

Metallic Crystals

Question Paper

Level	GCSE
Subject	Chemistry
Exam Board	Edexcel IGCSE
Module	Double Award (Paper 1C)
Topic	Principles of Chemistry
Sub-Topic	Metallic Crystals
Booklet	Question Paper

Time Allowed: 82 minutes

Score: /68

Percentage: /100

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	75%	70%	60%	55%	50%	<50%

Edexcel (I)GCSE

Chemistry

Double Award (Paper 1C)

Principles of Chemistry: Metallic Crystals

Total Marks: 68

You must have:

Ruler

Calculator

Instructions:

Use black ink or ball-point pen.

Answer All questions.

Answer the questions in the spaces provided there may be more space than you need

Show all the steps in any calculations and state the units.

Information:

The total mark for this paper is 68

The marks for each question are shown in brackets use this as a guide as to how much time to spend on each question.

Advice:

Read each question carefully before you start to answer it.

Keep an eye on the time.

Write your answers neatly and in good English.

Try to answer every question.

Check your answers if you have time at the end.

1. Like other metals, iron is malleable and is a good conductor of electricity.

(a) (i) Explain why iron is malleable.

(2)

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(ii) Explain why iron is a good conductor of electricity.

(2)

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(b) Iron forms two sulfates.

One has the formula FeSO_4 and the other has the formula $\text{Fe}_2(\text{SO}_4)_3$

The addition of sodium hydroxide solution can be used to distinguish between solutions of these sulfates.

(i) State what would be observed in each case.

(2)

FeSO_4

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$\text{Fe}_2(\text{SO}_4)_3$

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(ii) Write a chemical equation for the reaction of iron(II) sulfate (FeSO_4) with sodium hydroxide solution.

(2)

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(Total for Question 1 = 8 marks)

2 This question is about bromine and some of its compounds.

(a) Atoms of bromine can be represented as ^{79}Br and ^{81}Br

(i) State the number of protons, neutrons and electrons in an atom of ^{79}Br (2)

Protons

Neutrons

Electrons

(ii) What name is used for atoms of bromine that have different numbers of neutrons? (1)

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(iii) Why do all atoms of bromine have the same chemical properties? (1)

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(iv) The relative atomic mass of bromine is given in the Periodic Table as 80, but a more accurate value is 79.9

Suggest, with a reason, which of the atoms ^{79}Br and ^{81}Br exists in greater numbers in a sample of bromine. (2)

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(b) Hydrogen bromide (HBr) and sodium bromide (NaBr) are compounds of bromine.

(i) Draw a dot and cross diagram to represent a hydrogen bromide molecule.

Show only the outer electrons in each atom.

(2)

(ii) Explain how the atoms are held together in a hydrogen bromide molecule.

(2)

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(iii) Explain why sodium bromide has a higher melting point than hydrogen bromide.

(3)

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(c) A compound has the percentage composition 13.8% sodium, 47.9% bromine and 38.3% oxygen by mass.

Calculate its empirical formula.

(3)

Empirical formula =

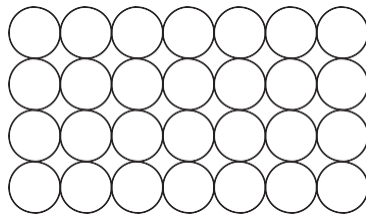
(Total for Question 2 = 16 marks)

3 The properties of substances can be explained in terms of their bonding and structure.

Electricity can be transmitted by overhead power lines. This method of transmission requires electrical conductors and insulators.

(a) Aluminium is used for the overhead lines because it is a good conductor of electricity and is ductile (can be pulled into a wire).

This diagram can be used to represent the structure of aluminium.



○ aluminium atom

(i) Explain why aluminium is a good conductor of electricity.

(2)

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(ii) Suggest why aluminium is ductile.

(2)

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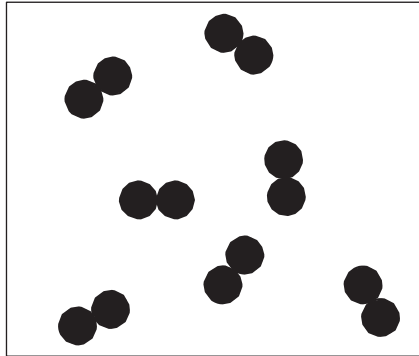
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(b) The main substance that acts as an insulator in this method of transmission of electricity is air, which is mostly nitrogen.

The power lines are supported by solid insulators. Most solid insulators are manufactured using silica.

The diagram shows the structures of nitrogen and silica.



Nitrogen



Silica

Explain, in terms of bonding and structure, why nitrogen is a gas at room temperature but silica is a solid with a high melting point.

(5)

Nitrogen

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Silica

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(Total for Question 3 = 9 marks)

4 The table shows some properties of four substances A, B, C and D.

Substance	Melting point in °C	Boiling point in °C	Conducts electricity when solid?	Conducts electricity when molten?
A	-101	-35	no	no
B	1063	2970	yes	yes
C	801	1413	no	yes
D	3550	4830	no	no

(a) Use the information in the table to identify the substance that

(i) is a metal

(1)

A B C D

(ii) could be diamond

(1)

A B C D

(iii) is a gas at 20°C

(1)

A B C D

(iv) contains oppositely charged ions

(1)

A B C D

(b) Some of the substances in the table are compounds.

What is meant by the term **compound**?

(2)

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(c) (i) The electronic configurations of atoms of sodium and chlorine are

Na 2.8.1

Cl 2.8.7

Describe the changes in the electronic configurations of sodium and chlorine when these atoms form sodium chloride.

(3)

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(ii) Calculate the relative formula mass of sodium chloride (NaCl).

Use the Periodic Table on page 2 to help you.

(2)

relative formula mass =

(Total for Question 4 = 11 marks)

5 Aluminium and iron have some similar properties.

Both metals

- are malleable
- are ductile (can be drawn into a wire)
- are good conductors of electricity
- are good conductors of heat
- have a high melting point

(a) (i) Choose two properties from the list that make iron a suitable metal for saucepans. (2)

1

2

(ii) Choose two properties from the list that make aluminium a suitable metal for power cables.

(2)

1

2

(b) Steel is an alloy containing iron.

These are three differences between steel and aluminium.

steel can rust but aluminium resists corrosion

steel has a higher density than aluminium

steel is much stronger than aluminium

(i) Use information from the list to suggest why steel is the better metal for making bridges.

(1)

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(ii) Use information from the list to suggest why aluminium is the better metal for making aircraft bodies.

(1)

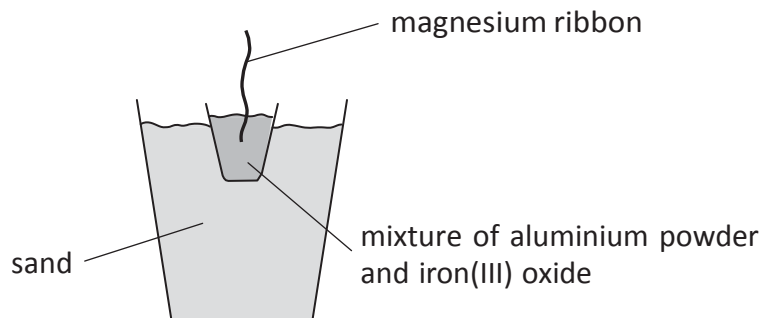
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(c) The reaction between aluminium and iron(III) oxide is known as a thermite reaction.

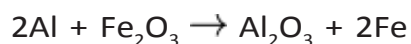
The diagram shows how this thermite reaction can be carried out.



The magnesium ribbon is lit to ignite the reaction mixture.

The reaction is highly exothermic.

The equation for the reaction is



(i) What is meant by the term **exothermic**?

(1)

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(ii) What does the reaction suggest about the reactivity of aluminium compared to the reactivity of iron?

Explain your answer.

(2)

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(iii) Which element is oxidised in this thermite reaction?

Give a reason for your answer.

(2)

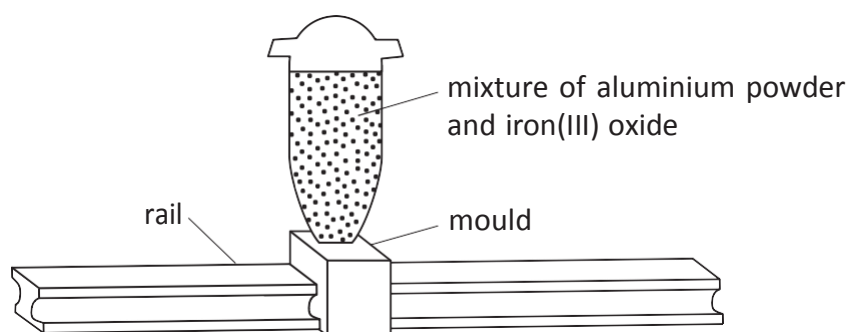
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(d) This thermite reaction can be used to join together two rails on a railway line.



The reaction mixture is ignited and molten iron pours into the mould. The mould is removed and the molten iron solidifies to create a join between the two rails.

Explain why the iron produced in the reaction is molten.

(1)

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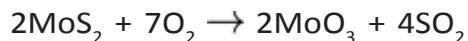
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(Total for Question 5 = 12 marks)

6 Molybdenum (Mo) is a metal. It is often used to make an alloy with iron.

Like iron, it is extracted from its oxide. Unlike iron, it occurs mainly as its sulfide.

(a) Molybdenum sulfide is converted into molybdenum oxide by heating in air.
The equation for this reaction is



(i) Why is molybdenum said to be oxidised in this reaction?

(1)

(ii) The sulfur dioxide formed in the reaction could form acid rain if it escaped into the atmosphere.

Write a chemical equation for the formation of an acid from sulfur dioxide.

(1)

(b) The table shows the melting points of molybdenum oxide and sulfur dioxide.

	Melting point in °C
molybdenum oxide	800
sulfur dioxide	-75

The melting point indicates the type of bonding and structure in a compound.

(i) What is the type of bonding in a molecule of sulfur dioxide?

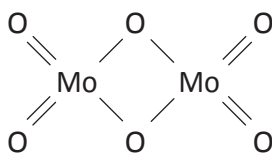
(1)

(ii) Explain why the melting point of sulfur dioxide is low.

(2)

- (iii) The melting point of molybdenum oxide suggests that it has ionic bonding. However, it is often represented as a molecular structure.

Deduce the molecular formula of molybdenum oxide as shown in this structure.



(1)

- (c) The metallic structure of molybdenum gives it some typical properties.

- (i) Describe the metallic structure of molybdenum.

(2)

- (ii) Explain why molybdenum is a good conductor of electricity.

(2)

- (iii) Explain why molybdenum is malleable.

(2)

(Total for Question 6 = 12 marks)