

Chapter 3 Electrical Power and Energy

Some Use of Electricity



- Electricity can be used in some daily life (transportation, light, heat, etc).
- Some peoples use electricity and some peoples doesn't use electricity in their daily life
- It means electricity is essential in modern life (right now).
- Electricity is a serious workplace hazard
- Electricity can be productive and safe

It has to be remembered that

- Energy is conserve.
 - Energy is not able to be created and destroyed, but it can be transformed into the others energy.
- Momentum and charge are conserve.
- Light speed has the same speed in every inertial reference frame works.

Electrical Energy



Recall for

1. Ohm's Law

$$V = IR$$

2. Potential difference as a the amount of energy for every charge, and it can be written as a

$$V = \frac{W}{q}$$

3. Electric current as a movement of the charges for every time

$$I = \frac{q}{t}$$

4. Electrical energy can be written by

- $W = qV$
- $W = Vit$
- $W = qIR$
- $W = \frac{q^2 R}{t}$

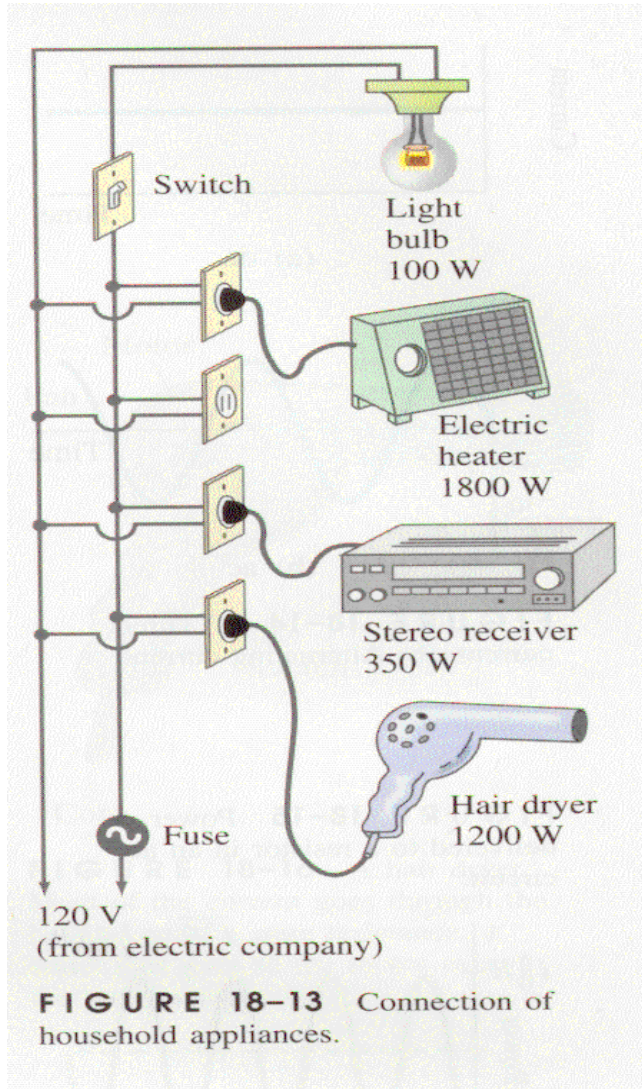
$W \equiv$ energy in joule (J)

$q \equiv$ charge in coulomb (C)

$I \equiv$ electric current in ampere (A)

$t \equiv$ time in second (S)

Electrical Power



- Electrical energy is the amount of energy per unit of time.

$$P = \frac{W}{t}$$

- $P \equiv$ power in watt (W or Js^{-1})
 - Energy is needed for the process in daily life.
 - Energy is taken up for the system of circulation.
- 100 W is written on the light bulb. It means: bulb needs the amount of energy 100 joule for every second to change the electrical energy to be light or heat energy.
- Work is required to transfer charge through an electric circuit. The work required depends on the amount of charge transferred through the circuit and the potential difference between the terminals of the battery: $W = QV$.
 - The rate at which work is done to maintain an electric current in a circuit is termed **ELECTRIC POWER**

Calculating the Cost of Electricity Consumption

Paijo has some electricity equipments in his house. He is businessman of electronic equipment and he is rich man in one of real estate in Tangerang. In his house, he has;



a television set of power 350 W is switched on every day for 12 hours,



a radio set of power 15 watt is switched on every day for 10 hours,



a refrigerator set of power 350 watt is switched on every day for 18 hours,



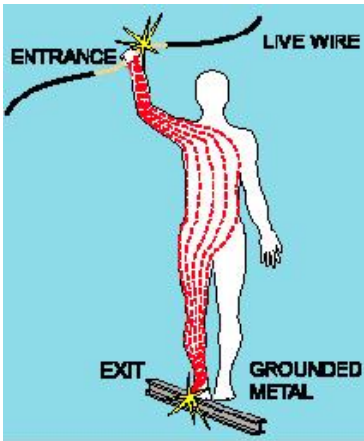
a water pump set of power 250 watt is switched on every day for 4 hours,



a washing machine set of power 500 watt is switched on every day for 5 hours

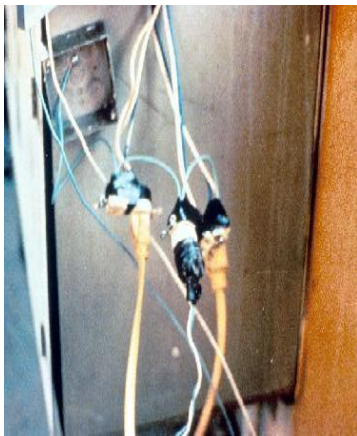
The question: What is the monthly (30 days) cost of electricity if one unit (1 kWh) costs IDR 180 and monthly customers cost of electricity is IDR 3500?

Dangers of Electricity



- Electrical Shock.
 - ✓ An electrical shock is received when electrical current passes through the body.
 - ✓ You will get an electrical shock if a part of your body completes an electrical circuit by:
 - Touching a live wire and an electrical ground, or
 - Touching a live wire and another wire at a different voltage.
- Severity of the shock depends on:
 - Path of current through the body.
 - Amount of current flowing through the body (amps).
 - Duration of the shocking current through the body.

LOW VOLTAGE DOES NOT MEAN LOW HAZARD



- Electrical Hazards.

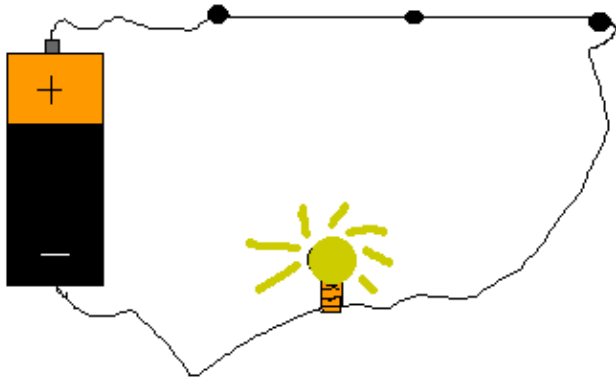
Electrical accidents are caused by a combination of three factors:

 - Unsafe equipment and/or installation.
 - Workplaces made unsafe by the environment.
 - Unsafe work practices.

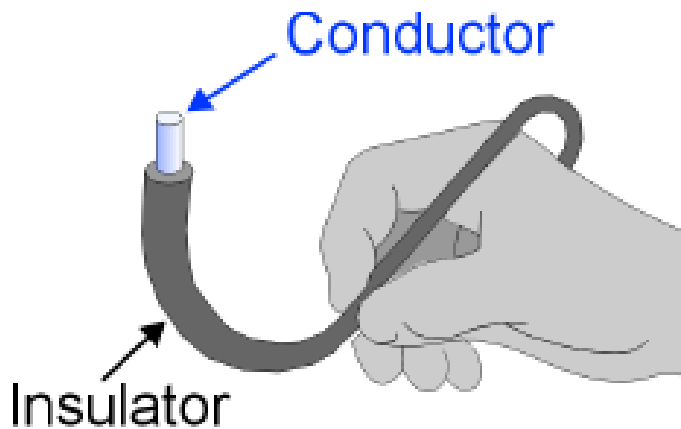


- Overheating.
 - Hazards may result from:
 - Too many devices plugged into a circuit, causing heated wires and possibly a fire.
 - Damaged tools overheating.
 - Lack of over current protection.

Safe Uses of Electricity at Home



- Don't pull cords. Why?
- Don't put metal in an electrical appliance. Why?



1. Insulation

- Parts of electrical equipment coated with a low-conductive material
- Insulators do not allow any current to pass through them.
- These protect us from the harm that electric current can cause.
- Wires are always covered with an insulator.
- Rubber, plastic, and glass make the best insulators.

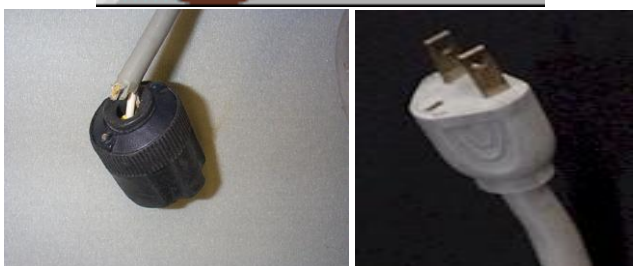
2. Grounding

- Protects from shock
- Safeguards against fire
- Protects against damage to electrical equipment



- System Grounding
 - One conductor of the circuit is intentionally connected to earth
 - Protects against high voltage contact
 - Stabilizes voltage in a system
- Equipment Grounding
 - Equipment grounded by a permanent and continuous connection or bond
 - Provides a path for dangerous fault current to return to system ground
 - Enables protective devices to operate

- Grounding creates a low resistance path from a tool to the earth to disperse unwanted current.
- When a short circuit occurs, energy flows to the ground, protecting you from electrical shock, injury and death.
- Tools plugged into improperly grounded circuits may become energized.
- Broken wire or plug on extension cord.
- Some of the most frequently violated OSHA standards.





3. Circuit Breakers

- Guard against overloads of current
- Ensure current flow does not produce heat that causes temperature to rise to dangerous levels
- Break the current path
- Type of circuit breakers: thermal (bimetal strip) and magnetic

4. Fuses

- Guard against overloads of current
- Ensure current flow does not produce heat that causes temperature to rise to dangerous levels
- Break the current path
- Melt when current exceeds a designated value
- A fuse protects a circuit from too much electric current from passing through.
- Fuses contain a thin wire and if too much electricity flows through the wire, it heats up and melts.

