Properties of Materials (H)

1. Ammonia has a simple molecular structure.

Which statement explains why ammonia has a low melting point and a low boiling point?

A The covalent bonds between the atoms are strong.
B The covalent bonds between the atoms are weak.
C The intermolecular forces between the molecules are strong.
D The intermolecular forces between the molecules are weak.

Your answer ☐ **[1]**

2. Graphite is a form of carbon. Graphite can conduct electricity.

Why can graphite conduct electricity?

A Delocalised electrons are between layers.
B The ions can move.
C Layers have weak intermolecular forces.
D Strong covalent bonds are between the carbon atoms.

Your answer ☐ **[1]**

3. Carbon can form different **allotropes**.

Which of these are allotropes of carbon?

A Diamond, graphite, graphene.
B Diamond, granite, graphite.
C Fullerene, graphene, ethene.
D Granite, graphite, graphene.

Your answer ☐ **[1]**

4. The melting point of bromine is −7 °C.

The boiling point of bromine is 59 °C.

What state would bromine be at room temperature?

A Aqueous
B Gas
C Liquid
D Solid

Your answer ☐ **[1]**

5. Carbon dioxide exists as a simple molecule.

Why do simple molecules have low boiling points?

A Simple molecules have weak covalent bonds between atoms.
B Simple molecules have weak intermolecular forces between atoms.
C Simple molecules have weak ionic bonds between the molecules.
D Simple molecules have weak intermolecular forces between the molecules.

Your answer ☐ **[1]**

6 (a). This question is about structure and bonding.

Look at the two structures, **A** and **B**, in **Fig. 16.1**.

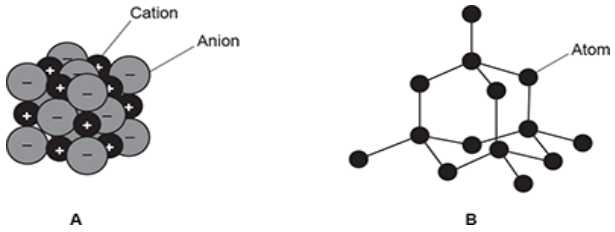


Fig. 16.1

i. Identify the bonding in structure **A**.

Explain your answer.

Bonding

Explanation

---

[2]

ii. Explain why structure **B** has a high melting point.

---

[2]

iii. Explain why structure **B** does **not** conduct electricity.

---

[1]

(b). Look at the structure of a metal in **Fig. 16.2**. Metals are malleable, which means they can be hammered or pressed into shape without breaking or cracking.

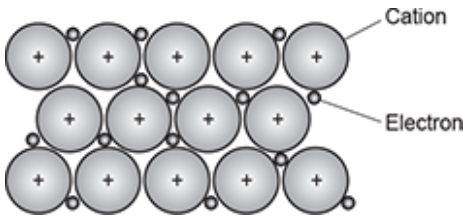
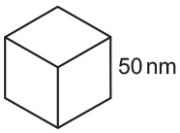


Fig. 16.2

Explain why metals are **malleable**.

--- **[2]**

7(a). A cube-shaped nanoparticle has sides of length 50 nm.



Calculate the surface area to volume ratio for this nanoparticle.

Use the equation: ratio = surface area ÷ volume

Surface area to volume ratio = ... **[4]**

(b).

i. Scientists compare the size of nanoparticles to the sizes of other small objects.

Look at the table.

Object	Diameter (nm)
Gold atom	0.14
Water molecule	0.27
DNA strand	2.5
Zinc oxide nanoparticle	32
Red blood cell	7000
Human hair	100 000

The diameter of a DNA strand is 2.5 nm.

Explain why DNA is a nanoparticle but a water molecule is **not** a nanoparticle.

---

[2]

ii. Calculate how many zinc oxide nanoparticles would fit across a human hair.

Give your answer to **2** significant figures.

Number of nanoparticles = ... **[2]**

(c). A new sun cream has been developed using zinc oxide nanoparticles.

The small particles provide better protection from the sun and they do not leave white marks on the skin.

Explain **one** possible risk of using nanoparticles in sun cream.

---

[1]

8. Zinc and dilute sulfuric acid react to make hydrogen.

$$Zn(s) + H_2SO_4(aq) \rightarrow ZnSO_4(aq) + H_2(g)$$

Inga measures the rate of this reaction by measuring the **loss in mass** of the reaction mixture.
She finds that the change in mass is very small and difficult to measure.
The reaction between zinc and dilute sulfuric acid is slow.
Inga decides to try and find a catalyst for this reaction.
She tests four possible substances.
Each time she adds 0.5 g of the substance to 1.0 g of zinc and 25 cm^3 of dilute sulfuric acid.
Look at her table of results.

Substance	Colour of substance at start	Colour of substance at end	Relative rate of reaction
no substance			1
calcium sulfate powder	white	white	1
copper powder	pink	pink	10
copper(II) sulfate powder	blue	pink	30
manganese(IV) oxide powder	black	black	1

i. It is important to do the reaction with **only** zinc and dilute sulfuric acid.

Explain why.

---

[1]

ii. It is important to do all of the reactions with the same concentration of acid.

Explain why.

---

[1]

iii. Which of the substances could be a catalyst for the reaction between zinc and dilute sulfuric acid?

Explain your answer.

---

[2]

iv. There is not enough evidence to confirm which substance is a catalyst.

Suggest an extra piece of experimental evidence that could be collected to confirm which substance is a catalyst.

---

[1]

v. Inga does the experiment with copper, zinc and dilute sulfuric acid again.

This time she uses a lump of copper rather than copper powder.

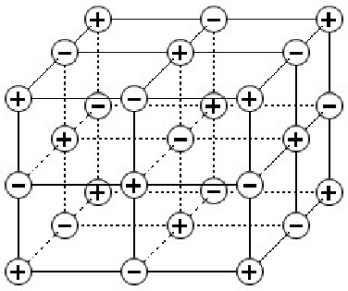
Predict, with reasons, the relative rate of reaction.

---

[2]

9(a). Look at the diagrams.

They show the structures of two compounds.



sodium chloride

water

Sodium chloride has a melting point of 801°C.

Use the structure of sodium chloride to explain why.

---

[2]

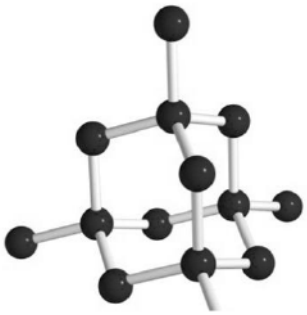
(b). Water has a low melting point and boiling point.

Explain why.

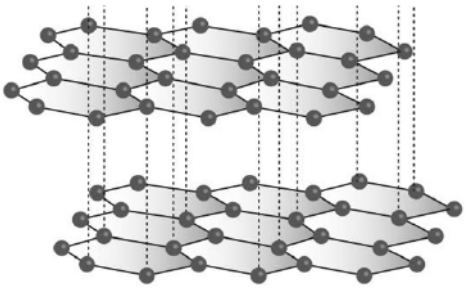
---

[2]

10(a). The diagrams show the structures of two forms of carbon.



diamond



graphite

Graphite is a good conductor of electricity.

Diamond does not conduct electricity.

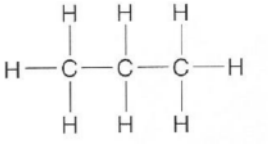
Use ideas about structure and bonding in diamond and graphite to explain these observations.

---

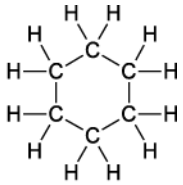
[3]

(b). Carbon can form many thousands of different compounds.

Two examples are shown below.



propane



cyclohexane

Why can carbon form many thousands of different compounds?

---

[1]

(c). Ethanol contains carbon.

Look at some information about ethanol.

Melting point = −114°C

Boiling point = 78°C

Predict the state of ethanol at 25°C. How can you tell?

---

[2]

11. Crude oil can be separated in the laboratory into fractions which have different boiling points.

Look at the table. It shows possible relationships between:

- boiling point
- number of carbon atoms in the molecule
- size of intermolecular forces.

Which letter represents the correct relationship between the boiling point, number of carbon atoms and size of intermolecular forces?

	Boiling point	Number of carbon atoms in the molecule	Size of intermolecular forces
A	high	more than 50	small
B	low	more than 50	large
C	high	less than 20	large
D	low	less than 20	small

Your answer ☐

[1]

12. Look at the diagrams.

Which diagram shows a solid with the **largest** surface area to volume ratio?

A

B

C

D

Your answer ☐

[1]

13. Rosa tests some compounds to find out if they conduct electricity.

Which row in the table shows the correct results for each compound

	Solid ionic compound	**Ionic compound dissolved in water**	**Molten ionic compound**
A	conducts	does not conduct	conducts
B	conducts	conducts	conducts
C	conducts	conducts	does not conduct
D	does not conduct	conducts	conducts

Your answer ☐

[1]

END OF QUESTION PAPER