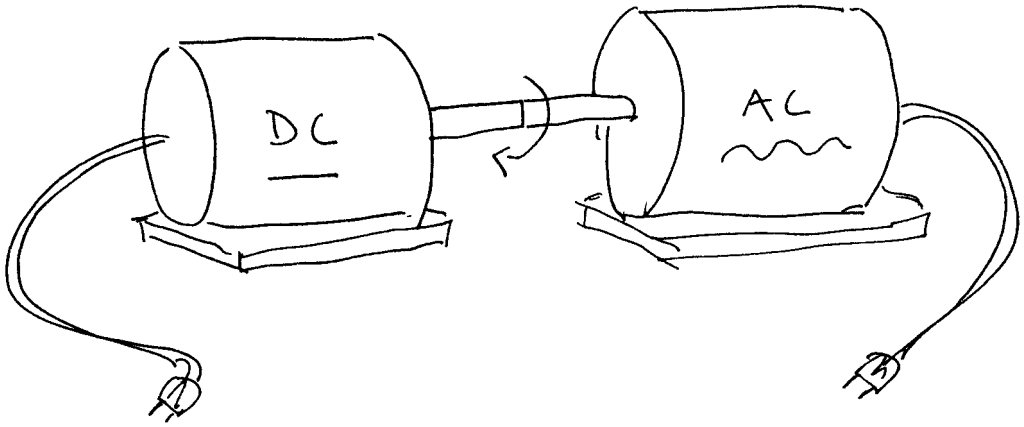
GEOS 24705 / ENST 24705
Problem set #9
Due: Thurs. April 26

**Problem 1: AC and DC**

A generator is a machine that converts mechanical into electrical energy. A "rotor" is turned mechanically, doing work, and electrical current then flows from the generator. A motor is a machine that converts electrical into mechanical energy. Current flows into the motor and does work, causing a rotor to turn. That parallelism means that the same machine can usually be either a generator or a motor, depending on whether you spin its rotor or apply current.

A. Consider the following case, where a DC motor is connected to an AC generator. What does this system do? How could you power it? Describe at least one potential use you might have for this system.




B. Now decide to reverse the system, so that the AC part is the motor and the DC part is the generator. Answer the same questions: what does the system do, how would you power it, and name one potential application.

C. ***(Optional)*** Draw a similar system that includes two AC motor/generators (and something else.. what?) and explain how it can work to convert AC power at one frequency to that at another.

This is not a crazy idea – this is how conversion was actually done in the early 20th century, before standardization, if a utility operating at one frequency wanted to sell power to another utility on a different standard.

**Problem 2: Efficiencies and making up your own mind**

Last year the U. of C. Maroon printed an op-ed piece decrying the foolishness of switching from incandescent to compact fluorescent bulbs. Read the article at http://www.chicagomaroon.com/2009/1/27/a-light-headed-plan.

From last week's table you know that CF bulbs are 10-12% efficient and that incandescent bulbs only 2-3% efficient, with the other 97-98% of the power they draw being lost as heat. The author of the op-ed argues that there's no reason to switch to CF bulbs since the heat dissipated in the bulbs is not wasted, as we're heating the campus buildings anyway. The lightbulbs act as little space heaters, and the more heat they put out, the more we can reduce building heating costs. He says, who cares if the building heating comes from electrical heating in lightbulbs or from our natural-gas-burning campus steam plant? Or rather, he says "who could know whether one is better than the other?"

Is the author correct that it's difficult to decide whether it's better to heat a building from the steam plant or from electrical resistance heating?