Physics 142E

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First we'll **go to the course website** and review it: WebAssign homework, in-class clickers: 20% forgiveness.

Syllabus: Dynamics, Fluids, Oscillations and Waves, Sound, Heat and Thermodynamics.

So we start with **dynamics**: study of motion, and, being physics, we need to be quantitative.

So it's all about making measurements.

Measurements of **size** and **mass** from quarks to quasars, of **speed** from continental drift rates to the speed of light. We need to be able to handle very big numbers and very small numbers easily: we use powers of ten.

The common ones are:

kilo for 1,000 such as kilometer and kilogram,

mega for 1,000,000 or 10^6 as in megawatt or megabyte,

giga for 10^9,

tera for 10^{12} (terabyte storage now easily available).

You may see **peta for 10^{15}**, but not often.

Going down:

deci for 10^{-1} as in decibel (otherwise not often used),

centi for 10^{-2} as in centimeter and centiliter (cl),

milli for 10^{-3}

micro for 10^{-6} (10^{-6} meter is called a **micron, μ**)

nano for 10^{-9}

pico for 10^{-12}

and you might come across **femto for 10^{-15}**. (A femtosecond is roughly how long electrons take to go round orbits in atoms.)

The actual units we use are almost always **SI**, the metric system, also known as **MKS** for meter, kilogram, second.

The **second** is now defined in terms of the oscillation frequency of a cesium atom in a particular state, the **meter** is defined in terms of how far light gets in one second.

Volume is measured in cubic meters, or more conveniently sometimes in ccs meaning cubic centimeters or mls meaning milliliters. These two units are the same!

One liter = 1,000 ccs

and

one cubic meter = 1,000 liters.

Mass is still defined in terms of a standard kilogram, a lump of platinum-iridium in Paris, but this will inevitably be replaced by a definite number of atoms of some kind eventually.

Unit conversion: **1 inch = 2.54 cm.** Used to be 2.5403.

1 kg = 2.2 lb.

One gallon = 3.875 liters.

1 ton (metric) = 1,000 kg (nobody calls it a megagram).

Density of water:

1 liter of water weighs 1 kg.

Conversions: speed will be in meters per second. 60 mph = 60/3600 miles per second, 1/60 miles per second (that's 88 feet). 1 mile = 1.609 km = 1609 m, so 60 mph = 1609/60 m sec^{-1} = 27 m sec^{-1}.

Significant figures: When we say 60 mph, we mean closer to 60 than to 59 or 61 (otherwise, we'd write 60.0, or 60.00, etc.) so there's a possible error around 1%.

Now, when converting to meters per second, don't write 26.81666..which is what the calculator gives—that extra information is junk! Your answer in any calculation cannot be more reliable than your input data, but your calculator doesn't know that. *It's your responsibility to apply commonsense, and to drop meaningless figures*.

Powers of Ten: *rice grains*. 100,000 grains fill a two liter bottle. So that's 50,000,000 grains in a cubic meter.

Estimation: How many grains of rice would it take to fill this room? (About 10^{11}: the room is about 12 meters wide, 20 meters from front to back and average height say 6 meters, so volume 1440 cubic meters, 0.7.E10 rice grains.) 10^{9}? 10^{10}? 10^{11}? 10^{12}? (*Note*: That's the same as the number of stars in our galaxy; *and* the same as the total number of galaxies in the universe. It's also worth noting that the number of air molecules in a 2 liter bottle is around ten times the number of stars in the universe.)

Estimate: what number is closest to your volume in cubic meters, approximately?

0.075? 0.15? 0.3? 0.5? (110 lb person is 0.05 m^3, 220 is 0.1 m^3)

Estimating the size of the earth: my lecture.