12 Stoichiometry

Stoichiometry: Balancing equations

Now whoever came up with a word like stoichiometry (pronounced 'stoy-key-om-e-tree')! It was the Greeks. *Stoicheion* means a first principle, or element, while *metry* refers to the science of measuring. Elements combine together in different ways and proportions, so chemists must be able to calculate how much of each element is required to perform their experiments.

Reading chemical equations is not difficult when you know the rules. The *reactants*, or substances being used in the experiment, are combined to form a *product*. Arrows indicate if the procedure is reversible. A single arrow pointing from reactants to products means it is a one-way reaction. A double set of arrows, pointing both ways, indicates a reversible reaction.

It is important to remember that the number of atoms of each substance on the reactant side of the equation (the left side) must equal the number of atoms in the product (the right side).

Example: Sodium plus water combines to form sodium hydroxide and hydrogen gas.

$2\ Na + 2\ H_2O \longrightarrow 2\ NaOH + H_{2(g)}$

(reactants) *(one-way reaction)* *(products)*

Although the atoms have become rearranged, there are still 2 sodium (Na), 4 hydrogen (H) and 2 oxygen (O) atoms present on each side of the equation. In the example above H_2 means two atoms of hydrogen together. The number 2 in front of H_2 means there are two such molecules, hence, 2 x 2 = 4 hydrogen atoms. The 2 also applies to the oxygen in the H_2O so there are 2 oxygen atoms as well. If no number is present, assume the number one (1).

Balance the equations, some have been started for you. (Hint! Balance the metals first.)

1	Cu	+	S	$\longrightarrow$	CuS			
2	$2\ H_2$	+	O_2	$\longrightarrow$	H_2O			
3	Mg	+	Cl_2	$\longrightarrow$	$MgCl_2$			
4	Mg	+	O_2	$\longrightarrow$	MgO			
5	KOH	+	CO_2	$\longrightarrow$	K_2CO_3	+	H_2O	
6	NO_2	+	H_2O	$\longrightarrow$	HNO_3	+	HNO_2	
7	NO	+	O_2	$\longrightarrow$	$2\ NO_2$			
8	Al	+	O_2	$\longrightarrow$	Al_2O_3			
9	Al_2O_3	+	$6\ HCl$	$\longrightarrow$	$AlCl_3$	+	H_2O	

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Take care with chemical symbols!

Upper case (capital) letters are always used for the first letter of the chemical symbol representing an element. Lower case letters are part of the name of an element as symbolised on the Periodic Table. It is important not to use upper case letters incorrectly. Take care writing symbols. Carelessness not only ruins your work, in a lab it is dangerous!

Consider Cu and CU: Cu represents the element copper; CU represents carbon (C) and uranium (U).

10 Explain the differences between the symbols below. What does each pair mean?

Pb _____ Ni _____

PB _____ NI _____

PO _____ Cf _____

Po _____ CF _____

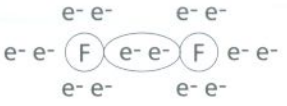
NB _____ Ho _____

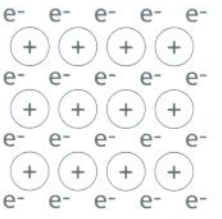
Nb _____ HO _____

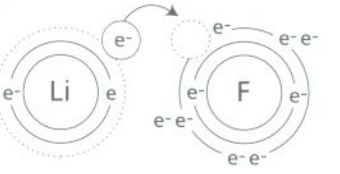
Chemical bonding

Depending on the substance, one of three types of bonding occurs. *Ionic bonding* occurs when an atom surrenders its electron to another atom. One atom, usually with three or less electrons in its outer shell, finds it easier to give up a few rather than find many. *Covalent bonding* occurs when atoms share electrons rather than give them up or accept them. *Metallic bonding* occurs only in metals. In the same way water flows over, under and around a swimmer, a 'pool' of valence electrons flows around the atoms of solid metals. This occurs because metal atoms are arranged in an organised series of positive ions.

11 Label the bond diagrams: Ionic, covalent or metallic







_____ _____ _____

Sentence jumble

Reassemble the sentences so they make sense. The first word is capitalised.

12 occurs an when atom gains Ionic bonding or loses electrons

_____

13 equally covalent bonding When share electrons atoms occurs

_____

14 metals around metal atoms negatively charged pool electrons of solid The valence create a

_____

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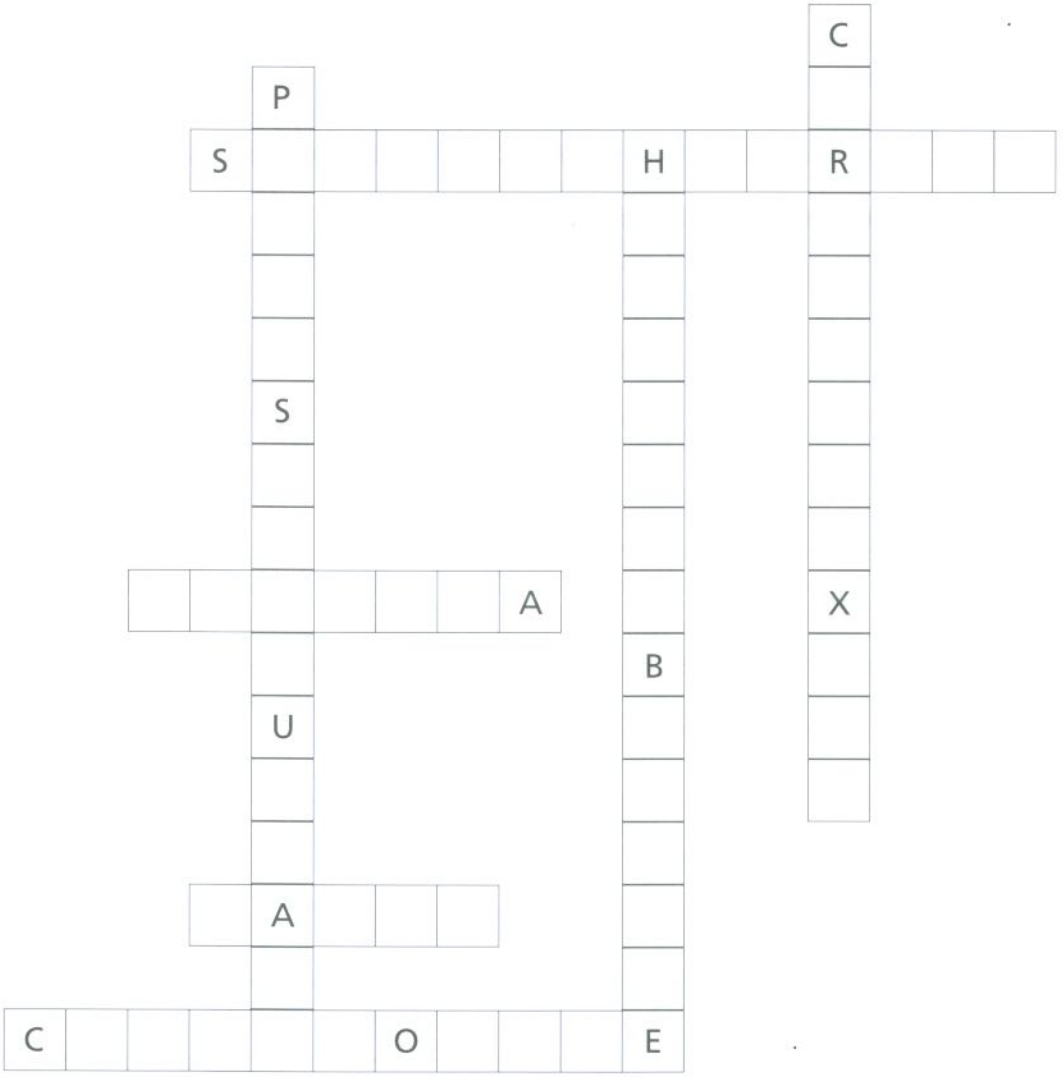
13 Chemistry Puzzle

1 Complete the puzzle.

Bonds involving shared electrons	C _____
Gas lighter than air	H _____
Described on the Periodic Table	E _____
Bonding by a pool of electrons	M _____
Bonding where an electron is lost from one atom and gained by another	I _____
Homogeneous liquid mixture	S _____
Process used to determine the concentration of a solution	T _____
Substance undergoing a reaction	R _____
Element with 39 protons	Y _____

2 Write the full names for the chemical abbreviations in the grid below.

NaCl NH_3 CO_2 HBr K_2SO_4 CuO H_2O



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