ISP 205
Review Questions,Week 2

This is not required homework. It will not be graded. Answers will be supplied next week.

These questions are intended to help you think about the more important points from my lectures. The exams will ask you about these points, as well as about additional details. But note that the exams will be multiple choice questions.

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1. Newton's second law says F = m×a . If you triple the force you are applying to some object, how many times bigger will its acceleration be? *Three time bigger. In the equation, "F" means "force" and "a" means "acceleration". The equation just tells us that the acceleration is directly proportional to the amount of force applied.*

2. In a "close fly-by", a spacecraft is aimed so that it passes close to a planet, but does not actually hit it. Why can we use a close fly-by as a means to accelerate the spacecraft enough so that it can travel to the outer planets? (Think back to the encounter between the twins after they had aged a bit, or to the tennis ball – basket ball demo.) *The spacecraft and the planet have what is in effect a collision, but the force is transmitted gradually via the gravitational attraction between the spacecraft and the planet, so nothing gets broken. But as described by Newton's third law, the planet and the spacecraft experience equal but opposite forces, so the less massive object (the spacecraft) can receive a large acceleration that is able to launch it way farther out into the solar system.*

3. In what way is the planet affected by this sort of close fly-by? *The planet will slow down slightly in its orbit, so it will edge in closer to the Sun by a tiny amount. Also, depending on the amount of sensationalist media coverage, the citizens of the planet might be scared to death.*

   But note that the spacecraft's trajectory could also have been arranged so the force experienced by the spacecraft would have slowed it down, while the planet was speeded up.

4. When an object is spinning, it has two important attributes describing its spin, each of which try to stay constant. What are they? *(1) The total AMOUNT of angular momentum, which is the product m×v×r summed up over every little piece of the spinning object. Here "m" is the mass of the little piece, "r" is its distance from the pin axis, and "v" is its velocity around the spin axis. The ice skater pulling in her arms speeds up because of this effect. (2) The direction of the spin axis. This is the effect that kept the rapidly spinning bicycle wheel from falling over. But the wheel's spin axis twisted around sideways, because the force of the Earth's gravitational pull was trying to make it fall over.*

5. What do we mean by the statement "Energy is always conserved"? *If there are no outside forces acting on an object or group of objects (for example, a cluster of stars), the*

total sum of all of the different kinds of energy in that set of objects will always stay constant. But energy still can slop around from one type to another… such as between kinetic energy and gravitational potential energy in the case of the pendulum.