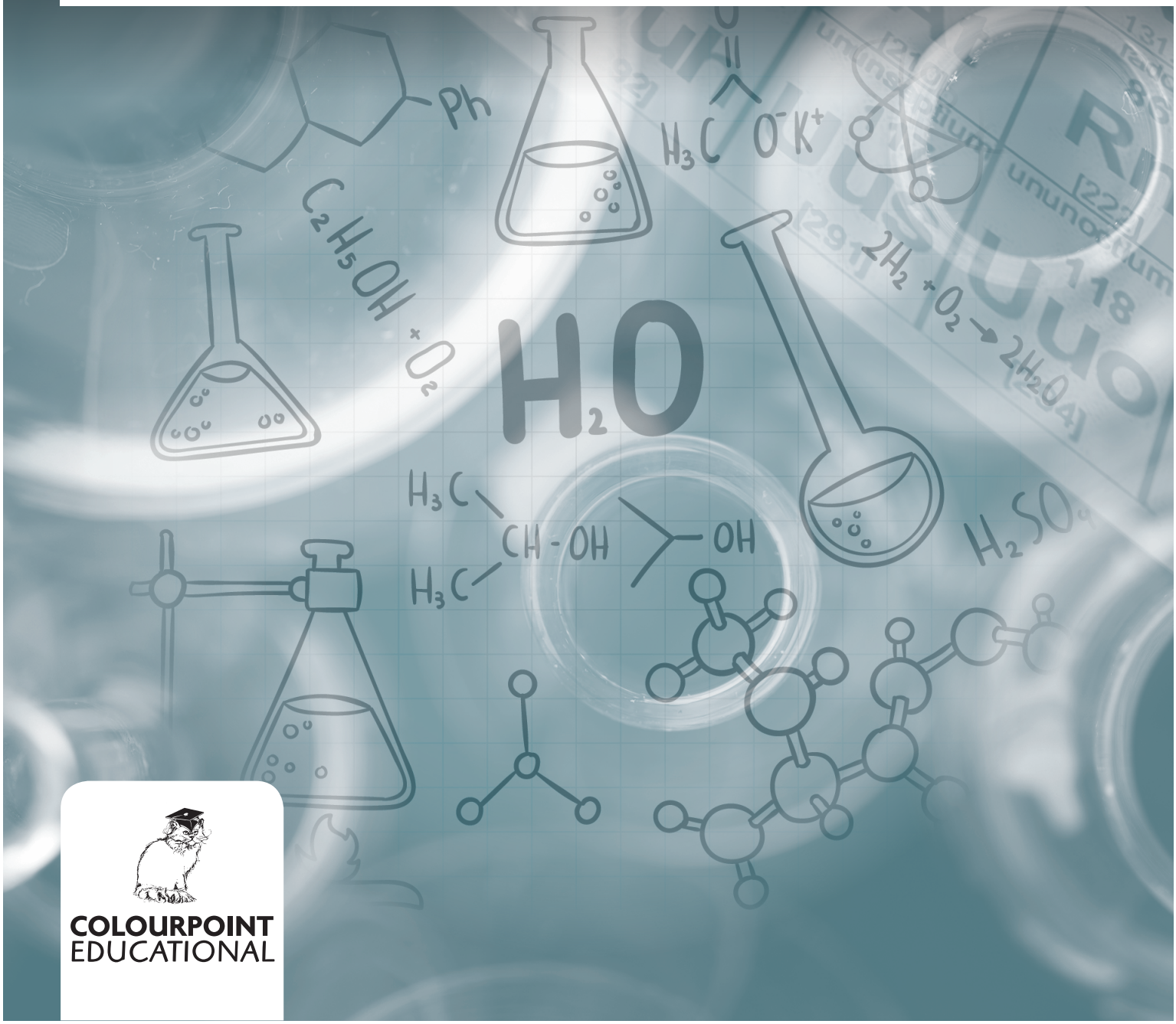
Alyn G McFarland

CCEA GCSE

CHEMISTRY QUESTIONS



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Colourpoint House
Jubilee Business Park
21 Jubilee Road
Newtownards
County Down
Northern Ireland
BT23 4YH

Tel: 028 9182 0505
E-mail: sales@colourpoint.co.uk
Web site: www.colourpoint.co.uk

The Author

Dr Alyn G McFarland has been teaching GCSE and GCE A-level Chemistry for 26 years and was Head of Chemistry in a large grammar school for 14 years. He has been writing textbooks, revision guides and workbooks for GCSE Chemistry and GCE A-level Chemistry for different examination boards for over 10 years. Dr McFarland is a senior examiner at both levels for an examination board and also contributes to the PGCE course for Science/ Chemistry students on a part-time basis.

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Note: This book is designed to be used by both Double Award Chemistry candidates and GCSE Chemistry candidates. Questions that should NOT be attempted by Double Award Chemistry candidates are indicated with grey shading, as shown here, or otherwise indicated in the text.

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Unit 1

Structures, Trends, Chemical Reactions, Quantitative Chemistry and Analysis

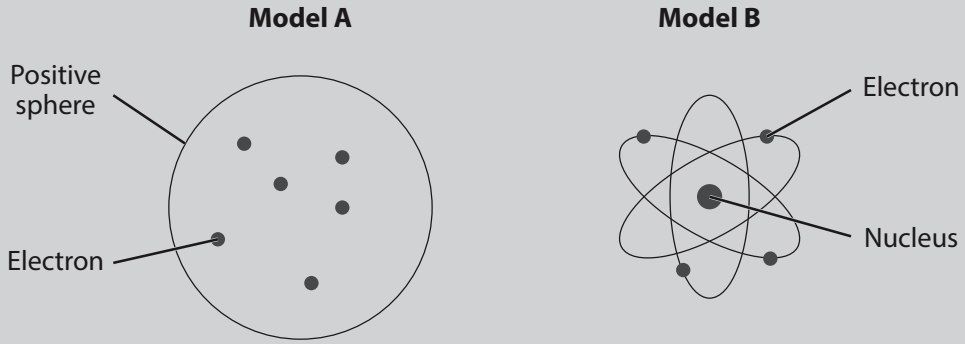
1.1 Atomic Structure

1. Complete the table below.

Subatomic particle	Relative charge	Relative mass
		$\frac{1}{1840}$
	+1	
neutron		

[3]

2. The diagrams below show two different models of the atom.



(a) What name is used for Model A? [1]
(b) Name the scientist who developed Model B. [1]
(c) The neutron is missing from Model B. Suggest why it was discovered later than the other subatomic particles. [1]

3. The table below gives details of some atoms and ions.

Particle	Atomic number	Electronic configuration
A	7	2, 5
B	16	2, 8, 8
C	3	2
D	12	2, 8
E	9	2, 7

(a) Which particles (A, B, C, D or E) are atoms? [1]
(b) Which particle (A, B, C, D or E) is of an element in Group 5? [1]
(c) Write the formula of particle C including any charge. [1]
(d) Which particle (A, B, C, D or E) has a charge of 2–? [1]

4. The atomic radius of a gallium atom is 1.87×10^{-10} m. The nuclear radius is 36 300 times smaller than the atomic radius. Calculate the nuclear radius to 3 significant figures in femtometres (fm). 1 fm = 1×10^{-15} m [2]

5. An atom of an element has 21 protons, 18 electrons and 24 neutrons.
(a) Identify the element. [1]
(b) What is the charge on the ion of the element? [1]
(c) What is the mass number of the element? [1]
(d) What is the electronic configuration of the ion? [1]
(e) Write the formulae of two other ions, including the charge, which have the same electronic configuration. [1]

6. Complete the table below for some simple atoms and ions.

Atom/Ion	Atomic Number	Mass Number	Number of protons	Number of neutrons	Number of electrons	Electronic Configuration
Be	4	9			4	
Cl^-			17	20	18	
	19	39				2, 8, 8
	10			10	10	
Mg^{2+}		24	12			
	7	14				2, 8

[6]

7. **(a)** Hydrogen (atomic number 1) has three isotopes with mass numbers 1, 2 and 3.
(i) What is meant by the term isotopes? [2]
(ii) Draw a labelled diagram of an atom of hydrogen with mass number 3, showing the location and number of all the subatomic particles. [2]

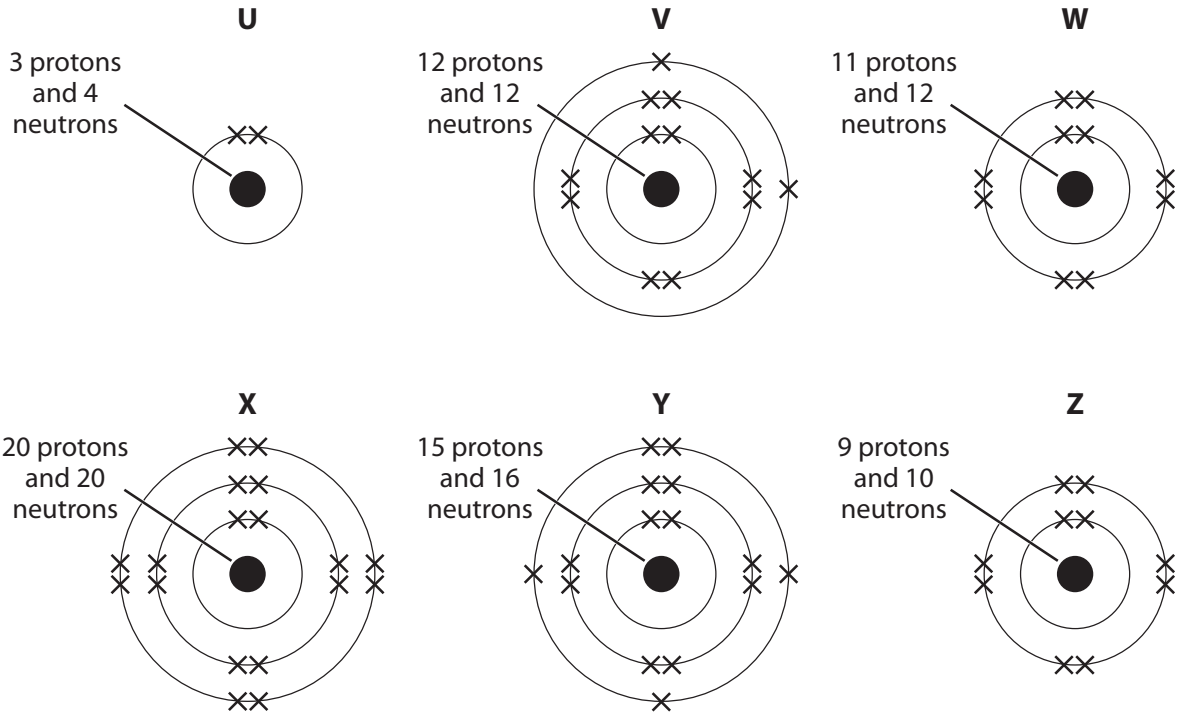
(b) An isotope of another element has 5 protons and 6 neutrons.
(i) Identify the element. [1]
(ii) What is the mass number of this isotope? [1]
(iii) Write the electronic configuration of an atom of this isotope. [1]

(c) Sulfur has three isotopes, as shown in the table below.

Isotope	Relative abundance
^{32}S	95.0
^{33}S	0.75
^{34}S	4.25

(i) Calculate the relative atomic mass of sulfur. Give your answer to 1 decimal place. Show your working out. [3]
(ii) Explain why isotopes have the same chemical properties. [1]

8. The diagram below show the electronic configuration of several atoms and ions. They are labelled **U** to **Z**. The letters do not represent symbols for the elements.



(a) Complete the table below giving the identity of the atom or ion (including any charge on the ion) and the atomic number, mass number and electronic configuration of **A** to **F**.

Atom/Ion	Identity	Atomic number	Mass number	Number of electrons	Electronic configuration
U	Li^+				
V					2, 8, 2
W				10	
X		20			
Y				15	
Z			19		

[5]

(b) Which **two** of the atoms or ions (**U**, **V**, **W**, **X**, **Y** and **Z**) above are from elements in the same group of the Periodic Table? [1]

(c) Explain why atoms are electrically neutral. [1]

(d) Draw a labelled diagram of an oxide ion which has a mass number of 16, showing the charge on the ion and the location and number of all the subatomic particles. [3]

1.2 Bonding and 1.3 Structures

1. The table below shows some ions labelled **A** to **I**.

A	B	C	D	E	F	G	H	I
CO_3^{2-}	K^+	Al^{3+}	NO_3^-	O^{2-}	SO_4^{2-}	Cu^{2+}	NH_4^+	Br^-

(a) Use the letters **A** to **I** to answers the questions.
- **(i)** Which, if any, are anions? [1]
- **(ii)** Which, if any, are both molecular ions and cations? [1]

(b) Name all the ions **A** to **I**. [9]

(c) Write the formula of the compound formed between the following ions:
- **(i)** **A** and **B** [1]
- **(ii)** **C** and **E** [1]
- **(iii)** **D** and **G** [1]

2. Sodium oxide is an ionic compound. It has a melting point of 1132 °C.

(a) Write the formula for sodium oxide. [1]

(b) Show, using a dot and cross diagram, how atoms of sodium react with atoms of oxygen to form sodium oxide. Include the charges on the ions formed. [6]

(c) Explain why sodium oxide has a high melting point. [2]

(d) State **two** other physical properties of sodium oxide. [2]

(e) From the compounds shown below, circle any other ionic compounds.

lithium iodide hydrogen chloride ammonium chloride water

hydrogen sulfide carbon dioxide magnesium oxide sodium sulfate

[2]

(f) Ionic compounds contain ionic bonding. What is meant by ionic bonding? [2]

(g) What is the structure of sodium oxide? [1]

3. Complete the table below. The first row has been completed for you.

Name of compound	Formula of compound	Formula of positive ion	Formula of negative ion
sodium chloride	NaCl	Na^+	Cl
		Mg^{2+}	O^{2-}
	AlF_3		
	KNO_3		
calcium sulfate			
copper(II) hydroxide			
		Zn^{2+}	Br^-
iron(III) oxide			

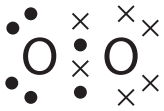
[8]

4. Methane reacts with oxygen to form carbon dioxide and water.

(a) Write a balanced symbol equation for the reaction. [3]

(b) Draw a dot and cross diagram for methane. [1]

(c) The dot and cross diagram for an oxygen molecule is shown below.



(i) Label any lone pair of electrons on the diagram. [1]

(ii) Name the type of bonding found in an oxygen molecule. [1]

(iii) Name the type of bonding found between oxygen molecules. [1]

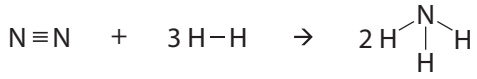
(iv) Explain why the bonding in an oxygen molecule is often shown as O=O. [2]

(v) Oxygen is a diatomic element. What is meant by the term diatomic? [1]

(d) Draw a dot and cross diagram for water. [1]

(e) How many lone pairs are present in a molecule of carbon dioxide? [1]

5. Ammonia is a compound formed from nitrogen and hydrogen. The equation below shows the molecules involved in the reaction. A very high temperature is required to break the bonds in the nitrogen molecule. Nitrogen, hydrogen and ammonia are all gases at room temperature and pressure.



(a) Name the type of bonding found in all three molecules. [1]
(b) Explain why a very high temperature is required to break the bonds in the nitrogen molecule. [2]
(c) Draw a dot and cross diagram for all three molecules. Label all lone pairs of electrons. [4]
(d) Explain why ammonia is a gas at room temperature and pressure. [2]
(e) Write a balanced symbol equation for the reaction. [1]
(f) Ammonia reacts with hydrochloric acid to form ammonium chloride.
(i) Write a balanced symbol equation for this reaction. [2]
(ii) Explain why ammonium chloride is a solid at room temperature. [2]

6. The table below gives information on four substances.

Substance	Melting point (°C)	Boiling point (°C)	Electrical conduction when solid	Electrical conduction when molten
Iron	1500	2862	good	good
Sodium oxide	1132	1950	poor	good
Chlorine	–102	–34	poor	poor
Silicon dioxide	1710	2230	poor	poor

(a) Explain why iron has a high melting point. [2]
(b) Explain why iron conducts electricity. [2]
(c) State the type of bonding present in sodium oxide. [1]
(d) Explain why sodium oxide conducts electricity when molten. [2]
(e) State the type of bonding found in chlorine molecules. [1]
(f) Explain why chlorine has a low melting point. [2]
(g) State the structure of chlorine. [1]
(h) Give two pieces of evidence to explain why silicon dioxide is giant covalent. [2]

7. Carbon exists as several allotropes including graphite and graphene.

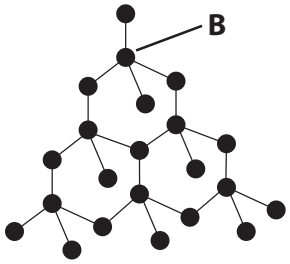
(a) Graphite is a slippery dark grey solid which conducts electricity.

(i) Draw a labelled diagram to show the structure and bonding in graphite. [4]

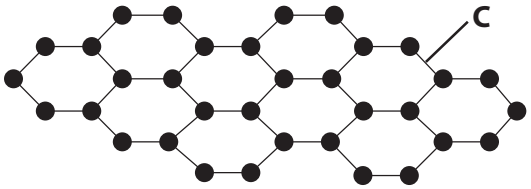
(ii) Explain why graphite conducts electricity. [2]

(iii) State one other property of graphite. [1]

(b) Two other allotropes of carbon are shown below.



Allotrope A



Graphene

(i) Name allotrope A. [1]

(ii) What is represented by the black dot labelled B? [1]

(iii) What is represented by the line labelled C? [1]

(iv) What is meant by the term allotrope? [2]

(v) State one use of graphene. [1]

8. Sodium and magnesium are typical metals.

(a) Draw a labelled diagram to show the structure and bonding in sodium metal. [3]

(b) Explain why metals conduct electricity and suggest why magnesium is a better electrical conductor than sodium. [3]

(c) The alloy duralumin is used to make aircraft bodies. It is composed of 95% aluminium and 4.5% copper. The remaining 0.5% is made up of magnesium and other metals as well as silicon.

(i) What is meant by the term alloy? [3]

(ii) Explain why duralumin is harder than aluminium on its own. [2]

(iii) Suggest one reason why duralumin is used to make aircraft bodies. [1]

9. Gold purity is measured in carats. The table below shows some different carat rated gold. Complete the table.

Carat rating	Percentage of pure gold (%)
24	
	75
11	

[3]

1.4 Nanoparticles

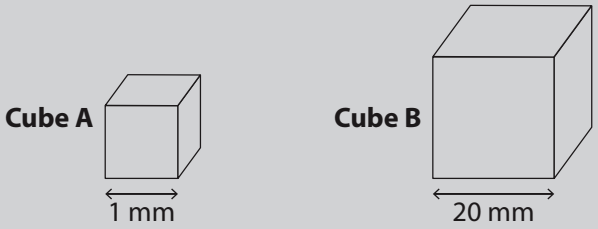
1. Nanoparticles contain only a few hundred atoms and they are 1 – 100 nm in size. Zinc oxide nanoparticles are used in some sun creams instead of bulk zinc oxide particles.

(a) What is a nanometre? [1]

(b) Explain why some people have reservations about the use of nanoparticles. [1]

(c) State one advantage of using zinc oxide nanoparticles rather than bulk particles in sun creams. [1]

2. Two cubes are shown below. Cube A has a side length of 1 mm whereas cube B has a side length of 20 mm.



(a) Complete the table below by calculating the surface area and volume of the two cubes and the surface area to volume ratio using the expression given below

$$\text{Surface area to volume ratio} = \frac{\text{surface area (mm}^2\text{)}}{\text{volume (mm}^3\text{)}}$$

	Cube A	**Cube B**
Surface area (mm^2)		
Volume (mm^3)		
Surface area to volume ratio		

[6]

(b) Convert 20 mm to nanometres. [1]

(c) What is the effect on surface area to volume ratio of increasing the side length of cube by a factor of 20, as in the example above? [1]

3. A cube has a surface area to volume ratio of 6:15 or 0.4. The surface area of the cube is 1350 nm^2.

(a) Calculate the volume of the cube and state the units. [2]

(b) Calculate the length of one side of the cube in nm. [2]

(c) Calculate the length of one side of the cube in m. [1]