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**Problem Set 1**

Due in class Monday 6 April 2009

*Estimates:* When making these estimates, you should base them on computations starting from ‘common knowledge’ facts you already know, or small experiments you perform, *not* on searches of the internet or libraries for someone else’s estimate or input numbers. It is not expected that your answer be good to better than a factor of 3 either way, but you should be able to do better than a factor of 30. There are often several quite different ways of making the estimates, and it is often useful to try more than one, see if the answers agree in order of magnitude, and figure out what went wrong if they don’t.

**Homework Problems:**

1. **Crowded Space.** Assuming that a typical satellite in low earth orbit has a cross-sectional area of  $10\text{m}^2$ ,
  - a) Estimate the number  $N$  of satellites that can be in random low-earth orbits (altitude 300km-2000km) before the collision rate reaches one per decade.
  - b) Given that the US and Russia alone have each launched more than 1000 payloads (plus several times more upper rocket stages and lost parts), how surprised are you by the Feb 10, 2009 collision between the US Iridium 33 and Russian Cosmos-2251 satellites?
2. **Water use.** Estimate how much water (in liters) you use every day for
  - a) Drinking
  - b) household use (washing, flushing, cleaning)
  - c) growing the food you eat
3. **Hollywood vs. Physics.** The premise of the new Disney/Pixar movie “Up” is that a small 2-story house (1-story plus a steep roof and gables) is lifted by a huge collection of party balloons and flies around the world with its crotchety old inhabitant. Estimate
  - a) How many 12-inch diameter helium-filled party balloons would be required to lift such a house.
  - b) The total mass of these balloons and their strings.
  - c) The diameter of the cluster of balloons compared to the size of the house.
4. **Too many cars?** In units of the speed of light, how fast is the total distance ever driven by *all* the cars on the earth increasing?
5. **Invent your own** Invent a problem of your own (you don’t have to know the answer). The most interesting problems submitted will be done in class, or assigned as homework in subsequent problem sets. Your problem can be like those above, or more general.