Problem Set #1: PHYS-310 The World: Energy Units & Conversions, Global Energy Use
Due Monday, April 8 in class.

Please do your work without a calculator, and estimate your answers best you can. Usually if you are within 20%, that is fine. We recommend you start a list of constants and equations – possibly keep them on a dedicated Excel Spreadsheet. Some of your assignments will involve simple computer models that Excel is nice for. Because you will need to look up values on the web and make some assumptions and estimates, your answers may vary considerably.

Proper canceling of units. Everyone in this class has some technical background. Thus, we presume that you're good with cancelling units. You are responsible for working problems out with a pencil to make sure that units work… this is VERY important because the world conspires to make life difficult with units that vary from Watts, to Tons (if ice per day). So, for full credit, please show all units all the way through a problem with proper canceling

1) Spend 10 – 15 minutes on the EIA website. Printout or write down your favorite:
   a) graph
   b) statistic
   c) fun fact
2) The US consumes about a 100 Quads of primary (raw) energy a year (for a long time, this was a forth of global energy consumption, but now is less than 1/5). Using this knowledge, please estimate:
   a) The average rate of primary energy consumption (in Watts) for the average US resident.
   b) Prove it it's true or not true: "daily energy consumption of a US American is about ¼ of their body weight in oil equivalent energy."
3) Calculate your own horsepower over a short period of time or a long period of time by exerting yourself in an activity. What is your maximum power output – for a short spurt and steady state for more than a minute? Please exert yourself a little to get an idea of maximum human power. You can run up some stairs, or do something more creative. There two videos for Monday that might be of assistance.
4) Show that e^{it} is a solution to $dQ/dt = iQ$, or for population = P, $dP/dt = iP$, or $d\$/dt = i\$$, where i is NOT square root of -1, but is a constant with units of $(time)^{-1}$.
5) What is the tripling time for exponential growth?
6) Hey, did you know that a Ton is not just a unit of mass, it's also a unit of *power* for AC or refrigeration. Back in the day, people would just buy ice to keep things cool in their insulated food space. So, if they got a ton of ice per day, then the latent heat of fusion would be absorbed each day as the ice melted. The accepted conversion is 1 T = 12,000 BTU/hr. Please show that this is about correct, and in the process, please convert to kW.
7) Let's say we did the equitable thing and split up the earth's surface area equally among all people. Direct noon sunlight on the equator is about 1000 W/m^2. No calculators please.
   a) Estimate the amount of land, ocean and fresh water surface area each of us gets
   b) Estimate the amount of power each person would absorb at noon.
   c) Estimate the amount of energy each person would absorb in a year.
8) A friend once told me that each person is a 100 W lightbulb (No wonder when we're all in a room together it gets hot). If this is the case, how many calories would we need to consume daily? Is this about right?