WJEC Chemistry GCSE

3: Chemical Formulae, Equations and Amounts of Substance

Practice Questions
England Specification

1.

(a) The table below shows information about four ionic compounds.
Complete the table. [3]

Compound	Formula	Elements present
aluminium oxide	Al_2O_3	aluminium and oxygen
calcium chloride	$CaCl_2$	.... and ....
....	CuO	copper and oxygen
magnesium bromide	....	magnesium and bromine

(b) The following diagram represents carbon dioxide, CO_2.

(i) Use the diagram to complete the key. [1]

hydrogen ⊕

carbon ....

chlorine ▨

oxygen ....

(ii) Using the key, draw a diagram that represents a molecule of

I. water, H_2O [1]

II. tetrachloromethane, CCl_4 [1]

6

2.

(a) An unknown alkane, X, was found to contain 9.0 g of carbon and 2.0 g of hydrogen. Calculate the simplest formula for this alkane. [3]

$$A_r(H) = 1 \qquad A_r(C) = 12$$

Simplest formula ....

(b) Calculate the percentage by mass of carbon in butane, an alkane containing four carbon atoms. [2]

$$A_r(H) = 1 \qquad A_r(C) = 12$$

Percentage by mass of carbon = ... %

5

3.

Complete the following table. [3]

Compound	Formula	Names of elements present
lead iodide	PbI_2	lead and iodine
....	NaBr	sodium and bromine
sulfuric acid	H_2SO_4	....
potassium oxide	....	potassium and oxygen

3

4.

Complete the following table. [4]

Name of compound	Formula of positive ion	Formula of negative ion	Formula of compound
ammonium hydroxide	....	OH^-	NH_4OH
lithium sulfate	Li^+	SO_4^{2-}	....
lead nitrate	Pb^{2+}	NO_3^-	....
calcium hydrogencarbonate	Ca^{2+}	....	$Ca(HCO_3)_2$

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5. Seawater is an important raw material from which many different substances can be obtained. The table below shows the concentration (measured in g/kg of seawater) of the most abundant ions found in seawater.

Ion	Concentration (g/kg of seawater)
lithium	0.000174
fluoride	0.0013
sodium	10.77
magnesium	1.29
chloride	19.35
potassium	0.399
calcium	0.412
bromide	0.000067
iodide	0.0000005

Use the information in the table to answer the following questions.

(a) (i) Name the two **most** abundant ions in seawater. [1]

.... and ....

(ii) Give the **chemical formula** of the compound formed from these ions. [1]

....

(b) Both chlorine and iodine were once obtained from seawater. Suggest why it is too expensive to use seawater as a source of iodine. [1]

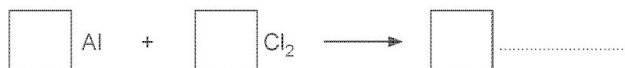..

3	

6. (a) Complete the following table. [3]

Positive ion	Negative ion	Formula
Na^+	Br^-	NaBr
Ba^{2+}	OH^-	....
....	SO_4^{2-}	$Fe_2(SO_4)_3$
K^+	....	K_2HPO_4

(b) Explain how a sodium atom and a bromine atom form ions when they react to make sodium bromide. [2]

....

....

....

5

7. (a) Aluminium reacts with chlorine to form aluminium chloride. Complete and balance the symbol equation for the reaction taking place. [2]

☐ Al + ☐ Cl_2 ⟶ ☐ ....

(b) Aluminium oxide, Al_2O_3, is found in bauxite.

(i) Calculate the relative formula mass (M_r) of aluminium oxide, Al_2O_3. [2]

A_r (Al) = 27 A_r (O) = 16

$M_r (Al_2O_3)$ = ...

(ii) Using your answer from part (i) calculate the percentage of oxygen present in aluminium oxide, Al_2O_3. [1]

Percentage oxygen present = ... %

8. (a) The diagrams below show the electronic structure of a sodium atom and a chlorine atom.
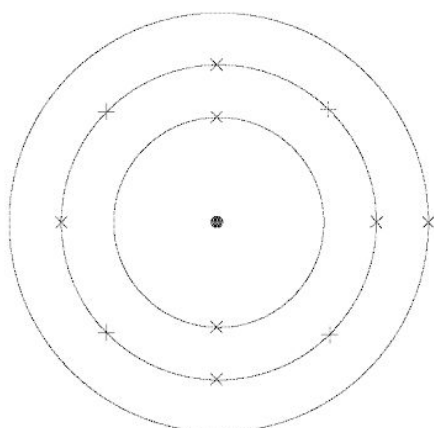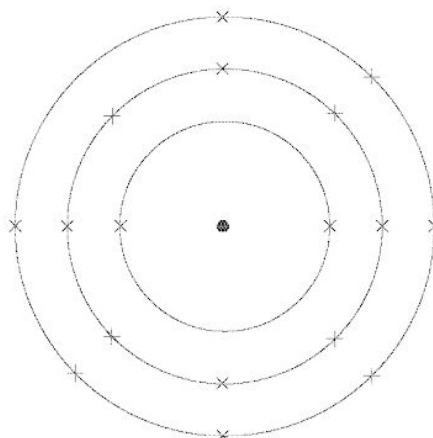
sodium atom   chlorine atom

(i) Give the number of electrons in the outer shell of   [1]

a sodium atom, ...

a chlorine atom.   ....

(ii) Sodium reacts with chlorine to form a white solid.

I   State, in terms of electrons, what happens to sodium and chlorine atoms during this reaction.   [2]

....

....

II   Complete the **word** equation for this reaction.   [1]

sodium + chlorine ⟶ ....

(b) Sodium chlorate, $NaClO_3$, is used to bleach paper.
Calculate the relative formula mass (M_r) of sodium chlorate.   [2]

$$A_r(O) = 16 \qquad A_r(Na) = 23 \qquad A_r(Cl) = 35.5$$

$M_r(NaClO_3) =$ ....

6

9. The table below gives information about the concentration of ions in drinking water from four different locations.

Location	Concentration of ions (mol/m^3 of water)					
	Na^+	NH_4^+	Mg^{2+}	F^-	SO_4^{2-}	NO_3^-
A	3.4	2.1	2.0	2.1	2.5	2.3
B	0.2	0.6	2.7	4.4	0.0	0.1
C	0.0	0.3	0.4	0.4	0.2	0.0
D	0.1	0.4	0.0	0.0	0.4	0.2

(a) (i) Sodium sulfate can be formed from the ions found in water at location **A**. [1]

Write the formula of sodium sulfate. ....

(ii) Suggest the names of **two** compounds that could be formed from the ions present in the water at location **C**. [1]

Compound 1 ....

Compound 2 ....

(b) State the location where you would expect to find the least amount of tooth decay. Give a reason for your choice. [2]

....

....

....

4

10. (a) The following diagrams represent atoms of 5 different elements, A, B, C, D and E.

A, B, C, D and E are not chemical symbols.

A
B
C
D
E
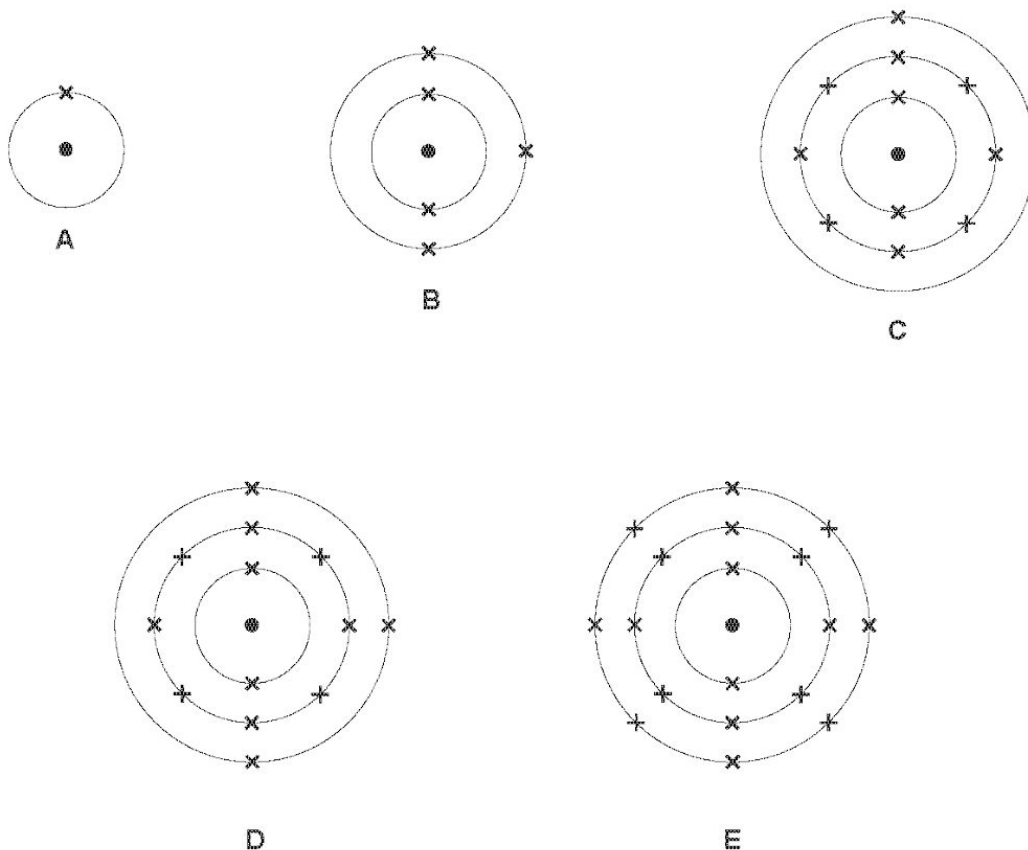
(i) Give the electronic structure of E. .... [1]

(ii) Which letter represents aluminium? .... [1]

(iii) Give the letters of the two elements which are found in the same group of the Periodic Table and give a reason for your choice. [2]

....

....

(b) (i) Calculate the relative formula mass (M_r) of sodium hydroxide, NaOH. [1]

$$A_r(Na) = 23 \qquad A_r(O) = 16 \qquad A_r(H) = 1$$

Relative formula mass = ...

(ii) Using your answer to part (i), calculate the percentage by mass of oxygen in sodium hydroxide, NaOH. [2]

Percentage by mass of oxygen = ... %

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11. An analytical chemist was asked to check the amount of vitamin C in a tablet. Vitamin C tablets contain ascorbic acid, $C_6H_8O_6$, and a starch "filler" which holds them together.

Ascorbic acid reacts with sodium hydroxide solution according to the equation below:

$$C_6H_8O_6 \quad + \quad NaOH \quad \longrightarrow \quad NaC_6H_7O_6 \quad + \quad H_2O$$

Vitamin C
300 mg

To determine how much vitamin C is present, a tablet was dissolved in water and titrated with sodium hydroxide solution of concentration 0.10 mol/dm³. The endpoint was determined using the indicator phenolphthalein. The procedure was repeated three times and the mean value of sodium hydroxide solution needed to neutralise a vitamin C tablet was found to be 17.5 cm³.

(a) Calculate the number of moles of sodium hydroxide in 17.5 cm³ of the 0.10 mol/dm³ solution. [2]

Number of moles = ... mol

(b) Calculate the relative molecular mass, M_r, of ascorbic acid, $C_6H_8O_6$. [1]

$$A_r(H) = 1 \quad A_r(O) = 16 \quad A_r(C) = 12$$

M_r = ...

(c) The label on the bottle states that each tablet contains 300 mg (0.3 g) of vitamin C. Using your answers to parts (a) and (b) show whether this statement is correct. [2]

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12. (a) The table below shows some properties of three elements in the Periodic Table.

Element	Melting point (°C)	Boiling point (°C)	Appearance	Malleable or brittle?	Electrical conductivity
aluminium	660	2519	shiny solid	malleable	good
silicon	1414	3265	shiny solid	brittle	semiconductor
phosphorus	44	280	white solid	brittle	poor

Describe how the information in the table shows that silicon is difficult to classify as a metal or a non-metal. [2]

....

....

....

(b) Give the **symbol** of the element which is found in Group 2 and Period 3 of the Periodic Table. [1]

....

(c) (i) The chemical formula of copper(II) nitrate is $Cu(NO_3)_2$. Give the number of nitrogen atoms in the formula $Cu(NO_3)_2$. [1]

....

(ii) Give the chemical formula of silver oxide. [1]

....

(d) Nano-scale silver particles are added to socks to reduce the effects of smelly feet. Recent research has found that these particles can easily leak into waste water during washing.

(i) State the property of nano-scale silver particles that makes them useful in socks.

.... [1]

(ii) Suggest a reason why some scientists are concerned about nano-scale silver particles entering waste water. [1]

....

....

7

13.

(a) Complete the table below that shows information about four ionic compounds. [3]

| Compound	Formula	Elements present
aluminium oxide	Al_2O_3	aluminium and oxygen
calcium hydroxide	$Ca(OH)_2$	....
sodium carbonate	....	sodium, carbon and oxygen
calcium nitrate	....	calcium, nitrogen and oxygen

(b) Sodium oxalate occurs naturally in many plants. It can be made from oxalic acid. Oxalic acid contains two hydrogen atoms, two carbon atoms and four oxygen atoms.

Use this information to write the formula of oxalic acid. [1]
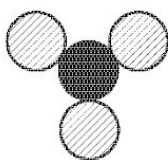
Formula of oxalic acid ....

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14. (a) The key below represents atoms of some elements.

○ (filled)   ○ (hatched)   ○ (open)

nitrogen, N   hydrogen, H   oxygen, O
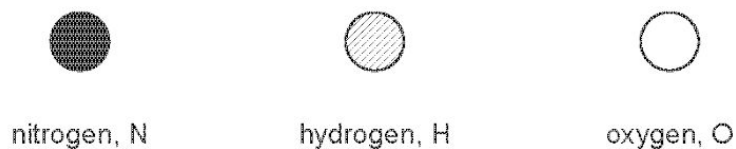
(i) Use the key to draw a diagram representing a molecule of nitrous oxide, N_2O.   [1]

(ii) Use the key to give the chemical formula for the following molecule.   [1]

Formula ....

(b) The box below shows the symbols and formulae for some gases.

| CO_2 | O_2 | He | CH_4 | Ne | SO_2 |

Choose from the box

(i) two elements, ... and ....   [1]

(ii) two compounds.   .... and ....   [1]

(c) The chemical formula of nitric acid is HNO_3.

(i) State how many nitrogen atoms are present in the formula, HNO_3. ....   [1]

(ii) Give the **total** number of atoms shown in the formula. ....   [1]

(d) You may wish to refer to the table of common ions to help you answer parts (i) and (ii).

(i) Give the **formulae** of the **ions** present in the compound $MgCl_2$. [1]

Positive ion .... *Negative ion* ....

(ii) Give the chemical formula for sodium hydroxide. [1]

....

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