Yesterday’s Homework

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Ions

SNC2D

"You've lost an electron? Are you sure you're all right?"
"I'm positive."
The Why of Ions

Atoms are most stable (and therefore happy) when they have 8 electrons in the outer shell.
The Why of Ions

Atoms are most stable (and therefore happy) when they have full outer shells.
The How of Ions

Atoms that have fewer electrons in their outer shells than it would take to fill that shell will preferentially lose electrons.
The How of Ions

E.g. Sodium has 1 valence electron. It would need to gain 7 to fill that shell. So it loses 1 instead. It now has fewer shells, but the last one is full.
The How of Ions

Because sodium has lost a negatively-charged electron, it now has a ?
The How of Ions

Because sodium has lost a negatively-charged electron, it now has a positive charge. Positively-charged ions are called **cations**.

![Sodium atom and ion diagrams](image)
The How of Ions

The elements that form positively-charged ions are **metals**.
Valence Charge

The charge on an ion is said to be its valence charge, or simply valence.

E.g. The valence of sodium is ?
Valence Charge

The charge on an ion is said to be its valence charge, or simply valence.

E.g. The valence of sodium is +1 or 1+.

Let’s look at some more metal ions. . . .
Valence Practice

Given the following Bohr diagrams, what will the valence of the ions be?

Magnesium atom,
Mg 2,8,2
Valence Practice

Given the following Bohr diagrams, what will the valence of the ions be?

- Magnesium atom, Mg 2,8,2
- Magnesium ion, Mg^{2+} [2,8]^{2+}
Valence Practice

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calium atom,
Ca  2,8,8,2
Valence Practice

Given the following Bohr diagrams, what will the valence of the ions be?

calcium atom, Ca 2,8,8,2

calcium ion, Ca\(^{2+}\) \([2,8,8]\)^{2+}\)
Valence Charge

Note that sodium and lithium, both in the 1\textsuperscript{st} column, have a valence of 1+.
And magnesium and calcium, both in the 2\textsuperscript{nd} column, have a valence of 2+.
Since elements in the same column or family on the periodic table have the same number of \_?
Valence Charge

Note that sodium and lithium, both in the 1\textsuperscript{st} column, have a valence of 1+.
And magnesium and calcium, both in the 2\textsuperscript{nd} column, have a valence of 2+.
Since elements in the same column or family on the periodic table have the same number of valence electrons, they will typically form ions in the same way and have the same valence charge.
Valence Charge

Some metals can form ions in two different ways and have two possible valences; these metals are said to be ?
Valence Charge

Some metals can form ions in two different ways and have two possible valences; these metals are said to be **multivalent**.

E.g. the valence of lead is ?
Valence Charge

Some metals can form ions in two different ways and have two possible valences; these metals are said to be multivalent.
E.g. the valence of lead is 2+ or 4+.

To indicate which ion we are dealing with, we write the valence charge in Roman numerals after the name of the metal.
E.g. lead (?) or lead (?)
Valence Charge

Some metals can form ions in two different ways and have two possible valences; these metals are said to be multivalent.

E.g. the valence of lead is 2+ or 4+.

To indicate which ion we are dealing with, we write the valence charge in Roman numerals after the name of the metal.

E.g. lead (II) or lead (II)
Valence Charge

Some metals can form ions in two different ways and have two possible valences; these metals are said to be multivalent. E.g. the valence of lead is 2+ or 4+.

To indicate which ion we are dealing with, we write the valence charge in Roman numerals after the name of the metal. E.g. lead (II) or lead (IV)
The How of Ions

Atoms that have more electrons in their outer shells than it would take to fill that shell will preferentially *gain* electrons.
The How of Ions

E.g. Chlorine has 7 valence electrons. It would need to gain 1 to fill that shell. So it just gains 1 (that was given up by a metal).

chlorine atom, Cl 2,8,7  
chloride ion, Cl⁻ [2,8,8]⁻
The How of Ions

Because chlorine has gained a negatively-charged electron, it now has a negative charge.

Negatively-charged ions are called **anions**.
The How of Ions

The elements that form negatively-charged ions are non-metals.

chlorine atom, Cl  2,8,7
chloride ion, Cl\(^{-}\)  [2,8,8\(^{-}\)]
The How of Ions

Non-metals, when they form ions, change their names to:

the first syllable + the suffix “ide”

chlorine atom, Cl  2,8,7

chloride ion, Cl\(^-\) [2,8,8\(^-\)]
Anion names

chlorine
fluorine
bromine
oxygen
sulphur
nitrogen
phosphorus
Anion names

- chlorine
- fluorine
- bromine
- oxygen
- sulphur
- nitrogen
- phosphorus

chlorine → chloride
Anion names

chlorine
fluorine
bromine
oxygen
sulphur
nitrogen
phosphorus

chloride
fluoride
Anion names

chlorine  →  chloride
fluorine  →  fluoride
bromine   →  bromide
oxygen
sulphur
nitrogen
phosphorus
Anion names

- chlorine
- fluoride
- bromine
- bromide
- oxygen
- oxide
- sulphur
- nitrogen
- phosphorus

- chloride
- fluoride
- bromide
- oxide
Anion names

chlorine → chloride
fluorine → fluoride
bromine → bromide
oxygen → oxide
sulphur → sulphide
nitrogen
phosphorus
Anion names

- chlorine → chloride
- fluorine → fluoride
- bromine → bromide
- oxygen → oxide
- sulphur → sulphide
- nitrogen → nitride
- phosphorus
Anion names

- chlorine → chloride
- fluorine → fluoride
- bromine → bromide
- oxygen → oxide
- sulphur → sulphide
- nitrogen → nitride
- phosphorus → phosphide
Valence Practice

Given the following Bohr diagram, what will the valence of the ion be?

![Bohr diagram of an oxygen atom with 2,6 electrons]
Valence Practice

Given the following Bohr diagram, what will the valence of the ion be?

- Oxygen atom, \( \text{O} \rightarrow 2,6 \)
- Oxide ion, \( \text{O}^{2-} \rightarrow [2,8]^{2-} \)
Tune in next time

Tomorrow we will discuss binary ionic compounds.

“Perhaps one of you gentlemen would mind telling me just what it is outside the window that you find so attractive...?”