QRMS Project 1: Energy Use (Due October 19, 2012)

In this project, you'll get experience working with units of energy and power and with the three ways of using percentages. To do this, you'll investigate your energy usage and the effect of various conservation strategies. You may work alone or in a group of up to three people.

Part 1: Energy Audit (30 pts)

You may present this portion of the project in any typed form so long as its clear and you show your work. If you're working in a group, you only need to do this for one group member. If possible, pick a group member who has access to a recent electric bill.

1. Estimate how many kilowatt-hours of energy you use in a month by performing an "audit" of your living area.
   Hints:

   - Most devices list the maximum number of watts that they use on their label, in their manual, or on the manufacturer's website. If the device only lists how many amps it uses, note that amps in the U.S. can be converted to watts by multiplying by 120. If you can't find a number for a device you use, try checking a website such as: `http://michaelbluejay.com/electricity/howmuch.html`.
   - A few devices are hard to calculate and may even lie on their labels. Do the best that you can for these devices; I'll be lenient regarding your accuracy for these. The link above also provides information on specific appliances that may cause trouble.
   - If you desire more accuracy, Boulder Public Library checks out Kill-a-watt meters designed to measure the power a device uses. Your grade will in no way be affected by whether you choose to use this or not; as the library has a limited supply, I don't recommend it unless you're really interested. More information is available at: `http://www.boulderlibrary.org/services/powercheck.html`.
   - Heating is especially hard to calculate. That probably isn't an issue at this time of year, but in case it is, you may ignore heating if you can't figure it out. Cooling is usually easier to calculate, but you may ignore cooling too if you can't figure it out.
   - Note that a device only lists the *maximum* watts used. For example, your microwave isn't really drawing 800–1200 watts except when you're actually using it and your refrigerator isn't drawing its maximum except when the compressor is running (which is nowhere close to 24 hours a day). When a device is only powering a clock, for example, it's probably only drawing 4 or 5 watts.
   - Review Unit 2B in your book if necessary.

   Example: "My microwave draws 900 watts (0.9 kilowatts). I use it for approximately 3 minutes a day and so about 90 minutes in a month (1.5 hours), for a total of 0.9 kW $\times$ 1.5 hr $=$ 1.35 kWh. For the remaining $720 - 1.5 = 718.5$ hours of the month, it draws about 4 watts (0.004 kilowatts) for the clock, for a total of $718.5 \times 0.004 = 2.874$ kWh. So, overall this device uses $1.35 + 2.874 = 4.224$ kWh of energy per month." (Then repeat for your other devices. You don't need to use full sentences if you can find another way to organize your data clearly. One strategy is to use a spreadsheet.)

2. Classify the devices into general categories (entertainment, food preparation, hygiene, illumination, heating, cooling, etc.) and find the total kilowatt-hours used in each category.

3. If at all possible, locate a recent electric bill, which will be useful below. If you can't get one, don't worry about it. (You don't need to include this when you turn the project in; it's just for your benefit.)

4. Determine how much your monthly energy bill should be. Your cost per kWh can often be found on your electric bill or at the electric company's website. If you can't find it, use the Colorado average of \$0.09 per kWh.

Part 2: Conservation and analysis (70 pts)

Write a typed double-spaced paper of about two pages in length (and not much more than three, please) that addresses the following questions. Note that you will be graded primiarily on the mathematical content. Whenever you include a number, you should include a parenthetical calculation, such as "Cooling costs accounted for 41% of my monthly bill (\$21.32/\$52.18 = 0.408 $\approx$ 41%)." *Present this in a structured paper that meets the normal expectations for formal writing: don't just write a list of disjoint numbered list of answers.*

1. Briefly describe the method you used in Part 1 and state the number of kilowatt-hours per month and cost per month that you found in Part 1. Do you think that the method provided you with an accurate answer? Does the answer agree with your electric bill (or, if a bill isn't available: is your answer reasonable)?

2. Speaking in terms of the general categories you used in Part 1, what were your three largest uses of electricity? Express the cost of each of these categories as a percentage of your total bill. (See Unit 3A.)

3. According to the Energy Information Agency, the average household in the U.S. uses 958 kWh of energy per month. How much (as a percentage) above or below that are you? Why do you think this is?

4. Environmentalists offer various strategies for conserving energy (for example, using CFL bulbs instead of traditional lightbulbs, turning lights off when leaving a room, washing laundry in cold water instead of hot, using a clothesline instead of a dryer, replacing devices with more energy efficient models, changing the energy settings on computers so that they enter a sleep state more rapidly, lowering your thermostat setting, unplugging cell phone chargers when not in use, etc.). Pick three of these (or other claims that you've heard) that you are not already doing and estimate how much you would save by implementing them. (*Be sure to include a calculation justifying/explaining your estimate.*) For each, by what percentage would implementing this strategy lower your electric bill?

5. Pick one of the strategies you discussed above. There are about 309 million people and 112 million households in the U.S., but not everyone will be affected by every conservation strategy. Estimate how many people/households could apply this strategy and how many kWh of energy per month could be saved in the U.S. if they all did. (Make any reasonable assumptions necessary in computing this, but be sure to explicitly state what assumptions you make.)