

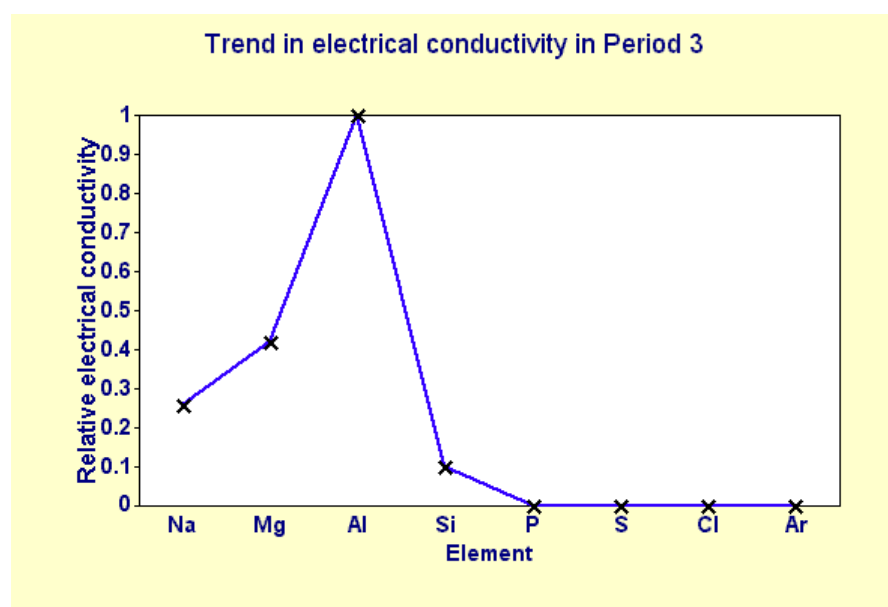
Trends in electrical conductivity of Period 3 elements

Electrical conductivity increases going across Period 3 from sodium to aluminium, then decreases to silicon. The remaining elements have negligible conductivity.

Table of physical data

Element	Proton number	Symbol	Relative electrical conductivity (Al = 1)
sodium	11	Na	0.26
magnesium	12	Mg	0.42
aluminium	13	Al	1.00
silicon	14	Si	0.10
phosphorus	15	P	0
sulphur	16	S	0
chlorine	17	Cl	0
argon	18	Ar	0

Graph of physical data



Explanation of these trends

For an element to conduct electricity, it must contain electrons that are free to move. In general, metals are good conductors of electricity and non-metals are poor conductors of electricity.

Sodium, magnesium and aluminium

Sodium, magnesium and aluminium are all metals. They have metallic bonding, in which positive metal ions are attracted to delocalised electrons. The delocalised electrons are free to move and carry charge. Going from sodium to aluminium:

- the number of delocalised electrons increases ...
- there are more electrons which can move and carry charge ...
- so the electrical conductivity increases.

Silicon

Silicon is a metalloid (an element with some of the properties of metals and some of the properties of non-metals). Silicon has giant covalent bonding. It has a giant lattice structure similar to that of diamond, in which each silicon atom is covalently-bonded to four other silicon atoms in a tetrahedral arrangement. This extends in three dimensions to form a giant molecule or macromolecule.

Silicon is called a semiconductor because:

- the four outer electrons in each atom are held strongly in covalent bonds ...
- at room temperature few electrons have enough energy to enter the higher energy levels ...
- so there are few delocalised electrons and silicon is a poor conductor ... but ...
- at higher temperatures more electrons are promoted to the higher energy levels ...
- so there are more delocalised electrons to move and carry charge.

Non-metals

The remaining elements in Period 3 do not conduct electricity:

- in phosphorus, sulphur and chlorine, the outer electrons are not free to move and carry charge because they are held strongly in covalent bonds ...
- in argon (which exists as single atoms) the outer electrons are not free to move and carry charge because they are held strongly in a stable third energy level.