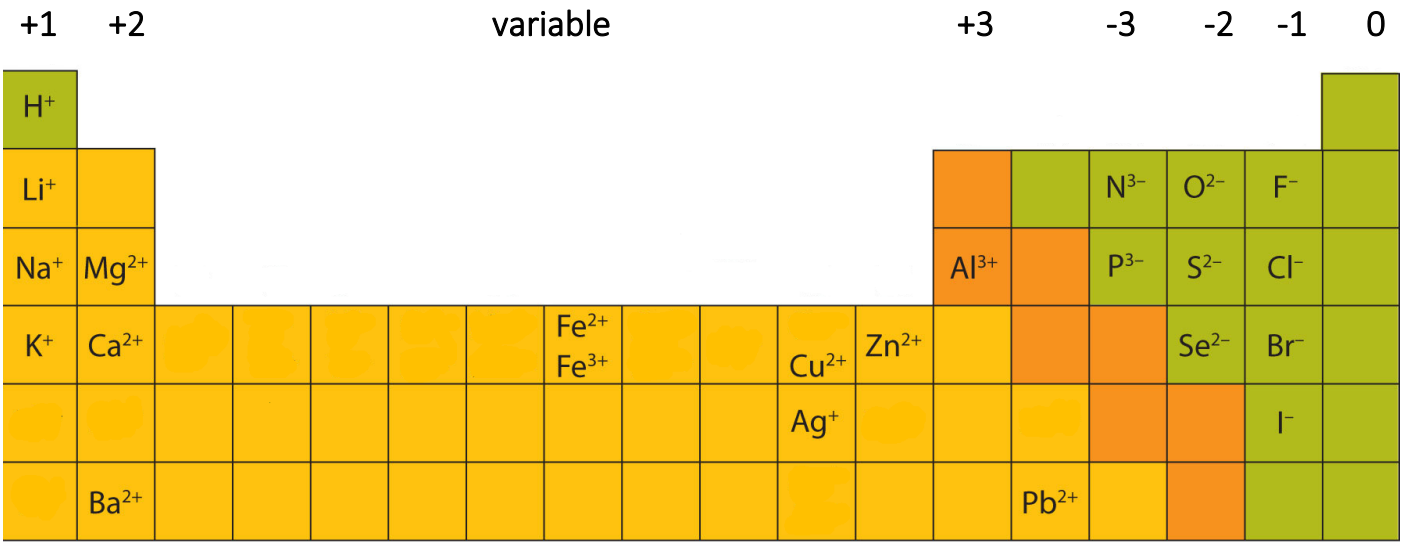
Acids and Bases

Problem You want to tell the difference between an atom and an ion.

Solution Look to see if the formula has an electric charge on it.



Trends for ionic charge

- Al is an **atom**; it has no overall electrical charge. Al^{3+} is an **ion**; it has a +3 overall electrical charge
- Cl^- is an **ion**; it has a -1 overall electrical charge. Cl is an **atom**; it has no overall electrical charge.

Discussion

- Atoms are electrically neutral. (They have no overall electrical charge).
- This is because they have the same number of protons in the nucleus as electrons found in all the electron shells.
- Ions have an electrical charge – this is because they have different numbers of protons and electrons
- Ions with more protons than electrons will have a positive charge.
- Ions with more electrons than protons will have a negative charge.
- Every proton in the nucleus has a positive (+) charge.
- Every electron in an electron shell has a negative (-) charge.
- Metal atoms form positive ions by losing electrons from the outer (valence) shell.
- Non-metal atoms (but not group 18 elements, the noble gases) form negative ions by gaining electrons to fill the outer (valence) shell.
- Some groups of atoms lose or gain electrons to form ions e.g. SO_4^{2-}. You will not be expected to explain the charge on these type of ions.

Worked Example

Which of the following are examples atoms and which are ions?

O K^+ Br^- Ne H^+ H NH_4^+ Mg^{2+} Mg O^{2-}

Atoms	Ions with a positive charge	Ions with a negative change
O Ne H Mg	K^+ H^+ NH_4^+ Mg^{2+}	Br^- O^{2-}

Questions to try yourself

Which of the following are examples atoms and which are ions?

N CO_3^{2-} F Ca Ba^{2+} OH^- SO_4^{2-} Al S S^{2-}

Atoms	Ions with a positive charge	Ions with a negative change

Is Ca^{2+} an atom or ion? Why?

Is Na an atom or ion? Why?

Explain how many protons and electrons a Mg^{2+} ion has. (The atom Mg has an atomic number of 12).

Answers

Which of the following are examples atoms and which are ions?

N CO_3^{2-} F Ca OH^- SO_4^{2-} Al S S^{2-}

Atoms	Ions with a positive charge	Ions with a negative change
N F Ca Al S	Ba^{2+}	CO_3^{2-} OH^- S^{2-}

Is Ca^{2+} an atom or ion? Why?

Ca^{2+} is an ion because it has a +2 electrical charge. It has 2 more protons than it has electrons.

Is Na an atom or ion? Why?

Na is an atom because it has a ZERO electrical charge. It has the same number of positively charged protons as it has negatively charged electrons.

Explain how many protons and electrons a Mg^{2+} ion has. (The atom Mg has an atomic number of 12).

The Mg^{2+} ion has 12 protons but only 10 electrons. It has lost 2 electrons from its valence shell which gives it an overall charge (net charge) of +2.

Extra! It is good to give electron arrangements in your answer – this will be covered in more detail in another sheet.

The Mg atom (atomic number 12) has an electron arrangement 2, 8, 2 It has 12 protons and 12 electrons.

It loses the 2 valence electrons. The ion Mg^{2+} has 12 (positively charged) protons and only 10 (negatively charged) electrons, giving it an overall (net) charge of +2. The ion has an electron arrangement of 2.8