PHYSICS

ELECTRICAL POWER, SOURCES AND SAFETY

ELECTRICAL POWER AND ENERGY

An "Energy Star" or an "Energuide" label states the amount of electrical energ consumed per month or year by an appliance in normal use (in Canada, every majo appliance has this label).

Power in electrical systems can be calculated using the formula:

P –
V –
I –

Ex: Calculate the power rating for a small colour TV connected to a 120-V circuit and drawing 1.5 A of current.

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SOURCES OF ELECTRICITY

1. **Generators**
   - Interaction with magnets can move electrons.

   - Example:

2. **Chemical**
   - Chemical reactions can move electrons as compounds break down and rebuild

   - Example:

3. **Electromagnetic Radiation (light)**
   - Energy from the Sun in the form of photons can excite electrons giving them the energy to move.

   - Example:

4. **Pressure**
   - Putting physical force on certain materials will cause the movement of electrons

   - Example:

5. **Heat**
   - Heating two different metals that are attached will cause electrons to move.

   - Example:

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ENERGY COSTS

The cost of electrical energy can be found using the formula:

Where ΔE - Energy (MJ or kWh)

**Note:* ΔE *can be found by rearranging the formula:*

Ex 2. A TV rated at 220 W is turned on for 4.5 h. Calculate:

a) *The energy consumed*

b) *The cost of the energy consumed using a typical rate of 8.9¢/kWh*

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ELECTRICAL SAFETY

Current (A, AC)	Current (A, DC)	Reaction
0.0004	0.001	Slight Sensation
0.009	0.05	Shock
0.02	0.07	Muscles Paralyzed
0.1	0.5	Fibrillation and Death

Moisture greatly affects the amount of current that passes though a human body.

	Resistance (Ω)	Voltage (V)	Current (A)
Dry Skin	1 000 000	120	0.00012
Wet Skin	1 500	120	0.08
In Bath	500	120	0.24

Overloaded Circuit:

Circuit breakers and fuses protect electrical circuits from overloading when the current becomes too high.

http://www.youtube.com/watch?v=SU7xkYmWwmQ

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Power

1. What is the voltage across a 1250 W baseboard heater that draws 5.2A?
2. If a 700 W toaster and an 1100 W kettle are plugged into the same 120 V outlet in parallel, what total current will they draw?
3. What is the maximum power that may be used in a circuit with a voltage of 120 V and a 20 A fuse?
4. A portable heater is plugged into a 120 V outlet and draws a current of 8.0 A for 10 min. Calculate each of the following:
   - **a)** the quantity of electric charge that flows through the heater.
   - **b)** the energy consumed by the heater.
   - **c)** the power dissipated by the heater.

The Cost of Electricity

1. Find the cost of operating an electric toaster for 3.0 h if it draws 5.0 A from a 120 V outlet. Electric energy costs 5.5 ¢/kW·h.
2. What is the cost to a storekeeper of leaving a 40 W light burning over the weekend, for 60 h, if electricity costs 5.5 ¢/kW·h?
3. The blower moter on a furnace, rated 250 W, comes on, for an average of 5.0 min at a time, a total of 48 times per day. What is the monthly (30 d) cost of operating the motor if electricity costs 5.5 ¢/kW·h?
4. The following appliances were operated for a 30 day month, in a 120 V circuit: a coffee maker with a resistance of 15 Ω for 0.5 h/d, a 250 W electric drill for 2.0 h/d, and a toaster that draws 5.0 A for 15 min/d. Calculate the electric bill for the month at an average cost of 5.5 ¢/kW·h.