Study Guide for Test 3

This test will cover a rather scattered set of topics . . .

Momentum conservation: net $\vec{p}_f =$ net $\vec{p}_i$, provided that the net external force on the system is zero. This is one of the Big Ideas of the semester. It is most useful when two (or more objects) undergo some sudden, complicated interaction such as a collision. You should be able to set up and solve problems that apply this principle, and distinguish between momentum ($\vec{p} = m\vec{v}$) and energy (which has many forms). You should be able to treat momentum correctly as a vector, with x and y components that can be positive or negative.

Circular motion of a pointlike particle. The only new fact here is that the acceleration vector for an object undergoing circular motion at constant speed has magnitude $|\vec{a}| = |\vec{v}|^2/R$, where R is the radius of the circle. You should be able to solve constrained motion problems involving such objects, correctly setting the proper acceleration component equal to plus or minus $|\vec{v}|^2/R$. You should be strong enough to resist the temptation to analyze motion with respect to a circularly moving frame of reference.

Gravity on large scales. We learned a new force equation for the gravitational force between any two objects: $|\vec{F}_g| = Gm_1m_2/r^2$. I'll give you this equation on the test. You should be able to apply it in various situations including constrained motion problems. You should know that G is a very small number (something times 10^{-11}) when expressed in SI units, and you should be able to figure out what those units are.

Rotational kinematics and dynamics. I'll give you an abbreviated version of the "table of analogies":

Linear	Rotational
t	t
x	θ
v_x	ω
a_x	α
m	I
F_x	τ
KE	KE
p_x	L

Knowing the definitions and interpretations of the linear quantities, you should be able to correctly define and use the rotational quantities. I'll also give you the following relations between linear and rotational quantities (you should already know the relation between force and torque):

$$\omega = \frac{v_t}{r} \qquad \alpha = \frac{a_t}{r} \qquad I = \sum_i m_i r_i^2 \qquad L = \sum_i r_i\, p_{t,i}$$

Fluid statics. You should know the definitions of density and pressure. You should also know the SI units of these quantities, and the conversions involving non-SI units such as liters, cubic centimeters, grams, atmospheres, and bars. You should know the approximate densities of water and air (under normal conditions), as well as the approximate value of atmospheric pressure at sea level.

I'll give you the formulas for pressure as a function of depth and buoyant force on a submerged object:

$$P = P_0 + \rho g h \qquad\qquad |\vec{F}_b| = \rho_{\text{fluid}} V g$$

You should be able to interpret these formulas, explain why they're true, and use them in solving problems as on the homework.