IGCSE Edexcel Chemistry Revision

Revision Guide Section 2: The Periodic Table and Bonding

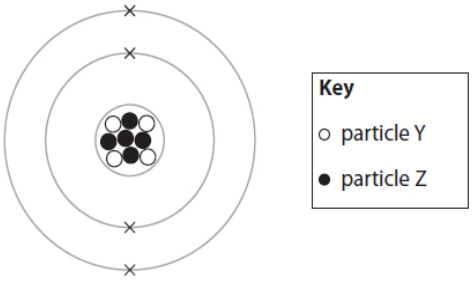
Paper 1 [All Pathways]

Please note, these questions may have parts related to **other** topics within the GCSE Chemistry course. However, all questions are related at least in part to The Periodic Table and Bonding.

Questions taken from 2019 and 2020 January and June Papers (C and CR)

6 questions
59 marks
Recommended time: 65 minutes

1. The diagram shows the particles in the atom of an element.



(a) Particle Y is a proton.
What is particle Z? (1)

- ☐ A an electron
- ☐ B a molecule
- ☐ C a neutron
- ☐ D a nucleus

(b) Which of these has the smallest mass? (1)

- ☐ A an electron
- ☐ B a neutron
- ☐ C a nucleus
- ☐ D a proton

(c) What is the mass number of this atom? (1)

- ☐ A 4
- ☐ B 5
- ☐ C 9
- ☐ D 13

(c) What is the atomic number of this atom? (1)

- ☐ A 4
- ☐ B 5
- ☐ C 9
- ☐ D 13

(e) (i) Identify the element that contains this atom. (1)

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(ii) State what is formed when this atom loses its outer shell electrons. (1)

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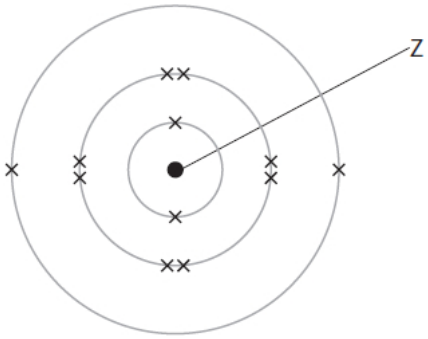
(Total for question = 6 marks)

2. The diagram shows the electronic configuration of an atom of an element.



(a) Complete the table by giving the missing information about this atom. (5)

name of the part of this atom labelled Z	
number of protons in this atom	
number of the group that contains this element	
number of the period that contains this element	
the charge on the ion formed from this atom	

(b) This element has three isotopes.
The table shows the mass number and percentage abundance of each isotope in a sample of this element.

Mass number	Percentage abundance (%)
24	79.2
25	10.0
26	10.8

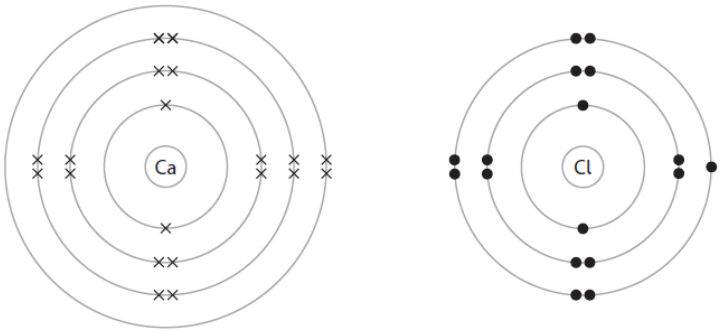
Calculate the relative atomic mass (A_r) of this element.
Give your answer to one decimal place. (3)

relative atomic mass = ...

(Total for question = 8 marks)

3.

(a) The diagram shows the arrangement of electrons in an atom of calcium and in an atom of chlorine.



Describe, in terms of electrons, what happens when calcium reacts with chlorine to form the ionic compound calcium chloride, $CaCl_2$ (3)

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(b) Describe tests to show that an aqueous solution of calcium chloride contains calcium ions and chloride ions. (4)

calcium ions

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chloride ions

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(c) Solid calcium chloride does not conduct electricity. Aqueous solutions of calcium chloride do conduct electricity.

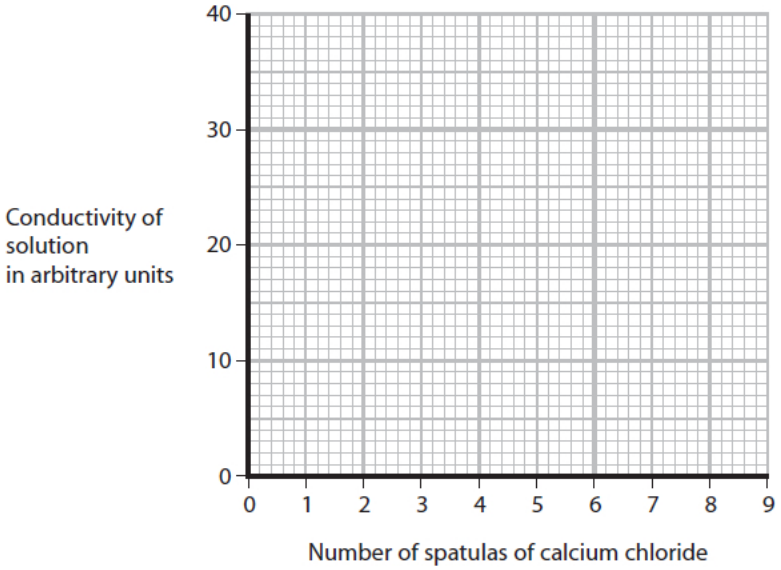
A student uses this method to investigate how the conductivity of a solution changes when calcium chloride is dissolved in pure water.

Step 1 add 100 cm^3 of pure water to a beaker
Step 2 add one spatula of solid calcium chloride to the beaker
Step 3 stir the solution
Step 4 measure the conductivity of the solution
Step 5 repeat until nine spatulas of solid calcium chloride have been added

The table shows the student's results.

Number of spatulas of calcium chloride	Conductivity of solution in arbitrary units
0	0
1	6
2	12
3	12
4	24
5	30
6	36
7	36
8	36
9	36

(i) Plot the results on the grid and draw two straight lines of best fit.
Ignore the anomalous result. (3)



(ii) State the trend shown on the graph for the first six spatulas of calcium chloride. (1)

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(iii) Suggest an error the student could have made to cause the anomalous result. (1)

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(d) Describe another way to make solid calcium chloride conduct electricity. (2)

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(Total for question = 14 marks)

4. This question is about ionic compounds.

(a) The table shows the formulae of some positive and negative ions, and the formulae of some compounds containing these ions.

	Mg^{2+}	Al^{3+}	NH_4^+
S^{2-}	MgS	Al_2S_3	
NO_3^-		$Al(NO_3)_3$	NH_4NO_3
CO_3^{2-}	$MgCO_3$		$(NH_4)_2CO_3$

(i) Complete the table by giving the three missing formulae. (3)

(ii) Give the name of the compound with the formula NH_4NO_3 (1)

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(b) Sodium oxide, Na_2O, is an ionic compound.
The sodium and oxide ions are held together by ionic bonds.

(i) State the meaning of the term ionic bond. (2)

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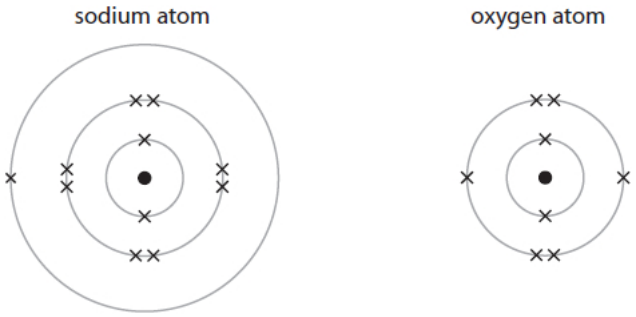
(ii) The diagram shows the arrangement of the electrons in a sodium atom and in an oxygen atom.



Draw diagrams in the boxes to show the arrangement of the electrons in the ions of sodium oxide.
Include the charges on the ions. (3)

sodium ion	oxide ion	sodium ion

(Total for question = 9 marks)

5. This question is about carbon and its compounds.

(a) (i) Draw a dot-and-cross diagram to show the outer shell electrons in a molecule of carbon dioxide, CO_2 (2)

(ii) The atoms in carbon dioxide are held together by covalent bonds.
Describe the forces of attraction in a covalent bond. (2)

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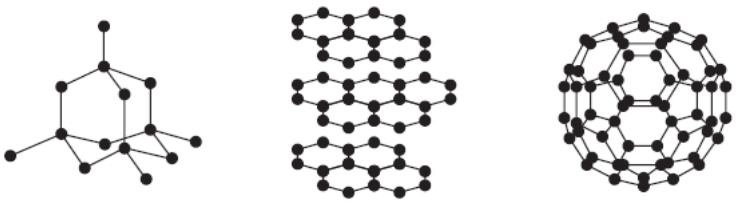
(b) The diagram shows three different structures of carbon.



diamond graphite C_{60} fullerene

(i) Explain why graphite conducts electricity. (2)

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(ii) Explain why diamond has a much higher melting point than C_{60} fullerene. Refer to structure and bonding in your answer. (5)

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(Total for question = 11 marks)

6.

(a) Carbon dioxide changes directly from a solid to a gas without becoming a liquid.

(i) Give the name of the change of state from solid to gas. (1)

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(ii) Describe the test for carbon dioxide gas. (2)

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(b) Carbon dioxide is a simple molecular covalent substance.

Explain why carbon dioxide turns from a solid to a gas at a very low temperature. (2)

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(c) Diamond and graphite are both giant covalent substances made up of carbon atoms.

- diamonds are used in cutting tools
- graphite is used in pencils to make marks on paper

Explain, with reference to structure and bonding, why each substance is suitable for its particular use. (6)

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(Total for question = 11 marks)

Mark Scheme

Q1.

Question number	Answer	Notes	Marks
(a)	C Neutron The only correct answer is C because the nucleus contains protons and neutrons. Protons are identified as the white dots A is not correct because electrons occur in the shells B is not correct because a molecule is not a particle found in the nucleus D is not correct because the nucleus contains protons **and** neutrons		1
(b)	A Electron The only correct answer is A because electrons have a relative mass of 1/1836 compared to a proton or a neutron B is not correct because a neutron has a relative mass of 1 C in not correct because the nucleus contains 4 protons and 5 neutrons D is not correct because a proton has a relative mass of 1		1
(c)	C 9 The only correct answer is C because the mass number is the sum of the protons and neutrons A is not correct because the atomic number is 4 B is not correct because 5 is the number of neutrons D is not correct because 13 is the total number of protons, neutrons and electrons		1
(d)	A 4 The only correct answer is A because the atomic number is equal to the number of protons which is 4 B is not correct because 5 is the number of neutrons C is not correct because 9 is the total number of particles in the nucleus D is not correct because 13 is the total number of protons, neutrons and electrons		1
(e) (i)	beryllium/Be		1
(ii)	(positive) ion	**ALLOW** ecf from the element given in (e)(i) **ACCEPT** any positive beryllium ion (or other ecf ion) **REJECT** any negative ion	1

(Q01 4CH1/1CR, Jan 2020)

Q2.

<table>
<tr><th>Question number</th><th>Answer</th><th>Notes</th><th>Marks</th></tr>
<tr><td>(a)</td><td>
<table>
<tr><td>name of the part of the atom labelled Z</td><td>nucleus</td></tr>
<tr><td>number of protons in this atom</td><td>12</td></tr>
<tr><td>number of the group that contains this element</td><td>2</td></tr>
<tr><td>number of the period that contains this element</td><td>3</td></tr>
<tr><td>charge on the ion formed from this atom</td><td>2+</td></tr>
</table>
</td><td>ACCEPT +2 / Mg^{2+}</td><td>5</td></tr>
<tr><td>(b)</td><td>
• calculate sum of mass numbers multiplied by percentage abundances
• divide answer by 100
• give answer to one decimal place

Example calculation

M1 (24 x 79.2) + (25 x 10.0) + (26 x 10.8) OR 2431.6

M2 2431.6 ÷ 100 OR 24.316

M3 24.3
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REJECT if correct working given but incorrectly evaluated

ALLOW ECF from M1

(24 x 0.792) + (25 x 0.100) + (26 x 0.108) OR 24.316 with or without working scores M1 and M2

ALLOW ECF from M2 if calculated answer is to 1dp
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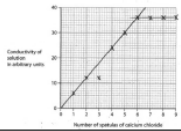
Total 8</td></tr>
</table>

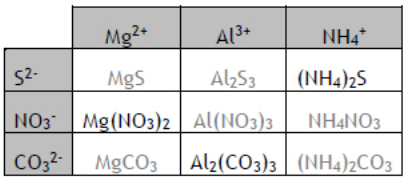
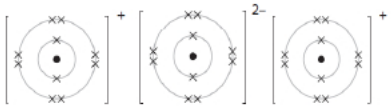
(Q02 4CH1/1C, Jan 2020)

Q3.

Question number	Answer	Notes	Marks
(a)	M1 calcium loses electrons M2 chlorine gains electrons M3 **two** atoms of chlorine each gain **one** electron **OR** M3 calcium loses 2 electrons and chlorine gains 1 electron	**IGNORE** references to redox Allow 1 mark from **M1** and **M2** for electron transfer from chlorine to calcium If chlorine molecules are gaining electrons do not award **M3** Any reference to sharing electrons or covalent or metallic bonding scores 0	3
(b)	(test for Ca^{2+} ions) M1 flame test (allow description of a flame test) M2 orange-red flame colour (test for Cl^- ions) M3 add silver nitrate M4 white precipitate	 **ALLOW** brick-red **IGNORE** orange / red alone **M2** dep on **M1** **ALLOW M1** add sodium hydroxide **ALLOW M2** (slight) white precipitate (reject precipitate dissolves in excess sodium hydroxide) **IGNORE** reference to nitric acid **REJECT** hydrochloric acid or sulfuric acid **M4** dep on silver nitrate in **M3**	4
(c)(i)	**M1** and **M2** all points correct ± half a square **M3** 2 straight lines of best fit ignoring the anomalous point 	One plotting error scores **M1**	3
(c) (ii)	the conductivity is (directly) proportional (to the number of spatulas of calcium chloride added) **OR** the conductivity increases (as the number of spatulas of calcium chloride increases)		1
(iii)	Any **one** from: **M1** The student took the reading before adding the calcium chloride **M2** The student forgot to stir the mixture **OR** did not stir the mixture properly	 **IGNORE** any references to human error	1
(d)	M1 Heat (the calcium chloride) M2 until molten / melts	 **IGNORE** references to electrons / ions	2

(Q08 4CH1/1CR, Jan 2020)

Q4.

Question number	Answer	Notes	Marks
(a) (i)		1 mark for each correct formula	3
(ii)	ammonium nitrate		1
(b) (i)	**M1** electrostatic (force of) attraction **M2** between oppositely charged ions	**ALLOW** electrostatic force **ACCEPT** between positive and negative ions **ACCEPT** between cations and anions	2
(ii)	 **M1** correct electron arrangement of both sodium ions **M2** correct electron arrangement of the oxide ion **M3** correct charges on all ions (with or without brackets)	If only outer shells shown correctly scores 1 mark **ACCEPT** dots in place of crosses or any combination of dots and crosses for M1 and M2	3
			Total 9

	Mg^{2+}	Al^{3+}	NH_4^+
S^{2-}	MgS	Al_2S_3	$(NH_4)_2S$
NO_3^-	$Mg(NO_3)_2$	$Al(NO_3)_3$	NH_4NO_3
CO_3^{2-}	$MgCO_3$	$Al_2(CO_3)_3$	$(NH_4)_2CO_3$

(Q04 4CH1/1C, Jan 2020)

Q5.

Question number	Answer	Notes	Marks
(a) (i)	M1 four electrons between the carbon and each oxygen M2 rest of molecule correct	 M2 dep on M1	2
(ii)	M1 shared pair(s) of electrons M2 attracted to (two) nuclei	 **REJECT** nucleus. Must be plural for M2. M2 dep on mention of electrons in M1	2
(b) (i)	M1 Graphite has delocalised electrons M2 (delocalised electron(s)) can move or flow (throughout the structure)	**IGNORE** sea of electrons **IGNORE** free electrons **IGNORE** number of electrons **IGNORE** references to carrying a charge or current **IGNORE** references to layers M2 dep on mentioning electrons in M1 Any mention of ions scores 0	2
(ii)	M1 (diamond) giant covalent M2 (in melting diamond) covalent bonds are broken M3 (C_{60}) (simple) molecular structure M4 (in melting C_{60}) intermolecular forces (of attraction) are overcome M5 more energy is needed to break covalent bonds (in diamond) than intermolecular forces (in C_{60})	**ALLOW** macromolecular **ALLOW** giant structure if M2 is scored **IGNORE** tetrahedral structure **REJECT** molecules of diamond **ALLOW** description of covalent bonds **ALLOW** molecules of C_{60} **ALLOW** strong covalent bonds and weak intermolecular forces (or attraction) **ACCEPT** breaking bonds in C_{60} if intermolecular forces clearly mentioned Mention of intermolecular forces in diamond no M2 or M5 Mention of breaking covalent bonds in C_{60} no M4 or M5	5

(Q10 4CH1/1CR, Jan 2020)

Q6.

Question number	Answer	Notes	Marks
(a) (i)	sublimation / subliming		1
(ii)	**M1** (add to/bubble into) limewater		2
	M2 (limewater) turns cloudy/milky	**ACCEPT** forms white precipitate M2 DEP M1	
(b)	An explanation that links the following two points		
	M1 weak forces (of attraction) between molecules / weak intermolecular forces (of attraction)	**ALLOW** weak intermolecular bonds **ALLOW** weak intermolecular attractions	
	M2 little energy needed to overcome the (intermolecular) forces	**IGNORE** less energy **ALLOW** little energy needed to separate the molecules **M2** DEP **M1** correct or missing	2
(c)	Any explanation that links any **three** of the following points for diamond		6
	M1 each (carbon) atom is (covalently) bonded to four other (carbon) atoms	**ALLOW** each carbon has four bonds	
	M2 in a (giant) tetrahedral lattice /network / structure	**ALLOW** 3D/rigid in place of tetrahedral	
	M3 the (covalent) bonds are (very) strong	**ALLOW** reference to lot of energy needed to break the (covalent) bonds **ALLOW** there are lots of/many (covalent) bonds	
	M4 (therefore) diamond is (very) hard (and so good for cutting tools)	**ALLOW** diamond is (very) strong If mention of intermolecular forces in diamond MAX 2 for diamond If mention of ions in diamond only M4 can be scored	
	Any explanation that links any **three** of the following points for graphite		
	M5 each (carbon) atom is (covalently) bonded to three other (carbon) atoms		
	M6 (the structure is) in layers	**ALLOW** sheets	
	M7 weak forces (between layers)		
	M8 (the layers can) slide over each other/ rub off		
	M9 this makes graphite soft (so it can make marks on paper)	**ALLOW** slippery If mention of intermolecular forces in graphite MAX 2 for graphite If mention of ions in graphite only M9 can be scored	Total 11

(Q08 4CH1/1C, Jan 2020)