7.) Some tests are performed on an electric motor used to operate a grain auger. (A grain auger is a agricultural tool used to lift and move grain.) The motor operates on 240 V RMS, 60 Hz AC power. When there is no grain in the auger the motor is loaded only by the friction of bearings and belt losses. Then the current is found to be about 9.5 A RMS. When the auger is fully loaded with grain the current is found to be about 18 A RMS.

a.) The farm where this motor is used does not have a meter to measure the power factor. A datasheet that came with the motor states that the power factor is typically 0.80. The datasheet mentions that this is "typical" for near-full-load conditions. This number is used as an estimate for the power factor. With these measurements and assumptions, how much electrical power will calculations show the motor draws when the auger is unloaded and when it is loaded?

b.) Upon further investigation the power factor is measured. It is 0.2 when the auger is unloaded and 0.85 when the auger is loaded. Repeat the power calculations based on the new information.

c.) Since power factor is more difficult to measure than voltage or current, it is tempting to just estimate it based on the manufacturer's rating. Is estimating power factor a reasonable method? Why or why not.

8.) A certain recreational house trailer has a 13 000 BTU/hr air conditioner and other miscellaneous electrical loads such as a TV set, various incandescent and fluorescent light bulbs, a small refrigerator, etc. All these items operate on 117 V, 60 Hz AC power. The air conditioner alone draws 15 A. The trailer came with a fat power cord with a special "NEMA TT30 P" connector to plug into a trailer park's electrical hook-up. This fat power cord is designed for currents up to 30 A.

When at home a matching "NEMA TT 30R" power receptacle is not available so an adapter is used. Furthermore, the trailer is parked behind the garage some distance from an electrical outlet so an ordinary "outdoor" 100 foot 12 gauge extension cord is used. The extension cord has two current-carrying conductors and a third ground conductor that under normal conditions has no current flowing through it. The extension cord plugs into a normal household electric outlet located inside the garage. The outlet is on a 20 A circuit. At the far end of the extension cord the adapter to NEMA TT 30R is attached and the trailer's fat power cord is plugged into the adapter.

a.) The voltage drop along the extension cord when the air conditioner alone is operating is measured to be about 6 V. (This means that if you connect a voltmeter to each blade of the plug at the source end you measure 117 V. If you connect the voltmeter to each blade at the far end you measure 111 V.) How much power is wasted in the extension cord when the air conditioner alone is operating? The power factor for the extension cord is exactly unity (1.000).

b.) The same situation occurs in a country where the line voltage is 240 V at 50 Hz AC. Suppose the air conditioner is redesigned to operate at the same 13 000 BTU/hr and with the same efficiency, same power factor, but now on 240 V, 50 Hz AC. It draws practically the same amount of electrical power as before but now at a lower current level and higher voltage level. (Actually it draws slightly more power since there is less loss in the extension cord, but this is negligible relative to the overall power the air conditioner draws.) The same extension cord (100 feet, 12 gauge) and adapter is used again but this time it is plugged into a 240 V, 50 Hz 15 A circuit. How much power is wasted in the extension cord now when the air conditioner alone is operating? Assume that the change in voltage drop in the extension cord is directly proportional to the change in the current flow. (e.g. if the current is reduced by a factor of 10 then so is the voltage drop in the extension cord.)

9.) What are the resistances of the following common electrical devices:

a.) A 65 W automotive low-beam headlight bulb that operates on direct current at 12.6 V.

b.) An incandescent 65 W household flood lamp that operates on 117 V, 60 Hz AC?
(All incandescent lamps have a power factor of unity.)

c.) A 1500 W electric heater that operates on 117 V, 60 Hz AC? (The power factor is unity.)

d.) A 1500 W range-top burner for a residential kitchen cook-stove? The burner operates on 240 V at 60 Hz AC with unity power factor.

e.) A flashlight-bulb that operates on four D-cell batteries in series so that their voltages add together.
Then the entire lamp current flows through each battery, one after the other.
Each battery provides 1.5 V. The lamp draws 300 mA.

f.) A key-chain-fob LED-type flashlight lamp that operates on two lithium coin-style batteries, 3.0 V each, in series so that their voltages add and the lamp current flows through each battery. The LED lamp draws 30 mA.