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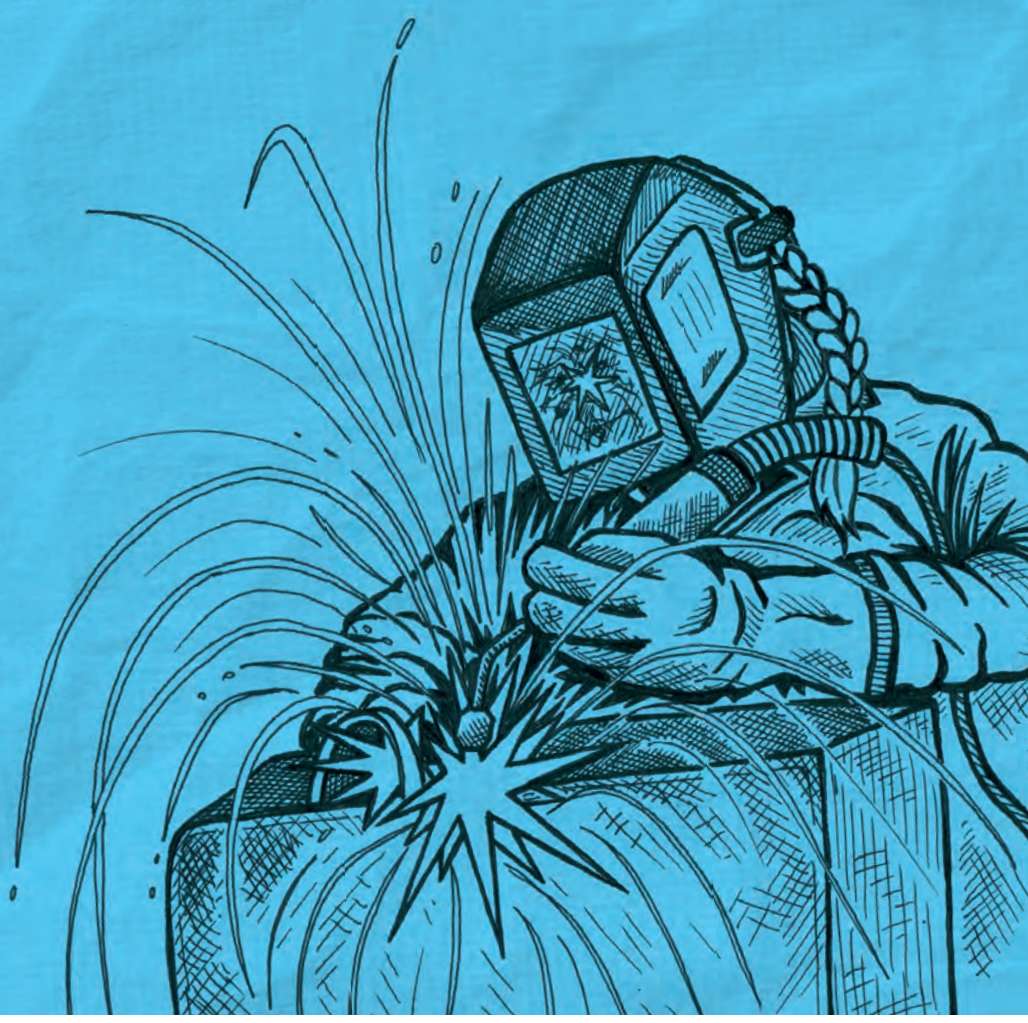
REVISE EDEXCEL GCSE (9–1)

Chemistry

REVISION WORKBOOK

Higher



For the 9–1 exams

Pearson

REVISE EDEXCEL GCSE (9–1)
Chemistry
Higher

REVISION WORKBOOK

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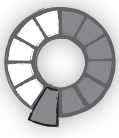


Question difficulty

Look at this scale next to each exam-style question. It tells you how difficult the question is.

Pearson

Contents

1-to-1 page match with the Chemistry Revision Guide
ISBN 9781292131924

Edexcel publishes Sample Assessment Material and the Specification on its website. This is the official content and this book should be used in conjunction with it. The questions have been written to help you practise every topic in the book. Remember: the real exam questions may not look like this.

Formulae

1 Which of the following is the formula for calcium carbonate?

☐ **A** CaCO

☐ **B** $CaCO_2$

☐ **C** $CaCO_3$

☐ **D** $CaCO_4$

Put a cross in **one** box. Always answer multiple-choice questions, even if you don't actually know the answer.

(1 mark)

2 State what is meant by the term **element**.

Guided

An element is a substance made from .....

with the same number of ..... **(2 marks)**

3 Chlorine is used to kill harmful microorganisms in drinking water. Its formula is Cl_2.

(a) Explain, using the information given, how you know that chlorine is **not** a compound.

.....

.....

..... **(2 marks)**

(b) Explain, using the information given, how you can tell that chlorine exists as molecules.

.....

.....

..... **(2 marks)**

4 Complete the table to show the formulae of some common substances.

Substance	water	carbon dioxide	methane	sulfuric acid	sodium
Formula					

(5 marks)

5 The formula for aluminium hydroxide is $Al(OH)_3$.

(a) State the number of elements in the formula $Al(OH)_3$.

..... **(1 mark)**

(b) State the total number of atoms in the formula $Al(OH)_3$.

..... **(1 mark)**

6 The formula for a carbonate ion is CO_3^{2-}. Describe what this formula shows.

.....

..... **(2 marks)**

Had a go ☐ Nearly there ☐ Nailed it! ☐

Equations

1 Which of these statements describes a chemical reaction?

☐ **A** Reactants form from products.

☐ **B** Products form from reactants.

☐ **C** An element changes into another element.

☐ **D** The total mass of substances goes down.

Answer **C** cannot be correct because one element cannot change to another element in chemical reactions.

(1 mark)

2 Sodium hydroxide solution reacts with dilute hydrochloric acid to form sodium chloride and water.

(a) Write the word equation for this reaction.

..... **(1 mark)**

(b) Write the balanced equation for this reaction.

..... **(1 mark)**

3 A teacher adds a piece of sodium metal to some water. The reaction produces sodium hydroxide solution and bubbles of hydrogen.

You should know the formulae of elements and simple compounds.

Guided

(a) Complete the balanced equation below to show the correct state symbols.

$2Na(.....) + 2H_2O(.....) \rightarrow 2NaOH(.....) + H_2(.....)$ ..... **(1 mark)**

(b) Describe how you know that the equation above is balanced.

.....

..... **(2 marks)**

4 The following equations are **not** balanced. Write the balanced equations in the spaces below them.

Do not add state symbols unless you are asked for them.

(a) $Cu + O_2 \rightarrow CuO$

..... **(1 mark)**

(b) $Al + Fe_2O_3 \rightarrow Al_2O_3 + Fe$

..... **(1 mark)**

(c) $Mg + HNO_3 \rightarrow Mg(NO_3)_2 + H_2$

..... **(1 mark)**

(d) $Na_2CO_3 + HCl \rightarrow NaCl + H_2O + CO_2$

..... **(1 mark)**

(e) $Fe + O_2 \rightarrow Fe_2O_3$

..... **(1 mark)**

(f) $Cl_2 + NaBr \rightarrow NaCl + Br_2$

..... **(1 mark)**

Ionic equations

1 Explain what is meant by the term **ion**.

Guided

An ion is a .....

formed when ..... **(2 marks)**

2 Silver nitrate solution is used to identify iodide ions in solution. A yellow precipitate of silver iodide, AgI, forms if iodide ions are present.

(a) Give the formula of the silver ion and the formula of the iodide ion in silver iodide.

silver ion .....

iodide ion ..... **(2 marks)**

(b) Write the balanced ionic equation for the formation of silver iodide. Include state symbols.

..... **(2 marks)**

3 Dilute acids contain hydrogen ions. These react with carbonate ions to form water and carbon dioxide.

(a) Give the formula for a hydrogen ion and the formula for a carbonate ion.

hydrogen ion .....

carbonate ion..... **(2 marks)**

(b) Write the balanced ionic equation for the reaction described above.

..... **(2 marks)**

4 The following ionic equations are **not** balanced. Write the balanced equations in the spaces below them.

(a) $Fe^{2+} + OH^- \rightarrow Fe(OH)_2$

..... **(1 mark)**

(b) $Fe^{3+} + OH^- \rightarrow Fe(OH)_3$

..... **(1 mark)**

5 Alkaline solutions contain hydroxide ions. These react with hydrogen ions during neutralisation reactions.

(a) Write the ionic equation for the reaction between a hydrogen ion and a hydroxide ion.

..... **(1 mark)**

(b) Name the product of this reaction.

..... **(1 mark)**

6 When chlorine reacts with potassium bromide solution, potassium chloride solution and bromine form:

$Cl_2 + 2KBr \rightarrow 2KCl + Br_2$

Potassium ions are **spectator ions** in this reaction. They are unchanged and can be left out of the equation.

(a) Write the formulae of all the ions present in this reaction.

..... **(3 marks)**

(b) Write a balanced ionic equation for the reaction.

..... **(2 marks)**

Had a go ☐ Nearly there ☐ Nailed it! ☐

Hazards, risk and precautions

1 Describe what is meant by the term **hazard**.

Guided

A hazard is something that could cause .....

.....

..... **(2 marks)**

2 Describe what is meant by the term **risk**.

Practical skills — Risk and hazard are **not** the same thing.

.....

..... **(2 marks)**

3 Hazard symbols are found on containers. Give **two** reasons why these hazard symbols are used.

.....

.....

..... **(2 marks)**

4 Complete the diagram below using a straight line to connect each hazard symbol to its correct description.

Guided

Symbol	Description
	**flammable** may easily catch fire
	**oxidising agent** may cause other substances to catch fire, or make a fire worse
	**corrosive** causes severe damage to skin and eyes
	**harmful or irritant** health hazard
	**toxic** may cause death by inhalation, ingestion or skin contact

(4 marks)

5 Copper reacts with concentrated nitric acid. The reaction forms copper nitrate, water and nitrogen dioxide. Nitrogen dioxide is a toxic brown gas with an irritating odour.

Explain a suitable precaution, other than eye protection, needed for safe working in this experiment.

.....

.....

..... **(2 marks)**

Atomic structure

1 Which of these statements correctly describes an atom?

☐ **A** Most of the mass is concentrated in the nucleus.

☐ **B** Most of the charge is concentrated in the nucleus.

☐ **C** The number of neutrons always equals the number of protons.

☐ **D** The number of electrons always equals the number of neutrons. **(1 mark)**

Guided

2 Complete the table to show the relative mass, relative charge and position of each particle in an atom.

Particle	proton	neutron	electron
Relative mass		1	
Relative charge			–1
Position	nucleus		

(3 marks)

3 Explain why a hydrogen atom has no overall charge, even though it contains electrically charged particles.

.....

..... **(2 marks)**

4 John Dalton described his atomic model of the atom in 1803. Suggest a reason that explains why his model did not include protons, neutrons and electrons.

..... **(1 mark)**

5 The diameter of a gold atom is 2.70×10^{-10} m. The diameter of a gold nucleus is 1.03×10^{-14} m. Calculate, to three significant figures, the diameter of a gold atom relative to the diameter of its nucleus.

Maths skills 1.03×10^{-14} is written in standard form. You could enter it on your calculator as: 1.03 EXP –14.

..... **(2 marks)**

6 Experiments were carried out in the early part of the last century to test the 'plum pudding' model of the atom. A very large number of positively charged particles were fired at a very thin gold sheet.

(a) Suggest a reason that explains why most of these particles passed straight through the gold sheet.

..... **(1 mark)**

(b) The positively charged particles are repelled when they come close to the nucleus of a gold atom. Explain what property of the nucleus is shown by this observation.

.....

..... **(2 marks)**

(c) In the experiments, only about 1 in 20 000 positively charged particles was repelled. Explain this observation.

You may be asked to analyse information and draw conclusions using your knowledge and understanding.

.....

..... **(2 marks)**

Had a go ☐ Nearly there ☐ Nailed it! ☐

Isotopes

1 State what is meant by the **mass number** of an atom.

Guided

The mass number of an atom is the total number of.....

..... **(1 mark)**

2 An atom of an element X has an atomic number 9 and a mass number 19. How many electrons does an atom of element X contain?

☐ **A** 9 ☐ **B** 10 ☐ **C** 19 ☐ **D** 28 **(1 mark)**

3 Describe, in terms of particles in the atom, what an element is.

.....

.....

What is the same for atoms of a given element, and what is different between atoms of different elements?

..... **(2 marks)**

4 Hydrogen has three natural isotopes: $^{1}_{1}H$ (hydrogen-1), $^{2}_{1}H$ (hydrogen-2) and $^{3}_{1}H$ (hydrogen-3).

(a) Complete the table to show the numbers of protons, neutrons and electrons in an atom of each isotope.

Isotope	Protons	Neutrons	Electrons
hydrogen-1			
hydrogen-2			
hydrogen-3			

(3 marks)

(b) Explain, in terms of particles, why these are isotopes of the same element.

.....

..... **(2 marks)**

5 Explain why relative atomic masses of some elements are whole numbers, but those of some other elements, for example chlorine, are not.

.....

.....

..... **(2 marks)**

6 A sample of neon contains two isotopes, Ne (neon-20) and Ne (neon-22).

Guided

The relative abundance of neon-20 is 90.5%.

Calculate the relative atomic mass, A_r, of this sample of neon. Give your answer to one decimal place.

relative abundance of neon-22 = (100 – 90.5) = ...

mass of 100 atoms = ...

A_r of Ne = ... **(3 marks)**

Mendeleev's table

1 (a) How did Mendeleev **first start** to arrange the elements in his periodic table?

☐ **A** in the order of increasing number of protons in the nucleus

☐ **B** in the order of increasing reactivity with other elements

☐ **C** in the order of increasing number of isotopes

☐ **D** in the order of increasing relative atomic mass **(1 mark)**

(b) State **one** factor, other than the one in your answer to part (**a**), that Mendeleev used when he arranged the elements.

..... **(1 mark)**

2 The diagram shows part of Mendeleev's 1871 table.

(a) Give **two** similarities between this table and the modern periodic table.

Remember that you will be given a periodic table in the exam. There is also one at the back of this book.

1 .....

2 .....

	Group 1	2	3	4	5	6	7
	H						
	Li	Be	B	C	N	O	F
	Na	Mg	Al	Si	P	S	Cl
	K Cu	Ca Zn	* *	Ti *	V As	Cr Se	Mn Br
	Rb Ag	Sr Cd	Y In	Zr Sn	Nb Sb	Mo Te	* I

(2 marks)

(b) Give **three** differences between this table and the modern periodic table.

1 .....

2 .....

3 ..... **(3 marks)**

3 Mendeleev had difficulty placing some elements. For example, the order of tellurium Te and iodine I appeared to be reversed in his table.

(a) Explain why the positions of these two elements appeared to be reversed in Mendeleev's table.

.....

.....

..... **(2 marks)**

(b) Explain, in terms of atomic structure, why the positions of these two elements were actually correct.

.....

.....

..... **(2 marks)**

4 State **one** feature of Mendeleev's work with his table that would later help to support his ideas.

..... **(1 mark)**

Had a go ☐ Nearly there ☐ Nailed it! ☐

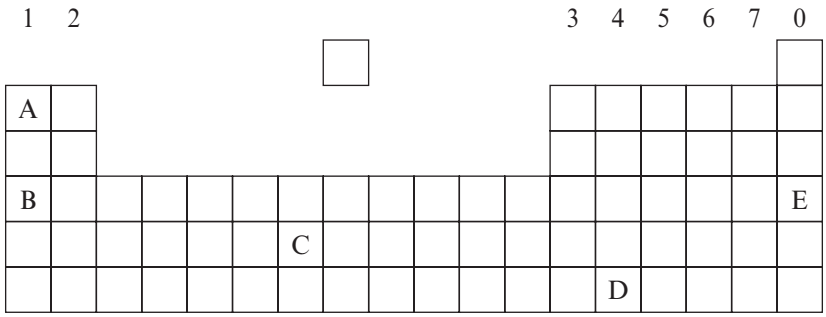
The periodic table

1 How are the elements arranged in the modern periodic table?

- ☐ **A** in the order of increasing mass number
- ☐ **B** in the order of increasing atomic number
- ☐ **C** in the order of increasing nucleon number
- ☐ **D** in the order of increasing numbers of electron shells

(1 mark)

2 The positions of five elements (**A**, **B**, **C**, **D** and **E**) are shown in the periodic table on the right. These letters are **not** the chemical symbols for these elements.



(a) Give the letters of **two** elements that have similar chemical properties to each other.

..... **(1 mark)**

(b) Give the letters of **all** the metal elements.

..... **(1 mark)**

(c) Give the letters of **two** elements in the same period.

..... **(1 mark)**

3 The meaning of the term **atomic number** has changed over time.

Guided

(a) Explain the meaning of the term **atomic number** as Mendeleev might have understood it in the nineteenth century.

The position of .....

..... **(2 marks)**

(b) Explain the modern meaning of the term **atomic number**.

.....

..... **(2 marks)**

(c) Suggest a reason that explains why the meaning of atomic number has changed over time.

.....

..... **(1 mark)**

4 Sodium is placed between elements **A** and **B** on the periodic table shown in question **2**. Argon is placed immediately above element **E**. Explain why there can only be six elements between sodium and argon.

Think about why two different elements cannot occupy the same position on the modern periodic table.

.....

.....

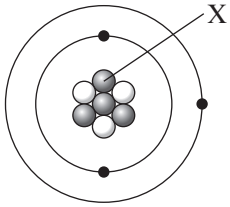
..... **(2 marks)**

Had a go ☐ Nearly there ☐ Nailed it! ☐

Papers 1 & 2

Electronic configurations

1 The diagram shows a lithium atom. It is not drawn to scale.



(a) State the electronic configuration of lithium.

..... **(1 mark)**

Guided

(b) Deduce the name of the shaded particle labelled **X**, and explain your answer.

There are three electrons, so there must be three .....

so the four shaded circles must be ..... **(2 marks)**

(c) The atomic number of oxygen is 8.

You need to show each electron shell and electron, but you can show the nucleus as a single dot.

Draw a diagram to show the arrangement of electrons in an oxygen atom.

(2 marks)

2 The table shows some information about two non-metal elements, fluorine and chlorine.

Non-metal element	Atomic number	Electronic configuration
F	9	2.7
Cl	17	2.8.7

(a) Explain, in terms of electronic configurations, why fluorine and chlorine are placed in group 7.

.....

..... **(2 marks)**

(b) Explain, in terms of electronic configurations, why fluorine and chlorine are **not** in the same period.

.....

..... **(2 marks)**

3 Deduce the electronic configurations of the following elements.

(a) calcium (atomic number 20):

..... **(1 mark)**

(b) phosphorus (atomic number 15):

..... **(1 mark)**

4 State and explain the number of the group in which helium (electronic configuration 2) is placed.

.....

..... **(2 marks)**

Had a go ☐ Nearly there ☐ Nailed it! ☐

Ions

1 Which of the following statements correctly describes the formation of an ion?

☐ **A** Positively charged ions, called cations, form when atoms or groups of atoms gain electrons.

You can quickly narrow the alternatives if you know the correct name for each type of ion, or how it forms.

☐ **B** Positively charged ions, called anions, form when atoms or groups of atoms lose electrons.

☐ **C** Negatively charged ions, called cations, form when atoms or groups of atoms lose electrons.

☐ **D** Negatively charged ions, called anions, form when atoms or groups of atoms gain electrons.

(1 mark)

2 The atomic number of magnesium, Mg, is 12. The symbol for a magnesium ion is Mg^{2+}.

(a) Deduce the number of electrons in a magnesium ion.

Maths skills Work out the number of electrons in an atom, then add or subtract electrons according to the charge shown.

..... **(1 mark)**

(b) Write the electronic configuration for a magnesium ion.

..... **(1 mark)**

3 Complete the table to show the numbers of protons, neutrons and electrons in each ion.

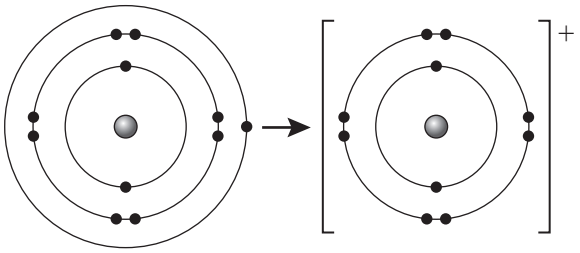
Guided

Ion	Atomic number	Mass number	Protons	Neutrons	Electrons
N^{3-}	7	15	7	8	10
K^{+}	19	40			
Ca^{2+}	20	40			
S^{2-}	16	32			
Br^{-}	35	81			

(4 marks)

4 The diagram on the right shows the formation of a sodium ion, Na^{+}, from a sodium atom.

Draw a similar diagram to show the formation of a chloride ion, Cl^{-}, from a chlorine atom.



(3 marks)

Formulae of ionic compounds

1 The formula of a sodium ion is Na^+. The formula of a phosphate ion is PO_4^{3-}. Which of the following is the formula for sodium phosphate?

☐ **A** $NaPO_4$ ☐ **C** Na_2PO_4

☐ **B** $Na(PO_4)_3$ ☐ **D** Na_3PO_4 **(1 mark)**

Guided

2 Complete the table to show the formulae of the compounds produced by each pair of ions.

Maths skills You may need more than one of each ion to obtain equal numbers of positive and negative charges.

You need to know the formulae of common ions. This helps you work out the formulae of ionic substances.

	Cl^-	S^{2-}	OH^-	NO_3^-	SO_4^{2-}
K^+				KNO_3	
Ca^{2+}			$Ca(OH)_2$		$CaSO_4$
Fe^{3+}		Fe_2S_3			
NH_4^+	NH_4Cl				

(15 marks)

3 Magnesium ribbon burns in air. It reacts with oxygen to produce magnesium oxide, MgO.

(a) Write the balanced equation for the reaction.

..... **(2 marks)**

(b) Magnesium nitride is also formed, as some of the hot magnesium reacts with nitrogen in the air.

(i) Nitrogen is in group 5. Suggest reasons that explain why the formula for a nitride ion is N^{3-}.

.....

..... **(2 marks)**

(ii) Write the formula for magnesium nitride.

The formula for a magnesium ion is Mg^{2+}.

..... **(1 marks)**

(iii) Explain why the NO_3^- ion is called the nitrate ion, but the N^{3-} ion is called the nitride ion.

.....

..... **(2 marks)**

4 Complete the table to show the names of the ions.

Remember to use the endings -ide and -ate correctly.

	S^{2-}	SO_4^{2-}	Cl^-	ClO_3^-
Name				

(4 marks)

Had a go ☐ Nearly there ☐ Nailed it! ☐

Properties of ionic compounds

1 Which statement about the formation of ionic compounds, such as sodium chloride, is correct?

☐ **A** Electrons are transferred from metal atoms to non-metal atoms, producing cations and anions.

☐ **B** Electrons are transferred from cations to anions, producing metal atoms and non-metal atoms.

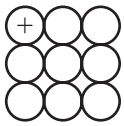
☐ **C** Electrons are shared between metal atoms and non-metal atoms.

☐ **D** Electrons are shared between cations and anions. **(1 mark)**

2 Ionic compounds have a lattice structure.

(a) Complete the diagram, using the symbols + and –, to show the positions of positive and negative ions in an ionic lattice.

Maths skills Remember that opposite charges will attract each other, and like charges will repel.



You should be able to visualise and represent 2D and 3D forms, including 2D representations of 3D objects.

(1 mark)

(b) Describe what ionic bonds are.

.....

..... **(2 marks)**

3 (a) Explain why ionic compounds have high boiling points.

Mention the forces between the particles found in ionic compounds.

.....

..... **(2 marks)**

(b) Suggest a reason that explains why the melting point of MgO is higher than the melting point of NaCl.

..... **(1 mark)**

4 Calcium metal can be produced on an industrial scale by passing an electric current through molten calcium chloride.

Guided

(a) Explain why molten calcium chloride can conduct electricity.

When calcium chloride is a liquid, its ions are .....

..... **(2 marks)**

(b) State why solid calcium chloride **cannot** conduct electricity.

..... **(1 mark)**

(c) Describe one way, other than by melting it, of making calcium chloride conduct electricity.

..... **(1 mark)**

Covalent bonds

1 What are the typical sizes of atoms and small molecules?

Maths skills The quantities are shown in standard form. For example, 10^{-3} is greater than 10^{-6}.

	☐ A	☐ B	☐ C	☐ D
Atoms	10^{-10} m	10^{-10} m	10^{-9} m	10^{-12} m
Molecules	10^{-11} m	10^{-9} m	10^{-12} m	10^{-9} m

(1 mark)

2 Explain how a covalent bond forms.

.....

..... **(2 marks)**

3 Hydrogen reacts with fluorine to form hydrogen fluoride: $H_2 + F_2 \rightarrow 2HF$

The electronic configuration of hydrogen is 1 and the electronic configuration of fluorine is 2.7.

Guided

(a) Explain why fluorine atoms can form only one covalent bond.

A fluorine atom has one unpaired electron in its .....

so it ..... **(2 marks)**

(b) Describe what the structure, H–H, tells you about a hydrogen molecule.

.....

..... **(2 marks)**

(c) Draw the dot-and-cross diagrams for a molecule of each of the following substances, showing the outer electrons only.

Show each chemical symbol. Show one atom's electrons as dots and the other atom's electrons as crosses.

(i) fluorine:

(2 marks)

(ii) hydrogen fluoride:

(2 marks)

4 The electronic configuration of nitrogen is 2.5.

(a) Draw a dot-and-cross diagram for a nitrogen molecule, N_2. Show the outer electrons only.

(2 marks)

(b) Draw the structure for a nitrogen molecule.

Look at question **3b**.

..... **(1 mark)**

Had a go ☐ Nearly there ☐ Nailed it! ☐

Simple molecular substances

1 Carbon dioxide, CO_2, is found in the air. Why does it have a low boiling point?

☐ **A** There are weak forces of attraction between carbon atoms and oxygen atoms.

☐ **B** There are weak covalent bonds between carbon atoms and oxygen atoms.

☐ **C** There are weak forces of attraction between carbon dioxide molecules.

☐ **D** There are weak covalent bonds between carbon dioxide molecules. **(1 mark)**

2 The table shows the properties of three different substances (**A**, **B** and **C**).

Substance	Melting point (°C)	Solubility in water (g per 100 g of water)	Conducts electricity when solid?	Conducts electricity when liquid?
A	290	43	no	yes
B	–95	0.001	no	no
C	660	0	yes	yes

State and explain which substance (**A**, **B** or **C**) is a simple molecular substance.

.....

.....

..... **(3 marks)**

3 Sulfur hexafluoride, SF_6, exists as simple molecules. It is used as an insulating gas for electrical equipment.

(a) Explain why sulfur hexafluoride does not conduct electricity.

Think about whether simple molecules are electrically charged or contain electrons that are free to move.

.....

..... **(2 marks)**

Guided

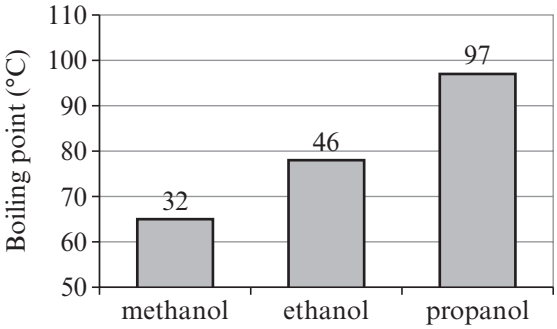
(b) Suggest reasons that explain why sulfur hexafluoride does not dissolve in water.

The intermolecular forces between.....

are weaker than those between.....

and those between..... **(3 marks)**

4 The graph shows the boiling points of three alcohols. Their relative formula masses are shown on each bar.



Describe the relationship shown by the graph, and suggest a reason that explains it.

.....

.....

..... **(2 marks)**

Had a go ☐ Nearly there ☐ Nailed it! ☐

Papers 1 & 2

Giant molecular substances

1 Silica, SiO_2, does not conduct electricity or dissolve in water. Its melting point is very high.

Which statement describes a molecule of silica?

☐ **A** a giant molecule with ionic bonds

☐ **B** a giant molecule with covalent bonds

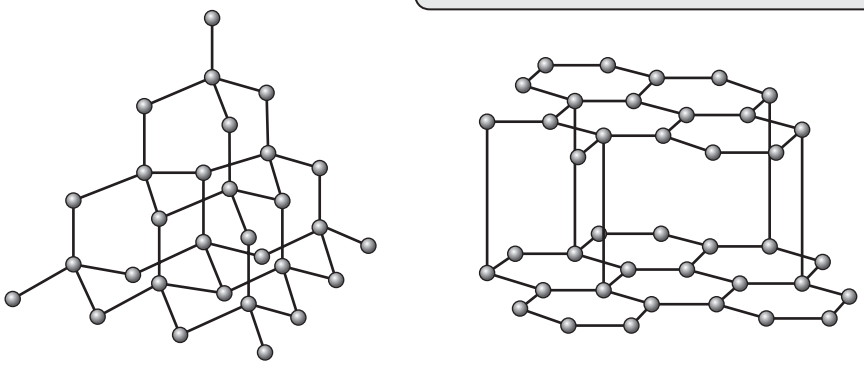
☐ **C** a simple molecule with covalent bonds

☐ **D** a simple molecule with ionic bonds

(1 mark)

2 The diagrams below show the structures of diamond and graphite.

You should be able to visualise and represent 2D and 3D forms, including 2D representations of 3D objects.



diamond graphite

(a) Name the element that has atoms represented by the balls in the diagrams.

..... **(1 mark)**

(b) State the maximum number of bonds present between each atom in a molecule of diamond.

..... **(1 mark)**

(c) Name the type of structure shown in both diagrams.

..... **(1 mark)**

3 Refer to structure and bonding in your answers to the following questions.

You need to explain why diamond is very hard.

(a) Explain why diamond is suitable for use in cutting tools.

.....

..... **(3 marks)**

Guided

(b) Explain why graphite is suitable for use as a lubricant.

The layers in graphite can .....

because ..... **(2 marks)**

(c) Explain why graphite is used to make electrodes.

You need to explain why graphite can conduct electricity.

.....

.....

..... **(2 marks)**

Had a go ☐ Nearly there ☐ Nailed it! ☐

Other large molecules

1 Ethene, C_2H_4, can be made into a polymer. What is the name of this polymer?

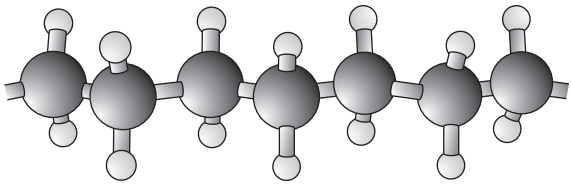
☐ **A** plastic

☐ **B** poly(ethane)

☐ **C** poly(ethene)

☐ **D** poly(ethyne) **(1 mark)**

2 The diagram is a model of a section of a simple polymer.



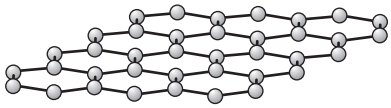
(a) Name the element with atoms represented by the larger, dark-grey balls in the diagram.

..... **(1 mark)**

(b) Name the type of bonding present in a molecule of this polymer.

..... **(1 mark)**

3 Graphene is a form of carbon. It is a good conductor of electricity and has a very high melting point.



The diagram is a model of part of the structure of graphene.

Guided

(a) Explain, in terms of its structure and bonding, why graphene has a very high melting point.

Include the type of bonds that must be broken during melting.

Graphene has ..... bonds in a .....

structure, and these bonds are..... **(3 marks)**

(b) Explain why graphene is a good conductor of electricity.

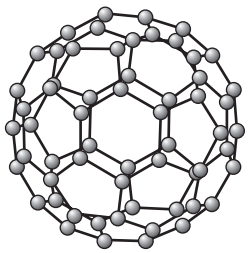
Graphene has a structure similar to a layer of graphite.

.....

.....

..... **(2 marks)**

4 Fullerenes are forms of carbon that include hollow balls, such as buckminsterfullerene, C_{60}.



Explain, in terms of bonding, why buckminsterfullerene has a much lower melting point than graphite.

.....

.....

..... **(3 marks)**

Metals

1 Metal elements and non-metal elements have different typical properties.

Complete the table below by placing a tick (✓) in each correct box.

	Low melting points	High melting points	Good conductors of electricity	Poor conductors of electricity
Metals				
Non-metals				

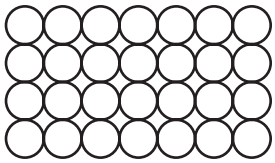
(4 marks)

2 Most metals are shiny solids with high densities. Explain what having a 'high density' means.

.....

..... **(2 marks)**

3 Copper is a metal used in electricity cables. It is a good conductor of electricity and is malleable (it will bend without shattering). The diagram is a model for the structure of copper. Each circle is a copper ion.



(a) State two improvements to the diagram that will make it a more accurate model of the structure of copper.

Remember that ions are charged particles.

.....

..... **(2 marks)**

Guided

(b) Explain why copper is malleable.

Layers of .....

can ..... **(2 marks)**

(c) Explain why copper is a good conductor of electricity.

.....

..... **(2 marks)**

4 Explain why many metals have high melting points, using ideas about metallic bonding to justify your answer.

In your answer, mention which particles are attracted to each other in a metal crystal.

.....

.....

.....

..... **(3 marks)**

5 Metals are insoluble in water. However, when a granule of calcium is added to water, it fizzes and gradually disappears. Suggest an explanation for these observations.

.....

..... **(2 marks)**

Had a go ☐ Nearly there ☐ Nailed it! ☐

Limitations of models

1 The formula of a substance can be given in different ways.

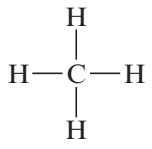
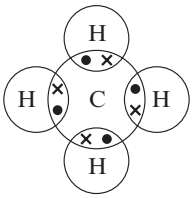
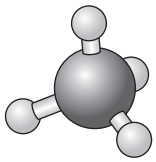
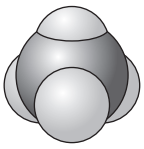
Which row (**A**, **B**, **C** or **D**) correctly shows the different formulae for ethene?

	Molecular formula	Empirical formula	Structural formula
☐ **A**	C_2H_6	CH_3	CH_3CH_3
☐ **B**	C_2H_4	CH_2	$CH_2=CH_2$
☐ **C**	CH_2	C_2H_4	$CH_2=CH_2$
☐ **D**	$CH_2=CH_2$	C_2H_4	CH_2

Answer **A** cannot be correct because it describes ethane, not ethene.

(1 mark)

2 The diagrams (**A**, **B**, **C** and **D**) show four different models for a molecule of methane, CH_4.

A	B	C	D
			
Structure	**Dot-and-cross diagram**	**Ball-and-stick model**	**Space-filling model**

State the letters (**A**, **B**, **C** or **D**) for the models that:

You may need to identify more than one model in your answers.

(a) show the covalent bonds present in a methane molecule

..... **(1 mark)**

(b) identify the elements present in a methane molecule

..... **(1 mark)**

(c) represent the three-dimensional shape of a methane molecule

..... **(1 mark)**

(d) show the electrons involved in bonding

..... **(1 mark)**

(e) show the relative sizes of each atom in a methane molecule

..... **(1 mark)**

3 A student draws a dot-and-cross diagram of a water molecule. Compare and contrast the advantages and disadvantages of drawing a ball-and-stick model instead.

Think about the limitations of each model. You do not need to write a conclusion in your answer.

.....

.....

.....

..... **(3 marks)**

Had a go ☐ Nearly there ☐ Nailed it! ☐

Papers 1 & 2

Relative formula mass

Use the relative atomic masses, A_r, in the table below when you answer the questions.

Element	Al	Ca	Cl	Cu	H	N	O	S
A_r	27	40	35.5	63.5	1	14	16	32

1 Calculate the relative formula mass, M_r, of each of the following substances.

You do not need to show your working out, but it will help you to check the accuracy of your answers.

If relative atomic masses are not given in the question, you can find them in the periodic table.

(a) water, H_2O

..... **(1 mark)**

(b) sulfur dioxide, SO_2

..... **(1 mark)**

(c) aluminium oxide, Al_2O_3

..... **(1 mark)**

(d) ammonium chloride, NH_4Cl

Do not round the answer to this question to a whole number.

..... **(1 mark)**

(e) calcium chloride, $CaCl_2$

..... **(1 mark)**

(f) aluminium chloride, $AlCl_3$

..... **(1 mark)**

2 Calculate the relative formula mass, M_r, of each of the following substances.

Guided

(a) calcium hydroxide, $Ca(OH)_2$

16 + 1 = 17, 17 × 2 = 34, 40 + 34 =. ..... **(1 mark)**

(b) aluminium hydroxide, $Al(OH)_3$

Maths skills: You could also enter the calculation into your calculator as: 40 + (2 × (16 + 1)) =

..... **(1 mark)**

(c) calcium nitrate, $Ca(NO_3)_2$

..... **(1 mark)**

(d) ammonium sulfate, $(NH_4)_2SO_4$

..... **(1 mark)**

(e) aluminium sulfate, $Al_2(SO_4)_3$

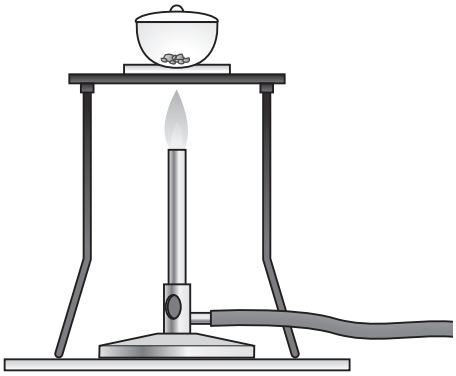
..... **(1 mark)**

Had a go ☐ Nearly there ☐ Nailed it! ☐

Practical skills

Empirical formulae

1 A student carries out an experiment to determine the empirical formula of magnesium oxide. He heats a piece of magnesium ribbon in a crucible. He continues until the contents of the crucible stop glowing.



The table shows his results.

Object	Mass (g)
empty crucible and lid	20.24
crucible, lid and contents before heating	20.49
crucible, lid and contents after heating	20.65

(a) Suggest a reason that explains why the student continued heating until the contents stopped glowing.

..... **(1 mark)**

(b) The hot crucible is a hazard. Explain one precaution needed to control the risk of harm.

.....

..... **(2 marks)**

Guided

(c) Calculate the empirical formula of magnesium oxide using the student's results.

(A_r of Mg = 24 and A_r of O = 16)

mass of magnesium used = 20.49 g – 20.24 g = 0.25 g

mass of oxygen reacted = 20.65 g – 20.49 g = ...

Mg	**O**	
$\frac{0.25}{24} = 0.0104$	$\frac{.....}{.....} = ...$	Divide the mass of each element by its A_r.
$\frac{0.0104}{.....} = ...$	$\frac{.....}{16} = ...$	Divide both numbers by the smallest number to find the ratio.

Empirical formula is ..... Write down the empirical formula.

(4 marks)

2 In an experiment, 11.2 g of hot iron reacts with 21.3 g of chlorine gas to form iron chloride.

Calculate the empirical formula of the iron chloride.

(A_r of Fe = 56 and A_r of Cl = 35.5)

..... **(2 marks)**

3 The empirical formula of a sample of gas is NO_2. Its relative formula mass, M_r, is 92.

Deduce the molecular formula of the gas.

.....

..... **(2 marks)**