



Additional Assessment Materials

Summer 2021

Pearson Edexcel GCE in Chemistry 9CH0

Resource Set 2 – Topic Group 1

Topics included:

Topic 1: Atomic Structure and the Periodic Table

Topic 2: Bonding and Structure

Topic 3: Redox I

Topic 4: Inorganic Chemistry and the Periodic Table

(Public release version)

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Additional Assessment Materials, Summer 2021

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General guidance to Additional Assessment Materials for use in 2021

Context

- Additional Assessment Materials are being produced for GCSE, AS and A levels (with the exception of Art and Design).
- The Additional Assessment Materials presented in this booklet are an **optional** part of the range of evidence teachers may use when deciding on a candidate's grade.
- 2021 Additional Assessment Materials have been drawn from previous examination materials, namely past papers.
- Additional Assessment Materials have come from past papers both published (those materials available publicly) and unpublished (those currently under padlock to our centres) presented in a different format to allow teachers to adapt them for use with candidate.

Purpose

- The purpose of this resource is to provide qualification-specific sets/groups of questions covering the knowledge, skills and understanding relevant to this Pearson qualification.
- This document should be used in conjunction with the mapping guidance which will map content and/or skills covered within each set of questions.
- These materials are only intended to support the summer 2021 series.

Answer ALL questions.

Some questions must be answered with a cross in a box . If you change your mind about an answer, put a line through the box and then mark your new answer with a cross .

1 (a) Which equation shows the third ionisation energy of aluminium?

(1)

- A $\text{Al(g)} \rightarrow \text{Al}^{3+}(\text{g}) + 3\text{e}^-$
 B $\text{Al}^{2+}(\text{g}) \rightarrow \text{Al}^{3+}(\text{g}) + \text{e}^-$
 C $\text{Al}^{3+}(\text{g}) + 3\text{e}^- \rightarrow \text{Al(g)}$
 D $\text{Al}^{3+}(\text{g}) + \text{e}^- \rightarrow \text{Al}^{2+}(\text{g})$

(b) Which element in this table is in Group 2?

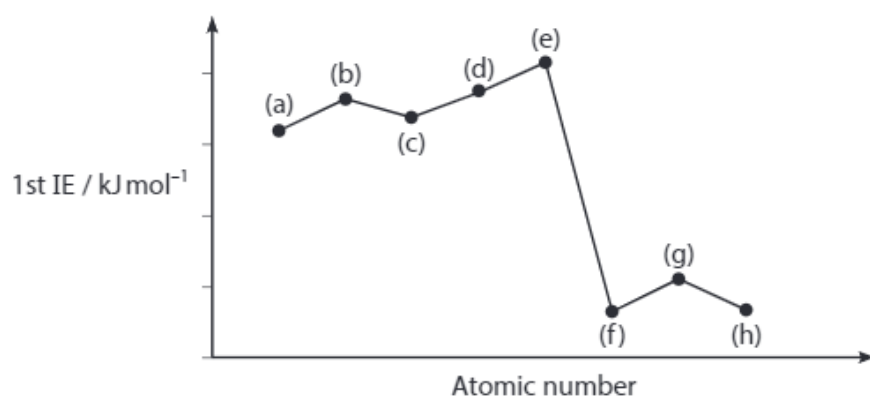
Element	Ionisation energy / kJ mol^{-1}			
	First	Second	Third	Fourth
W	1086	2353	4621	6223
X	653	1592	2987	4740
Y	590	1145	4912	6474
Z	496	4563	6913	9544

(1)

- A W
 B X
 C Y
 D Z

(c) The graph shows the first ionisation energies (IE) of eight successive elements from the first 20 elements in the Periodic Table.

Which letter represents the first ionisation energy of oxygen?



(1)

- A (a)
- B (b)
- C (c)
- D (h)

(d) Give the formula of a stable **ion** that is isoelectronic with the magnesium ion, Mg^{2+} .

(1)

F^{-}

Total for Question 1 = 4 marks

2 This question is about atoms, molecules and ions.

(a) Lithium exists as two isotopes.

Complete the table to show the numbers of subatomic particles in a ${}^6\text{Li}$ atom and a ${}^7\text{Li}^+$ ion.

(2)

Particle	Protons	Neutrons	Electrons
${}^6\text{Li}$	3	3	3
${}^7\text{Li}^+$	3	4	2

(b) The mass spectrum of a diatomic molecule, X_2 , has peaks at the following m/z values for the X_2^+ ion:

32, 33, 34, 35, 36

Deduce the formulae of all the species responsible for **each** of the peaks in the mass spectrum of X_2 , identifying element X and showing clearly the isotopes present.

(3)

Element is oxygen

$$32 - 160 = {}^{16}\text{O}^+$$

$$33 - 170 = {}^{16}\text{O}^+$$

$$34 - 170 = {}^{17}\text{O}^+ \quad \text{and} \quad 160 = {}^{18}\text{O}^+$$

$$35 - 170 = {}^{18}\text{O}^+$$

$$36 - 180 = {}^{18}\text{O}^+$$

(c) Complete the table to show the maximum number of electrons which can fill each region of an atom.

(3)

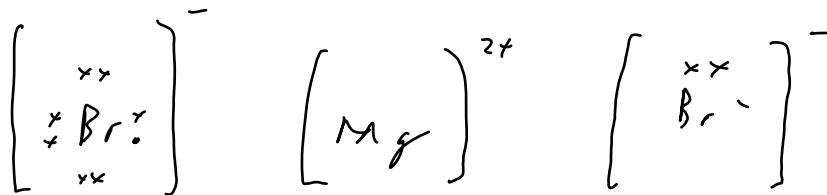
Region	Maximum number of electrons
the 1s orbital	2
the 2p subshell	6
the third quantum shell	18

(Total for Question 2 = 8 marks)

6 Magnesium bromide, MgBr_2 , is an ionic compound.

(a) (i) Draw a dot-and-cross diagram to show the bonding in magnesium bromide. Only outer shell electrons are required.

(1)



(ii) State all the conditions under which magnesium bromide conducts electricity.

(1)

(Total for question 6 = 2 marks)

2 This question is about some redox reactions of chlorine, bromine and iodine.

(a) An **excess** of aqueous potassium bromide was added to chlorine water and the solution turned orange.

(i) Write an equation for this reaction. State symbols are not required.

(1)

(ii) Silver nitrate solution was added to the mixture in (a) and excess dilute ammonia solution was then added to the precipitate formed. Only some of the precipitate dissolved.

Deduce why only **some** of the precipitate dissolved.

(3)

(iii) Aqueous potassium bromide was added to aqueous iodine, instead of chlorine water. There was no reaction.

Give a reason why no reaction occurred.

(1)

(b) Chlorine undergoes disproportionation when it reacts with **hot** aqueous sodium hydroxide solution.

(i) Complete the ionic equation for this reaction.
State symbols are not required.

(1)



(ii) Explain, in terms of oxidation numbers, why this is a disproportionation reaction.

(2)

(Total for Question 2 = 8 marks)

2 Magnesium nitrate decomposes on heating as shown by the equation.



(a) Explain, in terms of all the relevant oxidation numbers, why this is a redox reaction.

(3)

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(b) Calcium nitrate decomposes in a similar way to magnesium nitrate, but requires a higher temperature for decomposition.

Explain this observation in terms of the charge and size of the cations.

(3)

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(Total for Question 2 = 6 marks)

- (ii) Use the experimental data to calculate the value for x in the formula $\text{Mg}(\text{NO}_3)_2 \cdot x\text{H}_2\text{O}$.
You **must** show all your working.

(5)

(Total for Question 5 = 12 marks)

Total for paper = 40 Marks