Name: _____

Homework 3 – Ast 281 – Spring 2009
Due Thursday 2/05/09 – 12:00pm, Watanabe 420

There have been two recent movies the deal with comets, asteroids and the disaster theme: *Deep Impact* and *Armageddon.* This homework will be a little different, to see if you can think critically about the movies. The premise of Deep Impact was that a comet was coming toward Earth on a collision course, and astronauts are sent up to the comet to explode it and save the Earth. Armageddon has more or less the same theme, except that the "astronauts" sent up to the comet are oil rig workers (because of their experience with drilling operations.

1. The facts given in the movie for Deep Impact: the comet coming toward earth is split into two pieces, one with a radius of 0.8 km and the other with a radius of 4.8 km. Before splitting the comet's rotation period was 14 hours. The comet will collide with the earth at a heliocentric distance of 1 AU, and it is predicted to cause global destruction. Please assess the reasonableness of the facts.

   (a) Is it likely that the comet might have this size and should it rotate? (discuss why) [5 points]

   (b) In the movie, there is one shot on the screen showing the orbit of the comet. One can calculate the orbital velocity at any point in the orbit via the following formula:

   $$v^2 = GM(2/r - 1/a) \tag{1}$$

   where G is the gravitational constant (known), M is the mass of the body being orbited (in this case the sun), and r is how far from the sun the object is, and a is the radius of the orbit (=radius if circle or half the longest axis if it is an ellipse). Is there enough information to figure out the velocity of the comet (by making some reasonable assumptions). Discuss. [5 pts]

   (c) What might be the likely impact velocity on Earth, and is this something that would likely be hazardous? [5 pts]

   (d) In the movie, the astronauts fly into the tail of the comet, and have to dodge huge boulders. Discuss how likely we are to have house-sized boulders in the comet's tail. What forms the tail and what is it composed of? [5 pts]

(e) One of the worries in the movie was that when sunrise came on the comet, after 7 hours, huge geysers of activity would explode from the surface as it warmed up. Should they have been worried - why or why not? [5 pts]

(f) One of the pieces of the comet hits Earth in the Atlantic ocean. Calculations have shown that with likely impact velocities the deep water wave height would be about 35 m. When tsunamis run up against the land the bottom of the wave hits the ocean floor, and the wave height experiences a run-up and increases in height by as much as a factor of 25-40. In the movie a tidal wave is shown flowing over the Empire state building. Do a little exploring on the web to assess whether this disaster scenario is reasonable, and if folks trying to escape the city would have been able to outrun the wave on a moped (as was depicted). [10 pts]

2. Below is a picture of the comet from the movie Armageddon. The oil rig drillers on the surface kept breaking their diamond drill bits, although at one point they ran into an explosive pocket of methane (CH_4). Is this a a reasonable description of a comet. Why or why not? [15 pts]