Pearson Edexcel

Additional Assessment Materials Summer 2021

Pearson Edexcel GCSE in Chemistry (1CH0) Higher

Resource Set Topic B: Bonding and Structure

Questions

(Public release version)

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Additional Assessment Materials, Summer 2021

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- Additional Assessment Materials have come from past papers both published (those materials available publicly) and unpublished (those currently under padlock to our centres) presented in a different format to allow teachers to adapt them for use with candidate.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 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.

2a

(ii) Nickel is a metal.

Explain how the structure of a nickel atom, Ni, changes when it forms a nickel ion, Ni^{2+}.

(2)

In a nickel atom, there are 2 electrons in the outermost energy level. These 2 electrons are lost and nickel gains a charge of +2, forming Ni^{2+}.

1

(d) Metals have high melting points.

Explain, in terms of their structure and bonding, why metals have high melting points.

(2)

In metals, the metallic bonds present are very strong and require very high energy to break them. There is a strong electrostatic force between layers of positive ions and sea of delocalised electrons, so melting point is high.

8 Covalent substances can be simple molecular covalent or giant covalent.

(a) (i) Ammonia is a simple molecular, covalent substance.

Which is the most likely set of properties for ammonia?

(1)

	melting point in °C	boiling point in °C	ability to conduct electricity in liquid state
☒ **A**	1713	2950	does not conduct
☒ **B**	–78	–33	does not conduct
☒ **C**	–39	357	conducts
☒ **D**	801	1413	conducts

(ii) Ammonia, NH_3, is made by reacting nitrogen with hydrogen.

Write the balanced equation for this reaction.

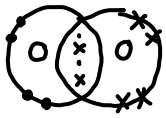
(2)

$N_2 + 3H_2 \rightarrow 2NH_3$

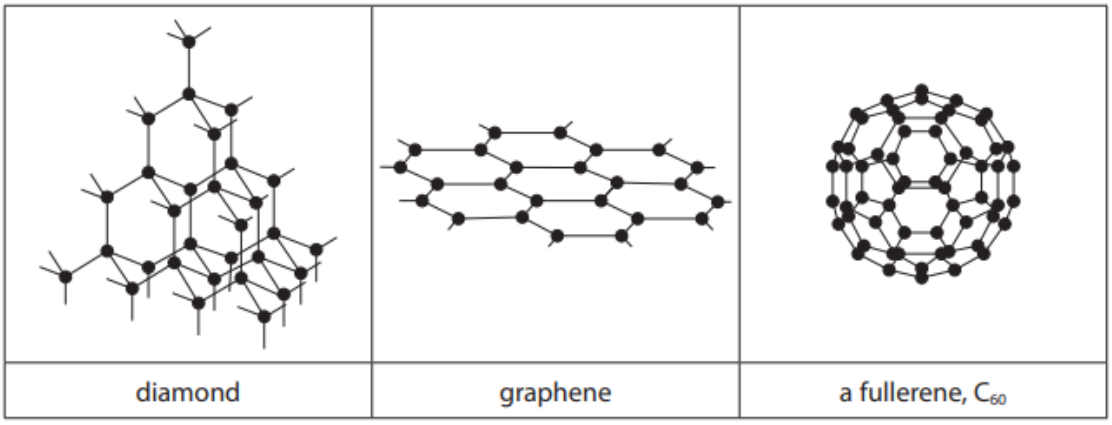
(b) Oxygen, O_2, is also a simple molecular, covalent substance.

Draw a dot and cross diagram for the molecule of oxygen.

(2)



*(c) Figure 8 shows the arrangement of carbon atoms in diamond, graphene and a fullerene (C_{60}).



diamond	graphene	a fullerene, C_{60}

Figure 8

Consider these three substances.

Explain, in terms of their structures and bonding, their relative melting points, strengths and abilities to conduct electricity.

(6)

In diamonds, each carbon atom is bonded to 4 other carbon atoms, forming a giant covalent structure. The covalent bonds in between the atoms are very strong, so the strength of diamond is high. The covalent bonds require high energy to break, so diamond has a high melting point. There are no delocalised electrons, so diamond does not conduct electricity.

In graphene, each carbon is bonded to 3 other carbon atoms, and there is one delocalised electron, so graphene can conduct electricity. The covalent bonds in between carbon atoms are strong and require high energy to break, so graphene also has high melting point and strength.

Fullerene has a simple covalent structure. The intermolecular forces require less energy to break, so fullerene have a lower melting point and strength. Fullerene cannot conduct electricity although there are delocalised electrons, as the electrons are not free to move between molecules.

2

(c) The ions present in sodium sulfate are

sodium	Na^+
sulfate	SO_4^{2-}

Write the formula of sodium sulfate using this information.

(1)

Na_2SO_4

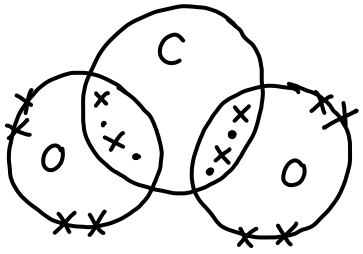
3

(c) The electronic configuration of carbon is 2.4
The electronic configuration of oxygen is 2.6

Draw a dot and cross diagram for a molecule of carbon dioxide.

Show outer electrons only.

(2)



8.

*(c) Calcium chloride can be prepared by the reaction of calcium with chlorine gas.

Figure 9 shows some properties of calcium, chlorine and calcium chloride.

substance	relative melting point	ability to conduct electricity	
		when solid	when molten
calcium	high	good	good
chlorine	low	poor	poor
calcium chloride	high	poor	good

Figure 9

Explain, in terms of bonding and structure, why the properties of the product, calcium chloride, are different from the properties of the reactants, calcium and chlorine.

(6)

Calcium chloride is an ionic compound. The ions are held together by ionic bonds, which are strong and require high energy to break, hence the high melting point. When molten, the ions, which carry charge, are free to move around, so it can conduct electricity. In a solid form, ions cannot move and therefore cannot conduct electricity.

Calcium has a high melting point as it is a metal. The metallic bonds require high energy to break. There is a sea of delocalised electrons so calcium can conduct electricity in both solid and molten form.

Chlorine has a simple molecular structure and the intermolecular forces are weak and require little energy to break, so it has a low melting point. There are no delocalised electrons, so chlorine cannot conduct electricity.

2

(c) Chlorine exists as diatomic molecules.

In a molecule, two chlorine atoms are joined by a covalent bond.

(i) Describe what is meant by a **covalent bond**.

(2)

A covalent bond is formed by atoms sharing a pair or pairs of electrons.

(ii) Explain why chlorine is a gas, rather than a liquid, at room temperature.

(2)

Chlorine has weak intermolecular forces which require very little energy to break.

7

(d) A solid ionic compound is dissolved in water to form a solution.

Describe a simple experiment to show that charged particles are present in this solution.

(3)

Connect a bulb, d.c. supply and 2 innert electrodes using wires. Dip the 2 electrodes in a beaker containing the solution. If the bulb lights up, charged particles are present in the solution.

1 (a) (i) Titanium(IV) oxide is an ionic solid.
Many ionic solids are soluble in water.

Titanium(IV) oxide is not soluble in water.
Its other physical properties are typical of ionic solids.

Predict **one** other physical property of titanium(IV) oxide that would be typical of ionic solids.

(1)

hard

(ii) The formula of titanium(IV) oxide is TiO_2.

Deduce the charge of the titanium ion in titanium(IV) oxide.

(1)

+4

3 (a) An aluminium atom has the atomic number 13 and the mass number 27.

Which row shows the numbers of subatomic particles present in an aluminium ion, Al^{3+}?

(1)

	protons	neutrons	electrons
☐ **A**	13	14	13
☒ **B**	13	14	10
☐ **C**	14	13	10
☐ **D**	14	13	17

(d) Sodium reacts with chlorine to form sodium chloride.

The electronic configuration of the sodium atom is 2.8.1 and the electronic configuration of the chlorine atom is 2.8.7.

Give the electronic configurations of the ions formed.

(2)

Na^+ 2.8

Cl^- 2.8.8

5

(b) Carbon dioxide is a simple molecular, covalent compound.

It has a low boiling point of –78.5 °C.

Explain why carbon dioxide has a low boiling point.

(2)

Carbon dioxide has weak intermolecular forces which require very low energy to break.

2 (a) An atom of potassium has atomic number 19 and mass number 39.

(i) Give the electronic configuration of this potassium atom.

(1)

2.8.8.1

(ii) This potassium atom forms the ion K^+.

Which row shows the number of protons and the number of neutrons in this potassium ion, K^+?

(1)

	number of protons	number of neutrons
☒ **A**	19	19
☒ **B**	19	20
☒ **C**	20	19
☒ **D**	20	20

(c) Fluorine boils at −188 °C.
There are forces between fluorine molecules.

Explain, in terms of these forces, why the boiling point of fluorine is low.

(2)

The intermolecular forces are weak and require low energy to break.

TOTAL FOR PAPER IS 42 MARKS