OCR GCSE GATEWAY CHEMISTRY A · J248

CHEMISTRY



EXAM QUESTION PACK

C2.3 PROPERTIES OF MATERIALS

SCORE	PERCENTAGE
/179	%

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Gateway Chemistry A (9-1)

Properties of materials

Please note that you may see slight differences between this paper and the original.

Candidates answer on the Question paper.

OCR supplied materials:
Additional resources may be supplied with this paper.

Other materials required:
- Pencil
- Ruler (cm/mm)

Duration: Not set

Candidate forename		Candidate surname	

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions, unless your teacher tells you otherwise.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Where space is provided below the question, please write your answer there.
- You may use additional paper, or a specific Answer sheet if one is provided, but you must clearly show your candidate number, centre number and question number(s).

INFORMATION FOR CANDIDATES

- The quality of written communication is assessed in questions marked with either a pencil or an asterisk. In History and Geography a *Quality of extended response* question is marked with an asterisk, while a pencil is used for questions in which *Spelling, punctuation and grammar and the use of specialist terminology* is assessed.
- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **179**.
- The total number of marks may take into account some 'either/or' question choices.

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1 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.

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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]

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2 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]

3 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]

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4 Look at the diagrams.

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

A



B



C



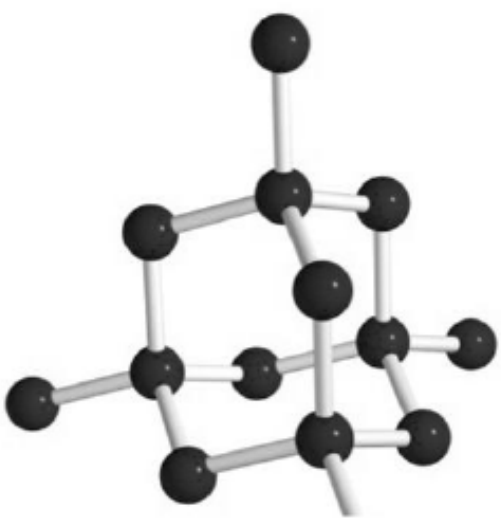
D



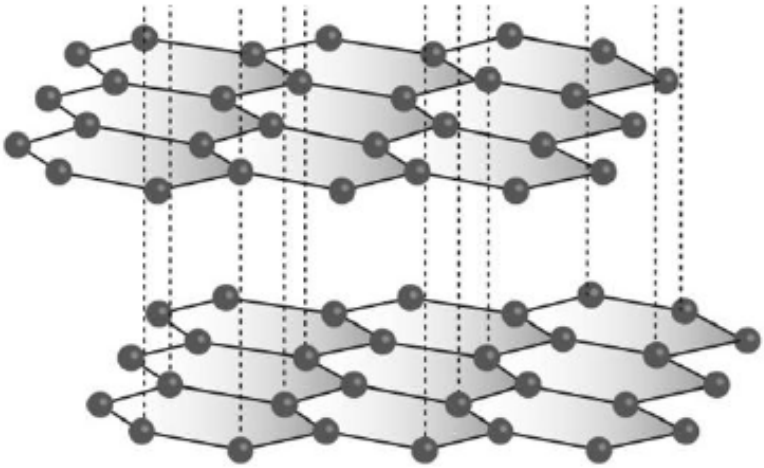
Your answer ☐

[1]

5(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.

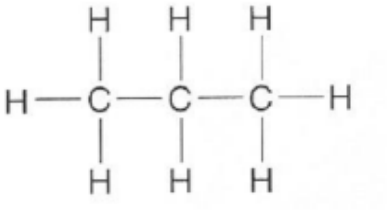
Use ideas about structure and bonding in diamond and graphite to explain these observations.

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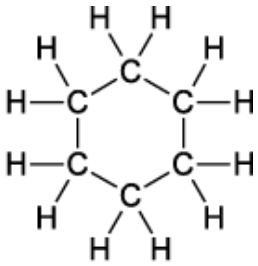
[3]

(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]

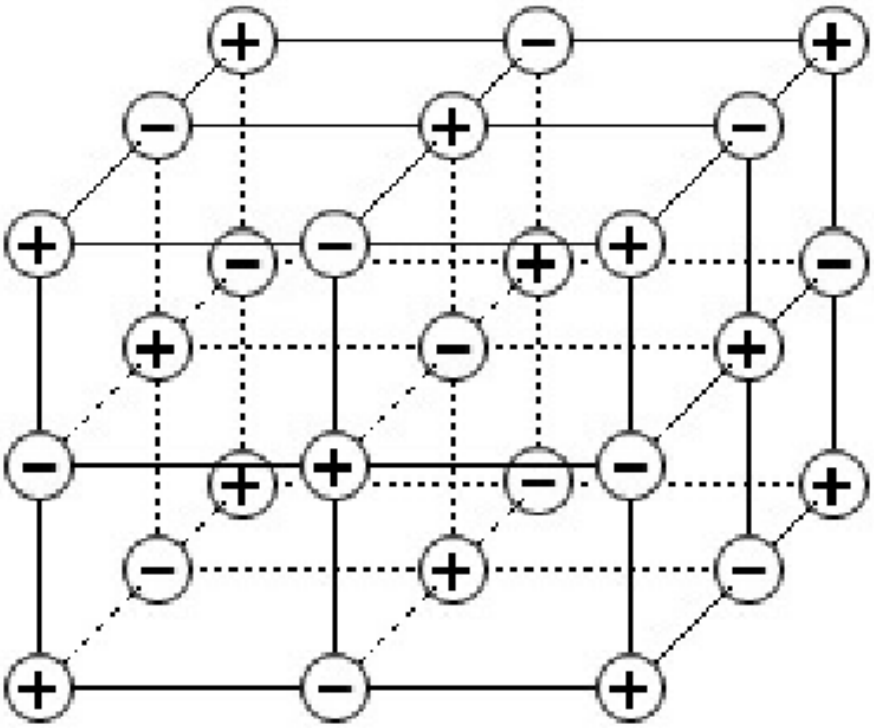
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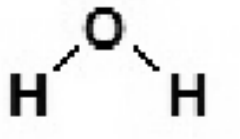
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6(a) Look at the diagrams.

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]

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7 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.

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(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.

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[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.

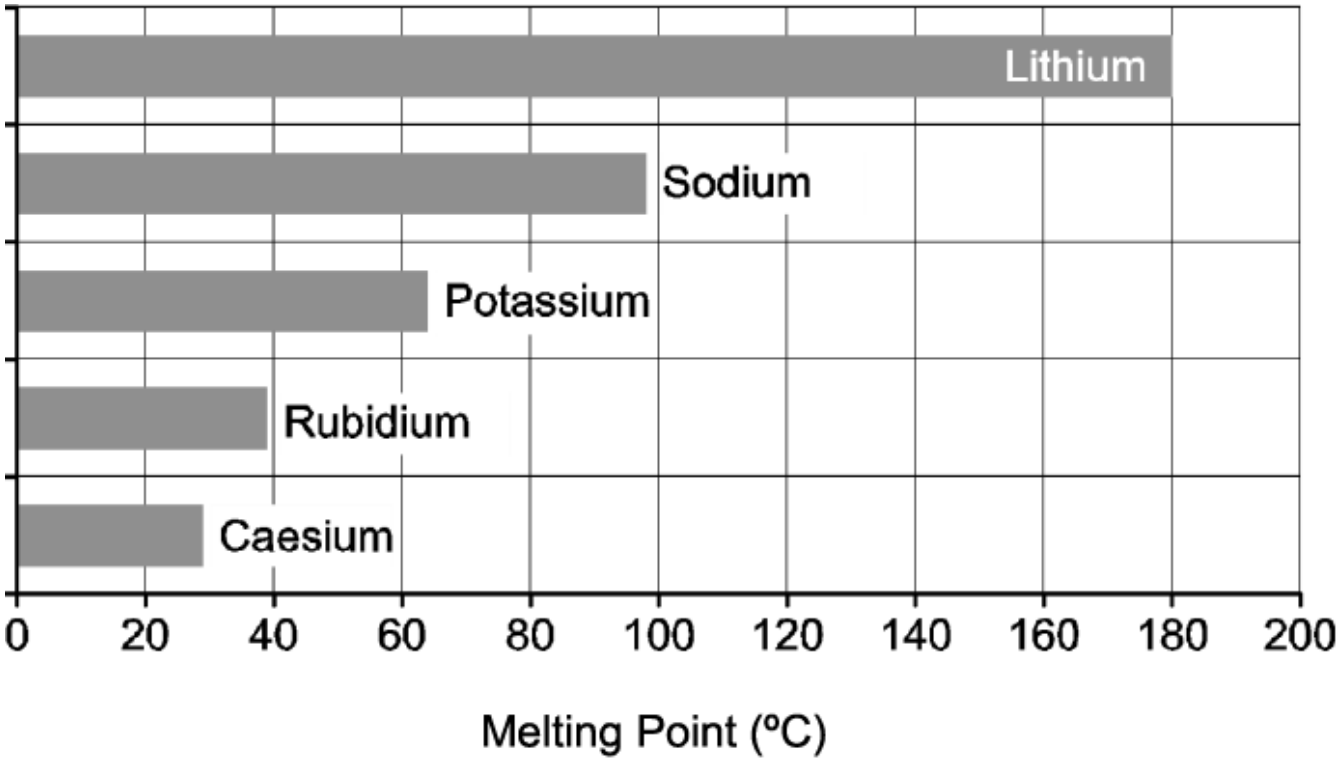
[2]

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8 The bar chart shows some information about the melting points of Group 1 elements.



What are the melting points of rubidium and caesium?

	Melting point of rubidium (°C)	Melting point of caesium (°C)
A	39	29
B	40	25
C	29	41
D	41	25

Your answer ☐

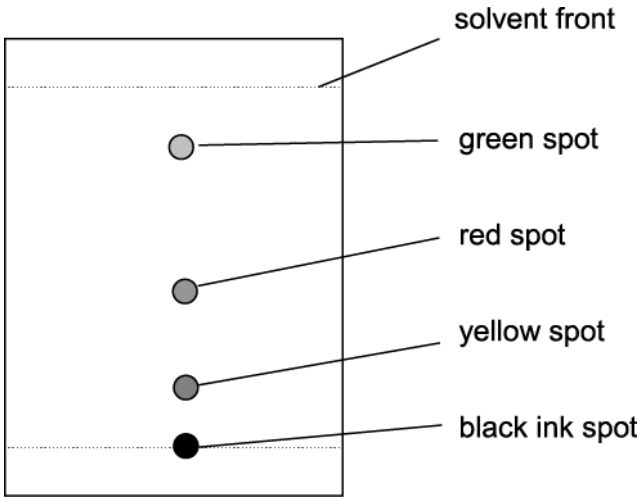
[1]

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9 Look at Tim's chromatogram.



What is the R_f value of the **green** spot? Use a ruler to help you.

A 0.17
B 0.42
C 0.83
D 1.00

Your answer ☐

[1]

10 Phil investigates some exothermic and endothermic reactions.

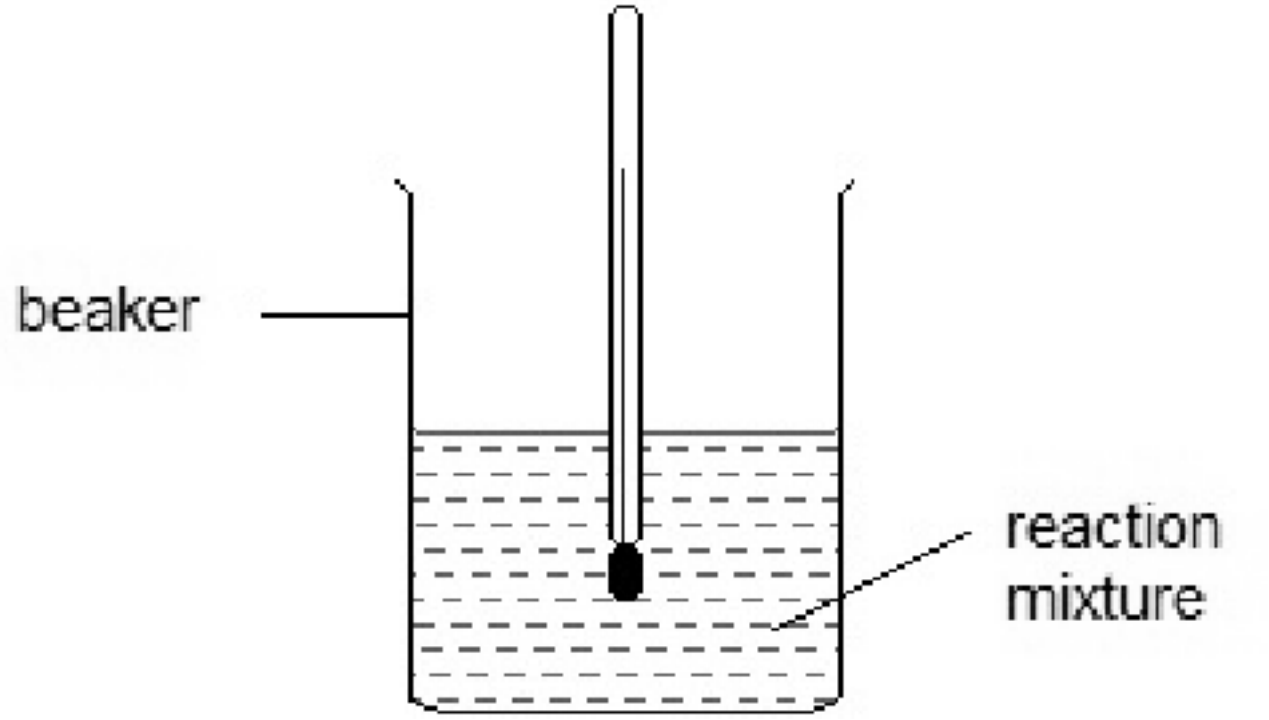
He measures the temperature changes during some chemical reactions.

Look at how Phil does the experiment.

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1 He measures the temperature of one of the reactants at the start.
2 He then adds the second reactant and stirs the mixture.
3 He removes the thermometer from the beaker and then reads it to take the temperature at the end of the reaction.

How should Phil improve his method? Explain your answer.

---

[2]

11(a) Which element is oxidised and which element is reduced?

oxidised: _____

reduced: _____

[1]

(b) Magnesium burns in oxygen to make magnesium oxide.

The reaction involves both oxidation and reduction.

$$2Mg(....) + O_2(....) \longrightarrow 2MgO(s)$$

magnesium + oxygen ⟶ magnesium oxide

Complete the equation above by adding the state symbols for magnesium and oxygen at room temperature.

[2]

12 Propane gives out 50 000 J/g when it reacts with oxygen.

A propane burner is used to boil water to make a cup of tea.

63 000 J of energy are required to boil the water.

There is only 3 g of propane in the burner.

Do a calculation to find out if there is enough propane in the burner to boil the water.

[3]

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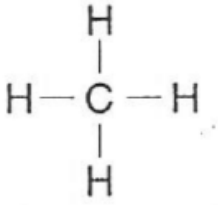
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13 Methane has the formula, CH_4.

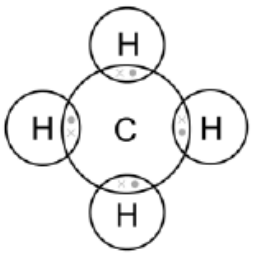
Look at the representations of methane.



ball and stick model



displayed formula



dot and cross diagram

Describe the limitations of a **displayed** formula.

---

[2]

14(a) Look at the table. It shows information about some atoms and ions.

Particle	Atomic number	Mass number	Number of protons	Number of neutrons	Number of electrons	Electronic structure
A	11	23	11	_____	11	2.8.1
B	9	19	9	10	9	_____
C	_____	37	17	_____	17	2.8.7
D	13	27	_____	_____	10	2.8

Complete the table.

[4]

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(b) Particle **A** is a metal **atom**, particle **D** is an **ion**.

Explain why.

---

[2]

(c) Element **C** has the electronic structure 2.8.7.

What does this tell you about the position of element **C** in the periodic table?

Explain your answer.

---

[4]

15 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]

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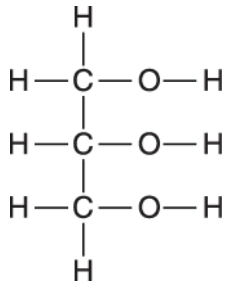
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16 Fats are compounds called esters.

Fats are made by the reaction between an alcohol called glycerol and carboxylic acids.

Look at the displayed formula of a molecule of glycerol.



(i) Look at the molecular formula for glycerol.

$$C_xH_yO_z$$

What are the numbers for **x**, **y** and **z** in the formula?

x = _____

y = _____

z = _____

[1]

(ii) Glycerol is **not** a hydrocarbon.

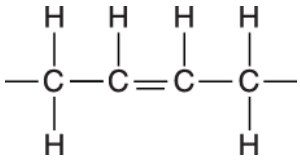
How can you tell from its formula?

---

[1]

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17(a) Look at part of the displayed formula of a fat.



The fat is **unsaturated.**

(i) How can you tell from its formula?

---

[1]

(ii) Dave does a chemical test to show that the fat is unsaturated.

Write about the chemical test and the result Dave gets.

---

[2]

(b) Write down **two** large scale uses of fats.

---

[2]

18(a) Fats are made by the reaction between an alcohol called glycerol and carboxylic acids.

What **type** of compound is a fat?

Choose from

alkene

emulsion

ester

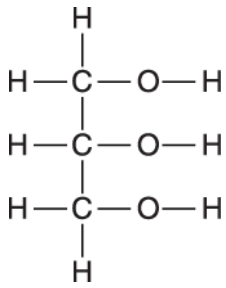
soap

solvent

answer _____

[1]

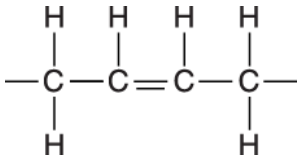
(b) Look at the displayed formula of a molecule of glycerol.



What is the **molecular formula** of glycerol?

_____ **[1]**

(c) Look at part of the displayed formula of a fat.



The fat is **unsaturated**.

(i) How can you tell from its formula?

---

[1]

(ii) Dave does a chemical test to show that the fat is unsaturated.

Write about the chemical test and the result Dave gets.

---

[2]

(d) Vegetable oils are also fats.

Vegetable oils can be used to make margarine.

Write about how margarine is manufactured.

---

[2]

19 Look at the table. It shows the properties of some alloys.

Alloy	Density in g / cm^3	Relative strength	Relative cost
A	2.8	high	high
B	8.4	high	medium
C	7.8	high	low
D	2.6	low	low



(i) Evaluate the advantages and disadvantages of these alloys for making aeroplane wings.

Put your answers in the table below.

Alloy	Advantages	Disadvantages
A	_____ _____ _____	_____ _____ _____
B	_____ _____ _____	_____ _____ _____
C	_____ _____ _____	_____ _____ _____

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D	_____	_____
	_____	_____
	_____	_____

[3]

(ii) Which alloy would you choose?

_____ [1]

20(a) This Gore-Tex® jacket is both waterproof and breathable.



Gore-Tex® is made from a layer of nylon that is laminated with a PTFE polymer membrane.

Use ideas about the structure of Gore-Tex® to explain why it is both waterproof and breathable.

_____

_____

_____

_____

_____ [2]

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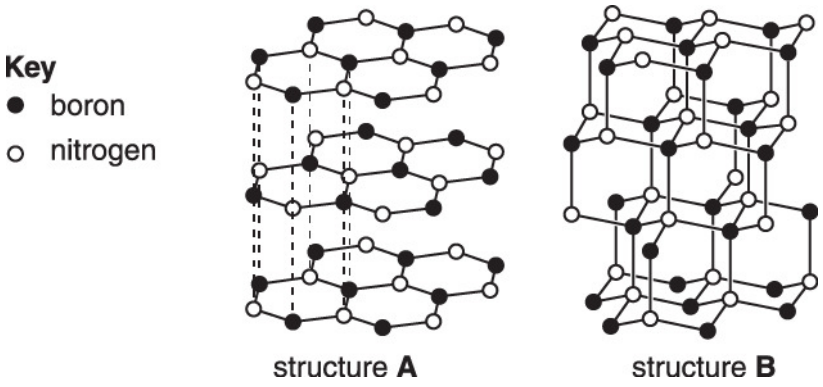
(b) Suggest **one** advantage of a Gore-Tex® jacket over one made from only nylon.

---

[1]

21(a) Boron nitride, BN, exists in two physical forms.

The structures of these forms are shown below.



These two forms of boron nitride resemble graphite and diamond, the two allotropes of carbon.

Boron nitride, with structure **A**, is slippery.

Explain why, in terms of structure and bonding.

---

[2]

(b) Boron nitride, with structure **B**, has a very high melting point.

Explain why, in terms of structure and bonding.

---

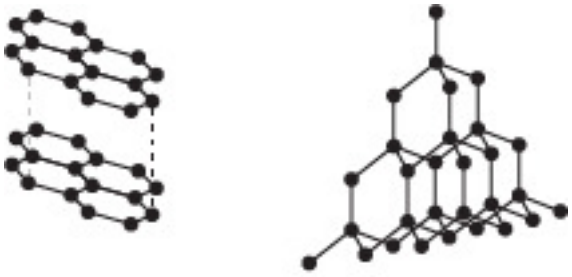
[2]

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22(a) Diamond and graphite are two forms of carbon.



graphite diamond

One of the physical properties of diamond is that it is colourless.

Describe some of the **other** physical properties of diamond.

---

[2]

(b) Graphite is used to make the electrodes for electrolysis.

Explain why.

---

[1]

23 Copper is a metal.

One property of metals is that they are good conductors of heat.

Write down **two** other properties of metals.

---

[2]

24 Sodium chloride is an ionic compound.

Carbon dioxide is a covalent compound.

Look at the table.

	Sodium chloride	Carbon dioxide
Formula	NaCl	CO_2
Type of particles present	ions	_____
Melting point	_____	low

(i) Complete the table.

[2]

(ii) Carbon dioxide has a low melting point.

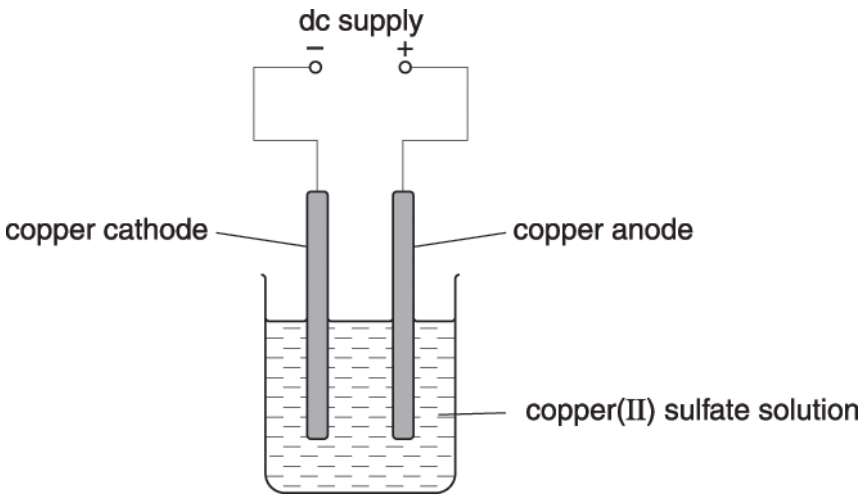
Explain why, using ideas about forces.

---

[1]

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25 Joel passes an electric current through **copper(II) sulfate solution.**



Joel does four experiments.

Joel changes either the **time** or the **current**.

Copper is made at the cathode.

He measures how much copper is made in each experiment.

Experiment	Current in amps	Time in minutes	Mass of copper made in g
1	0.15	5	0.20
2	0.30	5	0.40
3	0.15	10	0.40
4	0.60	10	1.60

Joel concludes that the amount of copper made is **proportional** to both the current and to the time.

Show how the results support this conclusion.

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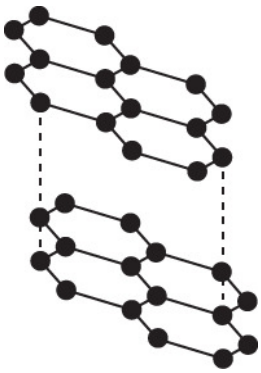
[2]

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26(a) Graphite is one of the allotropes of carbon.



Graphite is used to make pencil leads.

Explain why the properties of graphite make it suitable for pencil leads.

---

[2]

(b) Graphite is used as an electrode in electrolysis.

This is because it conducts electricity and has a high melting point.

(i) Explain why graphite can conduct electricity. Use the diagram to help you.

---

[1]

(ii) Explain why graphite has a high melting point. Use the diagram to help you.

---

[2]

27(a) An oil paint contains oil, a solvent, a binder and a phosphorescent pigment.

A phosphorescent pigment will glow in the dark.

Explain why.

---

[2]

(b) A layer of oil paint is left to dry and harden.

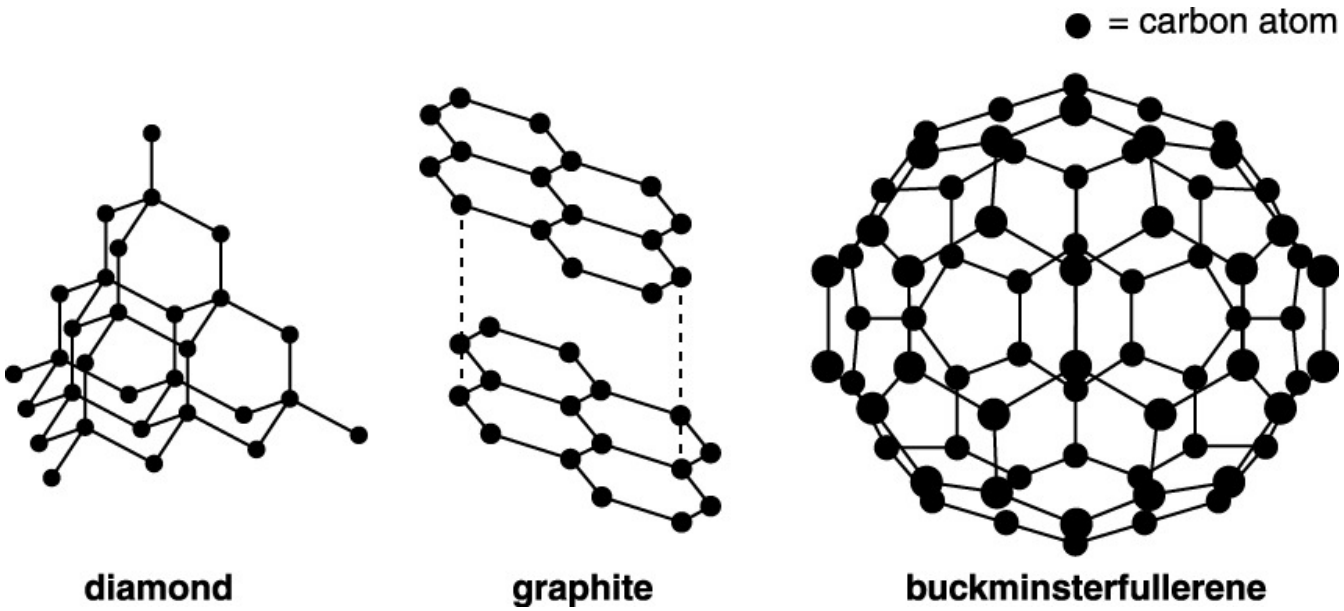
The solvent evaporates.

What happens to the oil?

---

[1]

28(a) Carbon can exist in different solid forms.

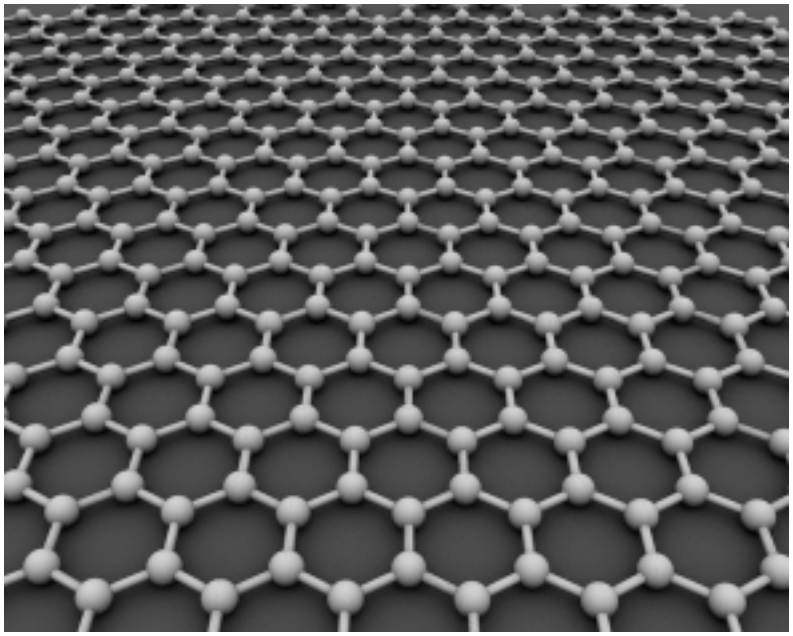


What is the name given to these three forms?

---

[1]

(b) Look at the diagram.



It shows the structure of a new solid form of carbon called graphene.

Graphene contains **one layer** of carbon atoms.

Graphene is made from graphite.

Graphene is harder than graphite.

Explain, using ideas about structure and bonding, why **graphene** is **hard** and **graphite** is **slippery**.

---

[2]

(c) Diamond and graphite have different properties and different uses.

Look at the table.

It shows some information about the properties of diamond and graphite.

Property	Diamond	Graphite

State at room temperature	solid	solid
Appearance at room temperature	transparent	black
Melting point	very high	very high
Hardness	very hard	soft
Electrical conductivity	does not conduct	good conductor

Diamond is used to make cutting tools.



The picture shows a drill bit with diamonds on its end.

This drill is used to cut through rock.

Explain why diamond is used to make cutting tools.

Use the table to help you.

---

[2]

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29 Diamond is a form of carbon.



Diamonds are used in jewellery because they are lustrous (shiny).

Write about two **other** properties of diamond.

---

[2]

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30 This question is about sodium chloride (salt).

Write down one **use** of sodium chloride.

---

[1]

31 This question is about some of the hydrocarbons found in crude oil.

The table shows some information about five of these hydrocarbons.

Hydrocarbon	Molecular formula	Fraction of crude oil that contains the hydrocarbon	Melting point in °C	Boiling point in °C	Density in g / cm^3
propane	C_3H_8	liquefied petroleum gases	−188	−42	0.002
hexane	C_6H_{14}	petrol	−95	68	0.66
decane	$C_{10}H_{22}$	paraffin	−30	174	0.73
hexadecane	$C_{16}H_{34}$	diesel	18	287	0.77
icosane	$C_{20}H_{42}$	heating oil	37	343	

The density changes as the number of carbon atoms in a hydrocarbon molecule increases.

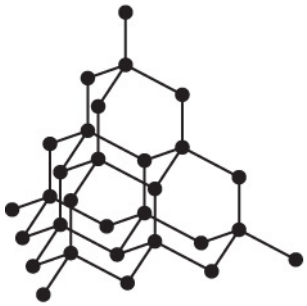
Describe this trend in density and predict the density of icosane.

---

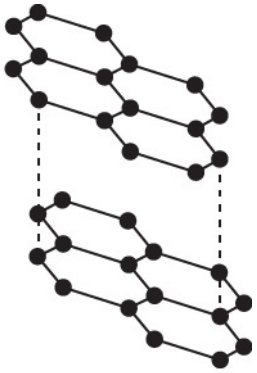
[2]

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32(a) This question is about diamond and graphite.



diamond



graphite

Diamond and graphite are made of the same element.

Which element?

---

[1]

(b) One property of diamond is that it is very hard.

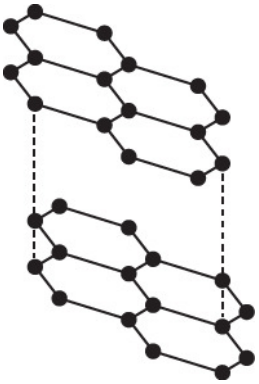
Diamond is used to make cutting tools.

Write about some other properties of diamond.

---

[3]

33(a) Graphite is a form of carbon.



Graphite is used as a lubricant.

Write down **one** property of graphite that explains why it is used as a lubricant.

---

[1]

(b) Graphite conducts electricity.

Explain how. Use ideas about structure and bonding.

---

[1]

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34 Stowmarket Synthetics make a polymer that is used to make bottles for fizzy drinks.



The polymer they use has a low melting point.

Suggest, with reasons, **two other** properties of the polymer that make it suitable for use as a bottle for fizzy drinks.

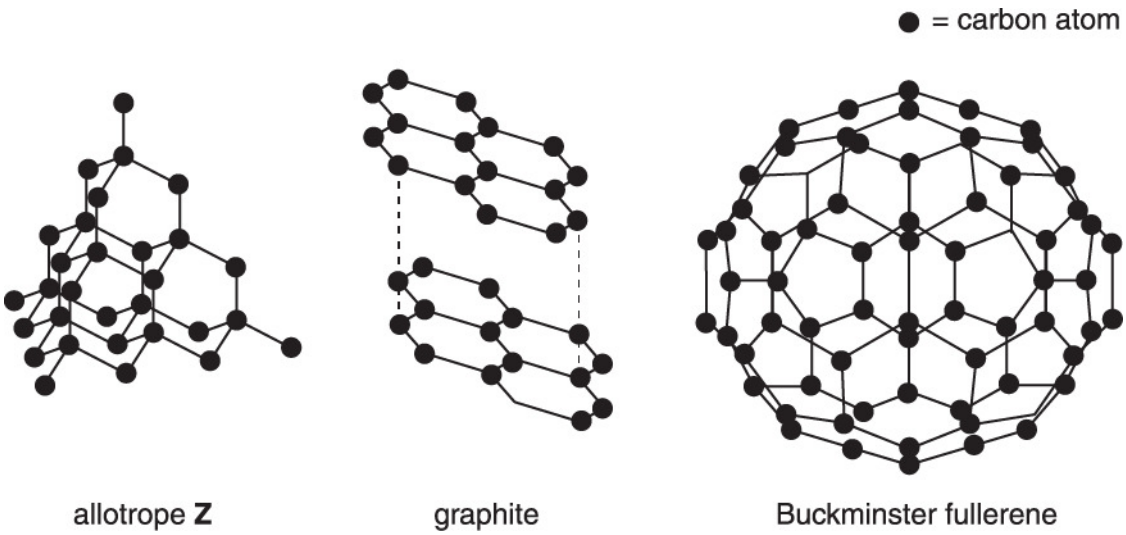
Use a simple model of the structure of the polymer to explain why it has a low melting point.

The quality of written communication will be assessed in your answer to this question.

[6]

35(a) This question is about carbon.

Look at the structures of the three allotropes of carbon.



What is the name of allotrope **Z**?

[1]

(b) One property of graphite is that it is slippery.

Write about two **other** properties of graphite.

[2]

(c) Fullerenes can be used in new drug delivery systems for patients who are ill in hospitals.

Explain why fullerenes can be used.

---

[1]

36 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]

37 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]

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38 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]**

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

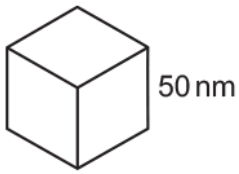
The small particles provide better protection from the sun and they do not leave white marks on the skin.

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

---

[1]

(b) 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]**

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(c)

(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]**

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40 The diameter of one type of carbon nanotube is 20 nm.

What is 20 nm in metres?

A 2×10^{-3} m

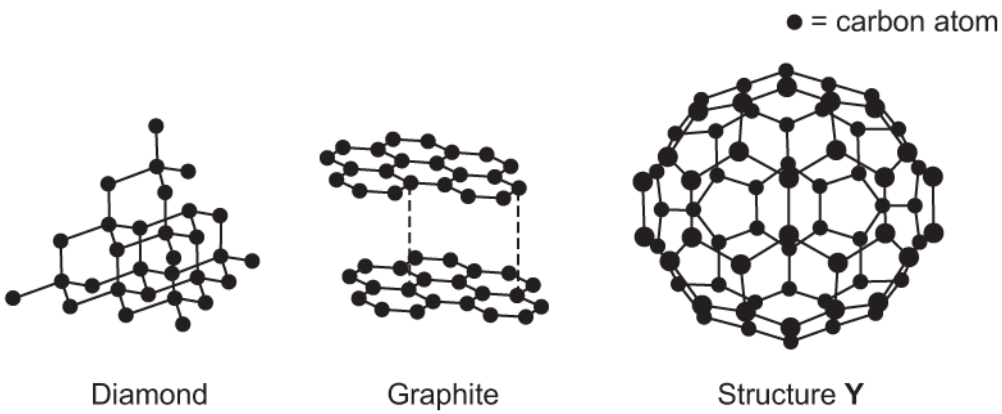
B 2×10^{-8} m

C 2×10^{-20} m

D 2×10^{-16} m

Your answer [ ] **[1]**

41(a) The diagrams show three different structures of carbon.



(i) What is the name of structure Y?

[1]

(ii) Diamond can be described as having a **giant lattice** structure.

Why is diamond described as a giant lattice structure?

[2]

(b)

(i) Diamond is the hardest naturally occurring substance on Earth.

Explain why diamond is hard.

---

[2]

(ii) Graphite is used in pencils. Graphite is a soft material.

Explain why graphite is soft.

---

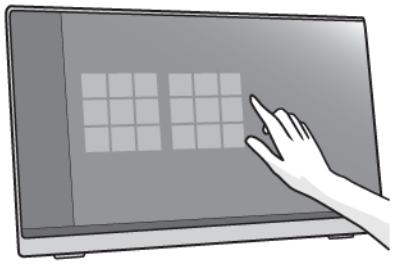
[1]

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(c) Graphene is another substance made of carbon atoms. Graphene is a single layer of graphite. It is just one atom thick. Graphene can be used to make touchscreens for electronic devices.



Look at the table. It shows some properties of graphite and graphene.

Substance	Cost	Electrical conductivity	Density	Strength	Colour
Graphite	low	high	low	low	black
Graphene	high	high	low	high	transparent

Explain why **graphene** is suitable for making touchscreens.

Use the information from the table.

---

[2]

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

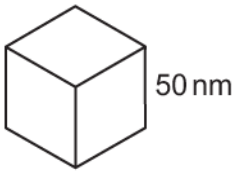
The small particles provide better protection from the sun and they do not leave white marks on the skin.

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

---

[1]

(b) 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]**

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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]**

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43 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]

44 Substance **Y** melts at –7 °C and boils at 59 °C.

What is the state of substance **Y** at room temperature?

A Gas
B Liquid
C Plasma
D Solid

Your answer ☐ [1]

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45(a) The table shows the properties of different substances.

Substance	Melting point (°C)	Boiling point (°C)	Soluble in water?	Conducts electricity in solid state?	Conducts electricity in molten state?
A	–210	–196	No	No	No
B	1084	2562	No	Yes	Yes
C	605	1137	Yes	No	Yes
D	–78	–34	Yes	No	No

(i) Which **two** substances are gases at room temperature?

Tick (✓) **two** boxes.

A ☐

B ☐

C ☐

D ☐

[1]

(ii) Substance **C** is an ionic substance.

Use the information in the table to explain why.

---

[2]

(b) You are provided with a mixture of substances **B** and **C**.

Substance **B** is insoluble in water. Substance **C** is soluble in water.

(i) Describe how you could separate substance **B** from the mixture.

---

[3]

(ii) Describe how you would then obtain substance **C** after separating substance **B**.

---

[2]

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

Look at the two structures, **A** and **B**, in **Fig. 22.1**.

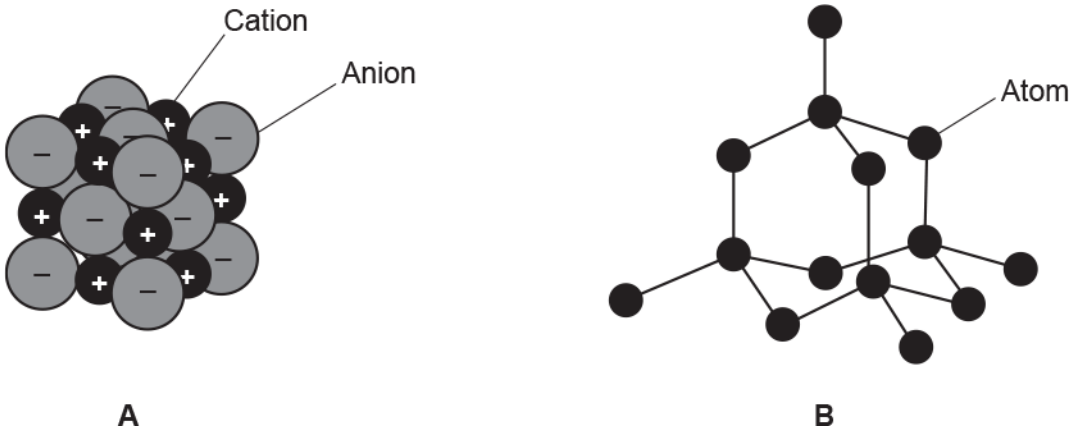


Fig. 22.1

(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. 22.2**. Metals are malleable, which means they can be hammered or pressed into shape without breaking or cracking.

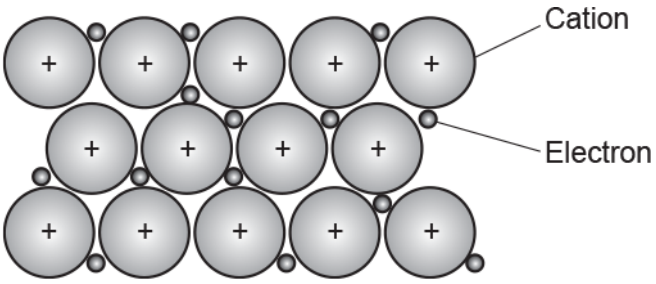


Fig. 22.2

Explain why metals are **malleable**.

---

[2]

47 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]**

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48 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]

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

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

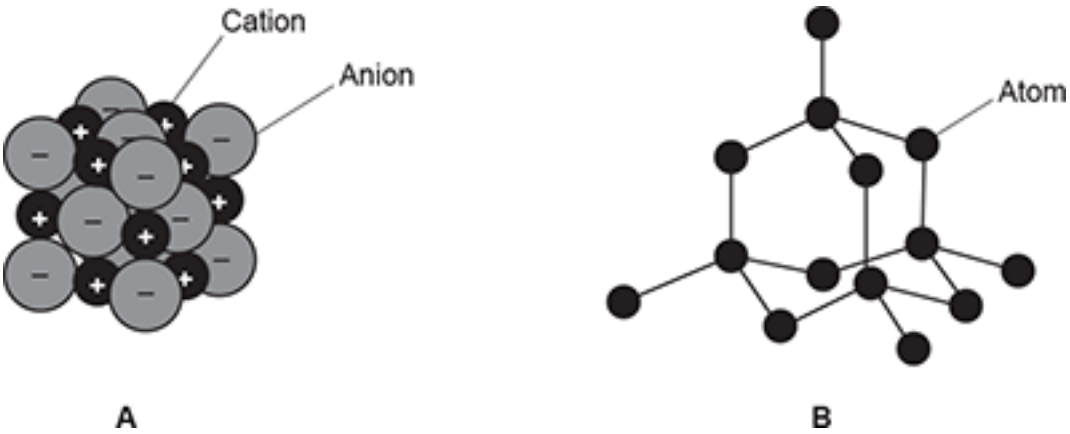


Fig. 16.1

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

Explain your answer.

Bonding _____

Explanation _____

[2]

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

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[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.

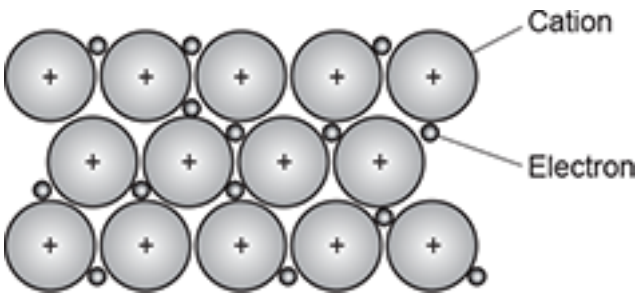


Fig. 16.2

Explain why metals are **malleable**.

[2]

(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.

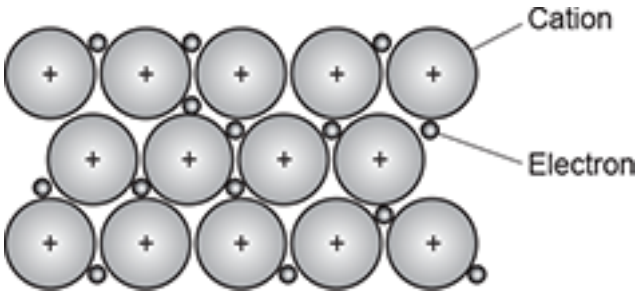


Fig. 16.2

Explain why metals are **malleable**.

---

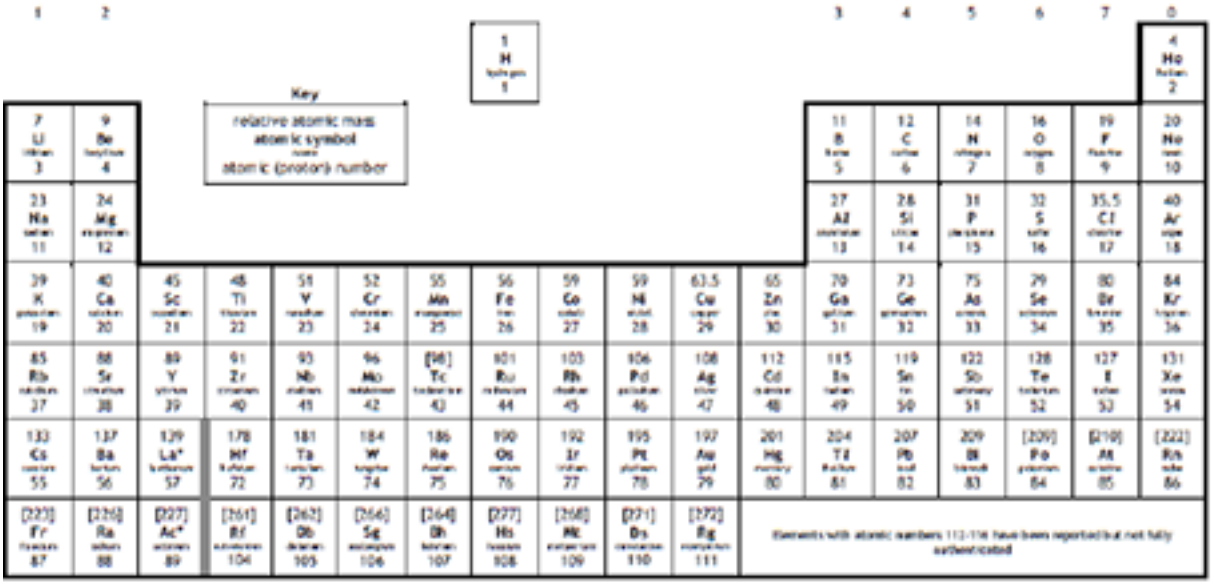
[2]

END OF QUESTION PAPER

Resource assets

Resource asset for Q23

The Periodic Table of the Elements



** The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.*

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.

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