rather than the algebra-based *Physics 114/115*, as many graduate and medical programs require a calculus-based physics course. Students in *211/212* typically pursue careers in science or engineering or attend graduate school.

Distinctions between similar courses:

More than other entry-level physics courses, this course emphasizes multi-step problem solving and applying mathematical approaches to physics problems. To succeed in *Physics 211/212*, a strong math background is essential. Students interested in a more general overview of physics should take Physics *114/115* (algebra-based integrated two-semester lab course) or Physics *111/116*, a concepts-based one-semester lecture course with an optional laboratory session.

Course Timing and Course Combinations:

The first course in this sequence, *Physics 211* should not be taken before the spring semester of the student's freshman year unless the student is very well prepared in math and science from high school.

Prior Knowledge and Skills required of student:

These courses are calculus-based physics courses, with *Math 116* or *Math 121* (Calculus I) as a pre-requisite for *Physics 211* and *Math 122* (Calculus II) as a co-requisite for *Physics 212*. However, the department may make exceptions on a case-by-case basis if a student has taken calculus in high school and/or scored highly on the math section of the ACT. While the department recommends high school chemistry and physics, they are not required.

To succeed in PHSX 211/212, students should be able to do these problems *BEFORE* enrolling in the course.

PRE-TEST

1. Write these numbers in scientific notation: a) 2,300,000 b) 0.0000456

2. Translate these numbers from scientific notation: a) 5.6×10^3 b) 7.6×10^{-4}

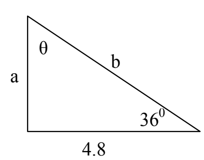
3. How many seconds are there in the month of August?

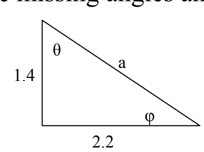
4. Find x: a) $2 = 3x$ b) $5 = 4x + 7$

5. A rectangle has area 47 m^2. If the long side has length 8.1 m, what is the length of the short side?

6. Find x: a) $3x^2 + 5x + 1 = 0$ b) $\ln(x) = 5.6$ c) $e^x = 5.6$ d) $\sin(x) = 0.445$

7. For the right triangles shown below, find the missing angles and lengths:





8. Solve these two simultaneous equations for the two unknowns: $3x + 2y = 7$, $5x - y = 3$.

9. Find the derivative of the following functions:
a) $y = x^3 + 3x^2 + 5x + 7$ b) $y = \cos(x)$ c) $y = \sin(x^2+1)$

10. Integrate the following functions:
a) $y = x^3 + 3x^2 + 5x + 7$ b) $y = \cos(x)$ c) $y = 1/x$

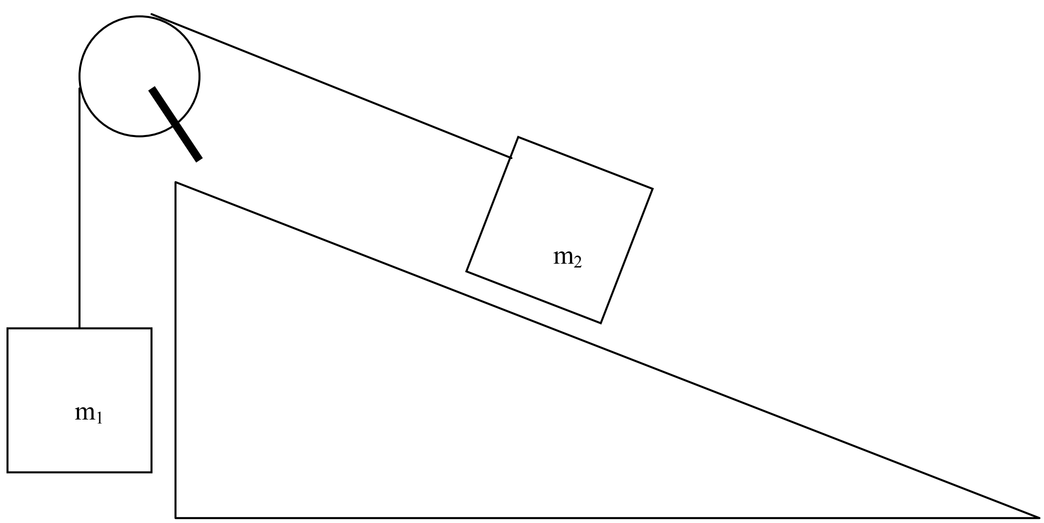
11. Consider the following function: $y = 9 - 3(x-2)^2$
a) Plot y versus x.
b) At what value of x does y have its maximum value (figure using graph *and* calculus)
c) Find the area under the curve between $x = 1$ and $x = 3$.

In addition, a student should be able to read, comprehend, and extract information from text similar to the sample below (Knight, 2004):

> We can define an instantaneous acceleration in much the same way that we defined the instantaneous velocity. The instantaneous velocity was found to be the limit of the average velocity as the time interval $\Delta t \to 0$. Graphically, the instantaneous velocity at time t is the slope of the position-versus-time graph at that time. By analogy: **The instantaneous acceleration a_s at a specific instant of time t is the slope of the line that is tangent to the velocity-versus-time curve at time** t. Mathematically, this is
>
> $$a_s \equiv \lim \frac{\Delta v_s}{\Delta t} = \frac{dv_s}{dt} \quad \text{(instantaneous acceleration)}$$
>
> The instantaneous acceleration is the derivative (i.e. the rate of change) of the velocity.

Examples of coursework students will encounter while enrolled in PHSX 211:

1. Two blocks of mass m_1=3.6 kg and m_2=5.3 kg are connected by a rope that passes over a frictionless pulley. One block sits on a ramp with friction coefficient μ=0.23; the other block hangs vertically alongside the ramp. The ramp makes an angle of 19^o with the horizontal. What is the direction and magnitude of the acceleration of this system?



2. A thermodynamic process followed by 0.015 mole of hydrogen is shown in the figure below. If the thermal energy of the gas decreased by 25 J, calculate the work done on and heat transferred to the gas.