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Homework: 27: 16, 20, 22, 24, 25, 26, 27

$$P = IV$$

$$P = I^2R$$

$$P = \frac{V^2}{R}$$

27.16 Since you are given current and resistance use the second equation above

27.20 Use the third equation to solve for the bulb's resistance when operated at 120 V. Then use that resistance to solve for the power when the voltage is lowered to 115 V

27.22 Use the third equation, then convert from watts (joules/second) to calories per second

27.24 Power is equal to VI. That is the power used

Power is also equal to Force times velocity. The force is simply the weight of the object (mg)

For the velocity you must convert the 7 m/minute to m/s. This will give you the power output

Efficiency is equal to  $\frac{\text{power\_out}}{\text{power\_used}}$

27.25 It must have enough energy to raise the temp of the water from 28° to 100°. This is a calorimetry problem

$$Q = mC\Delta T$$

Now, since the heater is 75% efficiency divide the answer you got above by 0.75. You need to produce more energy than it actually takes to heat the water.

You must produce this much electrical energy in 120 s, so find the required power.

You have the required power and the voltage. Solve for the resistance

27.26 Convert the heat of combustion from 8000 kcal to joules.

1 kilo watt hour is equal to 3,600,000 joules. So convert your first answer (in joules) to kwh. Then find the cost of that many kwh.

27.27 Actually this a lame question but it raises a very important point with transmission of electrical power.

The power losses that result from transmission through the lines is equal to  $I^2 R$ . Now the power lines are pretty long so there is a significant amount of resistance in them even though they are conductors.

As a result, the power company can reduce power losses by decreasing the current that goes through the line.

They can still transfer the same amount of power by raising the voltage.

Thus the power lines that come from the power company to your neighborhood are at a very high voltage but low current. Of course if you touch those high power lines while you are grounded to the earth you will go bye bye, which is why there are transformers in your neighborhood that lower the voltage (and thus increase the current). Since  $P = VI$ , the power stays the same.

This is the fundamental reason power to your house is AC (Alternating current) vs. DC (Direct current)

It is quite easy to transform the voltage and current of AC power but much more difficult to transform the voltage and current of DC power.

As a result, when electric power was first being developed, DC power plants (Edison Electric) could send power only very short distances and were required to use very thick cable to carry the high currents.

Westinghouse along with Nicholi Tesla developed AC power and the required transformers that were used to transport it. They first supplied Buffalo, NY with AC power using the Niagara Falls to generate electricity.

The principle is simple **and is very important for you to remember**

**A changing electric field creates (induces) a magnetic field**

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**This process is called induction**

**The ac current is always changing (in the US it reverses direction 60 times a second or 60 hz). Therefore it is always inducing a magnetic field which also changes 60 times a second**

**This changing magnetic field induces a secondary electric field which causes a current to run through a second wire even though the two wires are not actually connected to each other electrically. We will study this more in the next week or so.**

**A transformer consists of two coils of wire, the principle coil and the secondary coil.**

**The ratio of the turns in each coil to each other can be changed in order to *transform* the voltage and current in the principle to a different voltage and current in the secondary with ideally no power loss. In practice, of course, some power loss does occur.**

**Transformers are discussed on page 341 of the Schaums guide.**