

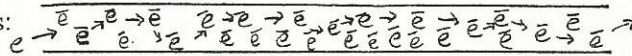
Conductors, Insulators, Semi-Conductors, and Resistive Conductors

PSC-4011

Conductors:

- are substances that conduct electricity.
- All metals are conductors, but Cu, Al, and Ag are among the best.
- Wiring in homes is mostly Cu (strong/durable, but expensive compared to Al).
- High-tension wires, which transport electricity over long distances are made of Al (lighter and cheaper than Cu).
- Lightning conductors/rods are made of Al or Cu.

Concerning the internal structure of conductors:



- The outer electrons of the metal atoms form a “community” and move freely, no longer belonging to any specific atom. There are lots of free floating electrons down the length of the conductor. Therefore, if electricity is pumped through, the electrons being pumped in move along and displace those already there.

Insulators:

- are substances that don't conduct electricity. e.g. glass, mica, porcelain, paper, air, rubber, and plastic.
- Flexible insulators (like rubber and plastic) are used as sheathing (covering) around wires to prevent electricity from “jumping” out of the wire.
- Plastic and porcelain are used for casings for electrical appliances equipped with two-pronged plugs.
- High voltage lines are covered with plastic or porcelain.

Concerning the internal structure of insulators:

- They don't have the “community” of electrons. The electrons are tightly bound to their atoms and resist being moved away from their atoms.

Semi-Conductors:

- are mid-way between conductors and insulators. e.g. Si and Ge
- These are used in electronic components (e.g. transistors, which act as switches or amplifiers, and diodes, ultra-fast automatic switches).

Resistive Conductors:

- are conductors, but their resistance is higher than other conductors, so lots of heat is generated when electrons move through.
- e.g. tungsten (W) is the resistive conductor that makes up a light bulb filament (heat and light are generated when electrons move through tungsten).
- e.g. nichrome is used in heating elements of electric stoves.

Select, from the list, the material or materials suitable for each of the following tasks.
Explain your choice:

- | | | |
|-------------|-------------|--------------|
| A) Aluminum | B) Copper | C) Germanium |
| D) Nichrome | E) Plastic | F) Porcelain |
| G) Silicon | H) Tungsten | |

a) Manufacture of insulators for high-voltage lines.

Material(s):

Reason(s):

b) Manufacture of heating elements for electric stoves:

Material(s):

Reason(s):

c) Manufacture of diodes and transistors:

Material(s):

Reason(s):

d) Manufacture of filaments for light bulbs:

Material(s):

Reason(s):

e) Manufacture of sheathing for certain types of electric wiring:

Material(s):

Reason(s):

f) Manufacture of electronic components:

Material(s):

Reason(s):

g) Manufacture of casings for electrical appliances equipped with two-pronged plugs:

Material(s):

Reason(s):

h) Manufacture of lightning conductors:

Material(s):

Reason(s):

Select, from the list, the material or materials suitable for each of the following tasks.
Explain your choice:

- | | | |
|-------------|-------------|--------------|
| A) Aluminum | B) Copper | C) Germanium |
| D) Nichrome | E) Plastic | F) Porcelain |
| G) Silicon | H) Tungsten | |

a) Manufacture of insulators for high-voltage lines.

Material(s): Plastic + porcelain

Reason(s): insulators

b) Manufacture of heating elements for electric stoves:

Material(s): nichrome

Reason(s): resistive conductor

c) Manufacture of diodes and transistors:

Material(s): germanium + silicon

Reason(s): semiconductors

d) Manufacture of filaments for light bulbs:

Material(s): tungsten

Reason(s): resistive conductor

e) Manufacture of sheathing for certain types of electric wiring:

Material(s): plastic (+ rubber)

Reason(s): insulators

f) Manufacture of electronic components:

Material(s): germanium + silicon

Reason(s): semiconductors

g) Manufacture of casings for electrical appliances equipped with two-pronged plugs:

Material(s): plastic + porcelain

Reason(s): insulators

h) Manufacture of lightning conductors:

Material(s): aluminum + copper

Reason(s): conductors