**Physics 2205** 21 September, 1999
**Study Guide for Exam 1**

## Preliminary Material

Appendix A sums up a fair bit of material that students should know before their first Physics 2205 lecture. This includes the definitions of sine, cosine, and tangent, basic geometric relationships, including (but not limited to) properties of triangles, areas of circles and spheres, the circumference of a circle, and the volume of a sphere. None of these will be provided on the equation sheet which accompanies the exam.

## Chapter 1

The key points in Ch. 1 are:
- uncertainty, significant figures, and error bars
- standard units
- unit conversions (the 1=... method)
- making order-of-magnitude estimates

Any of these might appear on the exam.

## Chapter 2

Velocity defined: $v = \Delta x/\Delta t$

Acceleration defined: $a = \Delta v/\Delta t$

From these and the application of average velocity, you should be able to derive the three kinematic equations for the special case of constant acceleration:

$$x = \tfrac{1}{2}\, a\, t^2 + v_o\, t + x_o$$

$$v = v_o + a\, t$$

$$v^2 = v_o^2 + 2\, a\, (x - x_o)$$

For the case of vertical motion with constant gravitational acceleration (g):

$$y = -\tfrac{1}{2}\, g\, t^2 + v_o\, t + y_o$$

$$v = v_o - g\, t$$

$$v^2 = v_o^2 - 2\, g\, (y - y_o)$$

## Chapter 3

You should know how to add and subtract vectors, how to find the components of a vector, and how to determine the length and direction of a vector given its components.

You should also be able to convert the three kinematic equations derived in Ch. 2 for the case of projectile motion in two dimensions:

$$x = v_{ox}\, t + x_o \qquad y = -\tfrac{1}{2}\, g\, t^2 + v_{oy}\, t + y_o$$

$$v_x = v_{ox} \qquad v_y = v_{oy} - g\, t$$

$$v_y^2 = v_{oy}^2 - 2\, g\, (y - y_o)$$

For the special case where $y=y_o=0$, the range equation applies:

$$R = v_o^2 \sin 2\theta_o / g$$

## Chapter 4

You should have Newton's Three Laws of Motion memorized, and you should know how to apply them. Newton's Second Law will be on the equation sheet, but this should be very familiar:

$$\Sigma\, \mathbf{F} = m\, \mathbf{a}$$

For dynamics problems, remember to:

(1) Draw a free-body diagram for each object;
(2) Pick a good coordinate system (with one axis in the direction of **a**);
(3) Apply Newton's Second Law to obtain the equations of motion;
(4) Apply the various constraints if needed:

weight: $F_g = mg$
friction: $f = \mu\, N$

You should also know how to use tension and normal forces.

Remember that one of the trouble spots we've run across is how to separate a vector into its components when applying Newton's Second Law. You can work on this by reviewing the beginning of Ch. 3, the first part of Appendix A-8, and going over problems and examples where components need to be found.

Physics 2205 Exam 1 Study Guide (continued)

## Chapter 5

For circular motion, we have another constraint and a couple of definitions:

$$a = v^2/r$$

| | |
|---|---|
| period | T = time to complete one orbit |
| frequency | $f = 1/T$ |

Can you determine the orbital velocity from the radius and period?

Newton's Law of Universal Gravitation:

$$F = G\, m_1\, m_2 / r^2$$

Kepler's Third Law:

$$T^2 = (4\pi^2/GM)\, r^3$$

If T is in years, M in solar masses, and r in AU, this becomes:

$$T^2 = r^3 / M$$

You don't need to memorize Kepler's First and Second Laws.

## General Study Tips

You will do well on the exam if you are comfortable with all of the problems that have been assigned and all of the examples that have been discussed. In one form or another, these account for about 90% of the exam. The primary exception to this might be derivations covered in lecture.

The best review would be to identify your weak spots and go over problems from the relevant sections. Don't necessarily limit yourself to problems we've discussed before.