

CHEMISTRY 135

REVISION OF NAMES, FORMULAE AND EQUATIONS

Answer the following questions as if you were going to hand them in for marking. You will be tested on them in class time.

- 1) Give the correct chemical symbol or formula as appropriate for each of the following substances.
- | | | |
|----------------------|-----------------------|-----------------------|
| a) sodium metal | j) tetraphosphorus | r) magnesium chloride |
| b) helium gas | hexoxide | s) iron(II) oxide |
| c) silicon | k) copper(I) chloride | t) boron trichloride |
| d) zinc metal | l) carbon monoxide* | u) ammonium sulphate |
| e) chlorine gas | m) lithium hydroxide | v) hydrochloric acid |
| f) fluorine gas | n) nitric acid | w) nitrogen monoxide* |
| g) copper(II) oxide | o) iron(III) sulphate | x) sulphuric acid |
| h) sulphur trioxide* | p) potassium sulphate | y) calcium |
| i) nitrogen dioxide* | q) potassium nitrate | hydrogencarbonate |

* Formulae marked in this way do not obey the normal rules of valency.

- 2) Write the empirical formula for each of the following compounds.
- | | | |
|--------------|----------------|-------------|
| a) C_6H_6 | c) $C_2H_4O_2$ | e) H_2O_2 |
| b) C_2H_6O | d) N_2O_4 | f) H_2O |
- 3) W, X, Y and Z are used here to represent elements from groups I, II, IV and VI (respectively) in the periodic table. Give the most probable formula (in terms of W, X, Y and Z) and state the likely bonding type of each of the following compounds. List the likely physical properties of each.
- A compound between X and Z.
 - A compound between Y and Z.
 - A compound between W and Z.
- 4) Give the chemical names of each of the following compounds.
- | | | |
|------------------|-----------------|-----------------|
| a) Na_2CO_3 | f) PbO_2 | k) $CuCl$ |
| b) Al_2S_3 | g) $CuSO_4$ | l) $MgCl_2$ |
| c) $Ca(HSO_4)_2$ | h) Na_2SO_4 | m) MgO |
| d) $CuCl_2$ | i) $NaNO_3$ | n) $Zn(NO_3)_2$ |
| e) H_2SO_4 | j) $Al(NO_3)_3$ | o) $NaHCO_3$ |

- 5) Imagine that X and Y are the symbols of elements. Given the valencies of X and Y suggested below, write the most probable formula of the compound they would form in each case. Two answers are given as examples.

VALENCY OF X		1	2	3	4	5	6
VALENCY OF Y	1	XY					
	2			X_2Y_3			
	3						
	4						
	5						
	6						
	7						

- 6) a) What is an ion? How are ions formed? What special names are given to ions with (i) a negative charge, and (ii) a positive charge?
- b) Write formulae (including charges) for each of the following ions:
- | | | | |
|-------------------------|-------------------|----------------|----------------------|
| i) sodium | ii) chloride | iii) magnesium | iv) aluminium |
| v) fluoride | vi) iodide | vii) oxide | viii) sulfide |
| ix) nitrate | x) ammonium | xi) calcium | xii) sulfate |
| xiii) carbonate | xiv) hydroxide | xv) sulfite | xvi) hydrogensulfate |
| xvii) hydrogencarbonate | xviii) copper(II) | xix) iron(II) | |
| xx) iron(III) | xxi) lead(II) | | |
- c) Ionic compounds normally contain two types of ions: one positive and the other negative. For example potassium sulfate contains potassium ions and sulfate ions. Its ionic formula is $(K^+)_2SO_4^{2-}$. The number of each type of ion shown in the formula is such that the total charge on the formula is zero. For example, in the above formula there are two potassium ions, each with one positive charge, and one sulfate ion with two negative charges. Hence the total charge is given by $(2 \times +1) + (1 \times -2) = 0$. Using this principle write the formula of all the compounds that might be formed between pairs of the ions listed in part (b) of this question. There are 108 of them and most can be prepared as pure solids.
- d) i) Pick out all the compounds of question (1) above which are likely to be ionic and write an ionic formula for each one. Careful use of brackets is essential. Almost all ionic compounds are compounds of a metal in a low oxidation state with a non-metal. The only notable exceptions are the ammonium salts. The ammonium ion is often referred to as a *metallic group*.
- ii) Decide which of the compounds in question (4) above are likely to be soluble in water and write an equation in each case showing how the compound splits into separate ions when it dissolves. For example, sodium carbonate is soluble in water (all sodium salts are soluble). Hence you would write:



7) Various chemical reactions are outlined below. Rewrite them in balanced form.

- a) $\text{H}_2 + \text{Cl}_2 \rightarrow \text{HCl}$
- b) $\text{Mg} + \text{O}_2 \rightarrow \text{MgO}$
- c) $\text{H}_2\text{O} + \text{F}_2 \rightarrow \text{O}_2 + \text{HF}$
- d) $\text{Fe} + \text{HCl} \rightarrow \text{FeCl}_2 + \text{H}_2$
- e) $\text{AgNO}_3 + \text{FeCl}_3 \rightarrow \text{AgCl} + \text{Fe}(\text{NO}_3)_3$

8) In each of the following cases the reactants and products of a chemical reaction are given. Write a balanced chemical equation in each case. It is essential to decide on the correct formula of each reactant and each product before attempting to balance the equation. Include states.

	REACTANTS	PRODUCTS
a)	lead(II) oxide and hydrogen gas	water and lead metal
b)	Sodium metal and oxygen gas	sodium oxide
c)	Silicon and oxygen gas	silicon dioxide
d)	Zinc metal and dilute sulphuric acid	Zinc sulphate and hydrogen gas
e)	carbon and steam	carbon dioxide and hydrogen gas
f)	Phosphorus and chlorine gas	phosphorus trichloride
g)	aluminium metal and iron(II) oxide	aluminium oxide and iron metal
h)	calcium hydroxide and hydrochloric acid	water and calcium chloride
i)	iron(III) nitrate and nitrogen dioxide	iron(III) oxide, oxygen gas
j)	lithium metal and water	lithium hydroxide and hydrogen gas

- 9) Write a balanced chemical equation to describe each of the following reactions. As before you must decide on the formulae of the reactants and the products before attempting to balance the equation, but in this question not all the reactants and products will be mentioned. If you get stuck look for them in your practical schedules or your textbook.
- The combustion of carbon.
 - The reaction between magnesium metal and dilute hydrochloric acid.
 - The reaction between potassium metal and water.
 - The reaction occurring when copper(II) carbonate is heated.
 - The reaction between copper(II) sulphate solution and sodium hydroxide solution.
 - The reaction between silver nitrate solution and barium chloride solution.
 - The reaction between barium chloride solution and sodium sulfate solution.
 - The reaction between solid sodium carbonate and dilute hydrochloric acid.
 - The reaction between sodium hydrogencarbonate and dilute sulfuric acid in solution.
 - The reaction between concentrated sulfuric acid and solid sodium chloride to produce sodium hydrogen sulfate and hydrogen chloride.
 - The reaction occurring when lead(II) nitrate is heated.
 - The reaction occurring when a mixture of potassium carbonate and copper(II) carbonate is heated.
 - The two reactions occurring when sodium hydroxide solution is slowly added to zinc sulfate solution until the sodium hydroxide is in excess.
 - The reaction of copper metal with concentrated nitric acid.
 - The two reactions occurring when ammonia solution is slowly added to copper(II) nitrate solution.
 - The reaction occurring when concentrated ammonia solution is added to the precipitate produced by the reaction of a silver salt with sodium bromide in solution.
- 10) Some of the above reactions in question (9) may be written in ionic form. Rewrite them in this way excluding spectator ions. Note: concentrated acids are covalent, except concentrated hydrochloric acid and concentrated nitric acid (since these are concentrated aqueous solutions).
- 11) Classify each of the reactions of question (9) under one or more of the following headings as appropriate:
- | | | |
|-------------------|---------------------|------------------|
| a) combination | d) dissociation | g) redox |
| b) decomposition | e) association | h) precipitation |
| c) neutralisation | f) partner exchange | i) displacement |
- 12) a) Chemical reactions may be classified as *endothermic* or *exothermic*. Explain the meaning of these terms, making it clear what happens to the temperature of a solution in which each type of reaction was occurs.

- b) The reaction between nitrogen and hydrogen to form ammonia is exothermic. Write a balanced equation for the reaction and indicate that the reaction is exothermic by writing ΔH in the appropriate place.
- c) The formation of nitrogen triiodide from ammonia and iodine in solution is an endothermic reaction. What is the sign of ΔH ? What would happen to the reading on a thermometer dipped into a solution in which ammonia and iodine were reacting.
- d) The temperature in a solution where sulfuric acid is being reacted with sodium hydroxide is observed to rise. Is the reaction exothermic or endothermic. What is the sign of ΔH ?