OCR GCSE GATEWAY CHEMISTRY A · J248

CHEMISTRY



EXAM QUESTION PACK

C2.2 BONDING

SCORE	PERCENTAGE
/211	%

STEMUP

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Gateway Chemistry A (9-1)

Bonding

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 **211**.
- The total number of marks may take into account some 'either/or' question choices.

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1 The Group 7 elements are known as the halogens.

The halogens have similar chemical properties.

Their physical properties vary with increasing atomic number.

All halogens react with alkali metals to make a salt.

(i) All halogens have similar chemical reactions.

Explain why in terms of electronic structure.

---

[1]

(ii) Sodium reacts with bromine to make sodium bromide, NaBr.

Construct the **balanced symbol** equation for this reaction.

---

[2]

(iii) What is the formula of the product of the reaction between astatine and potassium?

---

[1]

2(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) Particle **C** has the electronic structure 2.8.7.

What does this tell you about the position of particle **C** in the Periodic Table?

Explain your answer.

---

[4]

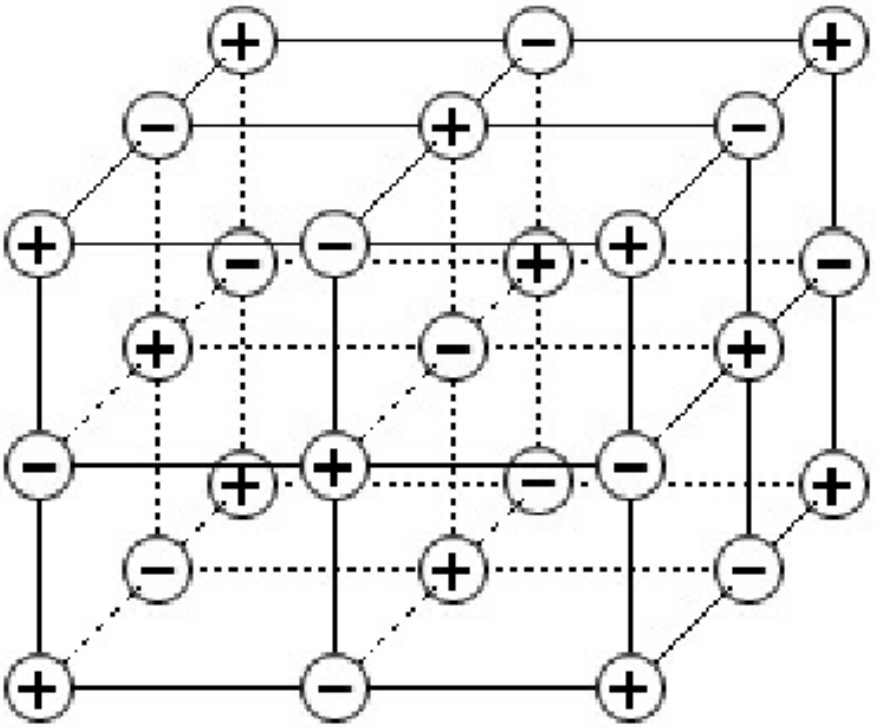
3 Look at the diagrams.

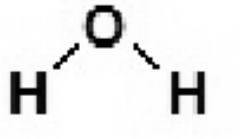
They show the structures of two compounds.

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sodium chloride **water**

Magnesium oxide has a similar structure to sodium chloride.

Draw ‘dot and cross’ diagrams to show the ionic bonding in magnesium oxide.

You should include the charges on the ions.

The electronic structure of magnesium is 2.8.2.

The electronic structure of oxygen is 2.6.

[3]

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4 The Group 7 elements are known as the halogens.

The halogens have similar chemical properties.

Their physical properties vary with increasing atomic number.

All halogens react with alkali metals to make a salt.

(i) All halogens have similar chemical reactions.

Explain why in terms of electronic structure.

---

[1]

(ii) Sodium reacts with bromine to make sodium bromide, NaBr.

Construct the **balanced symbol** equation for this reaction.

---

[2]

(iii) What is the formula of the product of the reaction between astatine and potassium?

---

[1]

5 Lead is a metal.

Which statement is true about lead **because** it is a metal?

A It is a dull grey colour.
B It is in Group 4 of the Periodic Table.
C It is in Period 6 of the Periodic Table.
D It is malleable so can be easily shaped.

Your answer ☐

[1]

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6 What is the relative formula mass of sodium carbonate, Na_2CO_3?

A 83.0
B 90.0
C 106.0
D 130.0

Your answer ☐

[1]

7(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]

(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]

(d) Complete the table below to give information about protons, neutrons and electrons.

	Charge	Mass in atomic mass units
proton	_____	1
neutron	_____	_____
electron	negative	_____

[2]

(e) Rutherford was a scientist who helped to develop the atomic model.

State how Rutherford's work contributed to the development of the atomic model

---

---

[1]

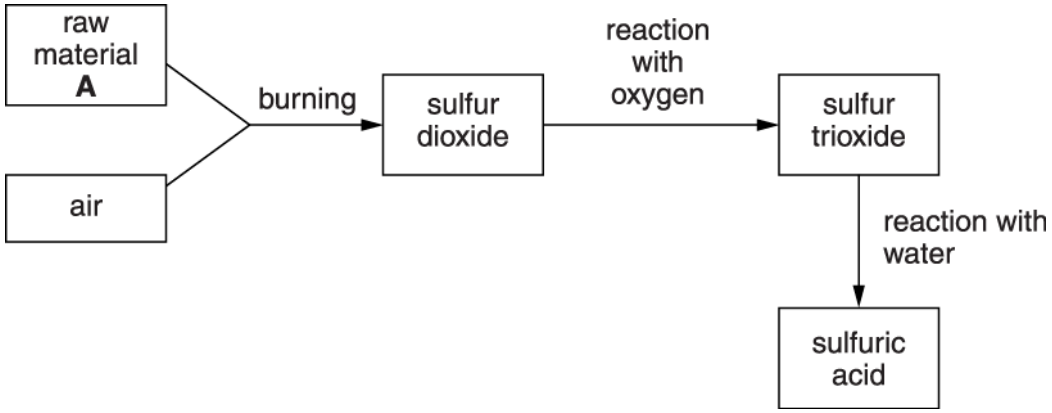
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8 This question is about the Contact Process used for the manufacture of sulfuric acid.

Look at the flow chart for the process.



In the process, sulfur dioxide, SO_2, reacts with oxygen, O_2, to make sulfur trioxide, SO_3.

Write the **balanced symbol** equation for this reaction.

[2]

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9(a) This question is about the Periodic Table.

Look at the list of elements.

aluminium

boron

bromine

helium

potassium

silver

Answer these questions.

Use the Periodic Table on the back page to help you.

Choose your answers from the list.

(i) Two elements are in the same **group** of the Periodic Table.

Which two elements?

_____ and _____ **[1]**

(ii) Two elements are in the same **period** of the Periodic Table.

Which two elements?

_____ and _____ **[1]**

(iii) Write down the name of a **transition** element.

_____ **[1]**

(b) One scientist who helped to develop the Periodic Table was called Mendeleev.

Write about how Mendeleev helped in the development of the Periodic Table.

---

[2]

10 Fluorine reacts with chlorine to make a compound called chlorine fluoride, C*l*F.

C*l*F is a **covalent** compound.

The electronic structure of chlorine is 2.8.7.

The electronic structure of fluorine is 2.7.

Draw a 'dot and cross' diagram to show the covalent bonding in chlorine fluoride.

[2]

11(a) Fluorine reacts with chlorine to make a compound called chlorine fluoride, C*l*F.

C*l*F is a **covalent** compound.

The electronic structure of chlorine is 2.8.7.

The electronic structure of fluorine is 2.7.

Chlorine fluoride has a **simple molecular** structure.

Predict **two** physical properties of chlorine fluoride.

---

[2]

(b) One scientist who helped to develop the Periodic Table was called Mendeleev.

Write about how Mendeleev helped in the development of the Periodic Table.

---

[2]

12 Jed is testing iron(III) chloride and some unknown compounds.

He does some tests.

These are the tests that Jed does on solutions of the compounds:

- adding sodium hydroxide solution
- adding silver nitrate solution.

Look at his results.

Compound	Adding sodium hydroxide	Adding silver nitrate

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	solution	solution
iron(III) chloride	brown solid made	white solid made
A	blue solid made	white solid made
B	green solid made	cream solid made

Iron(III) chloride, $FeC?_3$, reacts with silver nitrate, $AgNO_3$, to make silver chloride, $AgC?$, and iron(III) nitrate, $Fe(NO_3)_3$.

Write a **balanced symbol** equation for this reaction.

Identify the unknown compounds **A** and **B** and explain your answers.

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

[6]

13(a) Esters can be used in nail varnish remover.

Look at the table of information about some esters.

Ester	Molecular formula of ester	Melting point in °C	Boiling point in °C	How well it dissolves in water (1 = poor 10 = good)
methyl ethanoate	$C_3H_6O_2$	?98	57	1
ethyl ethanoate	$C_4H_8O_2$	?84	77	8
propyl ethanoate	$C_5H_{10}O_2$	?95	102	2
butyl ethanoate	$C_6H_{12}O_2$	?77	127	1
pentyl ethanoate		?71	149	1

Esters are **not** hydrocarbons.

Explain why using information from the molecular formulas.

---

[1]

(b) Pentyl ethanoate has **seven** carbon atoms in its molecule.

Deduce the **molecular formula** for pentyl ethanoate.

---

[1]

(c) The solvent in a nail varnish remover needs to have these properties

- liquid at room temperature, 25 °C
- evaporates easily
- fairly soluble in water.

Which ester would be **most** suitable for use as a nail varnish remover?

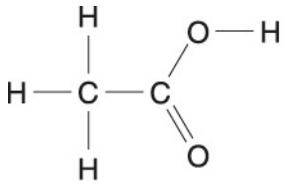
Explain your answer.

---

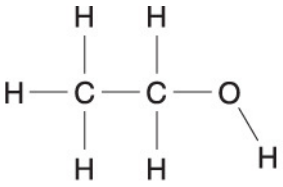
[3]

14(a) This question is about carbon compounds.

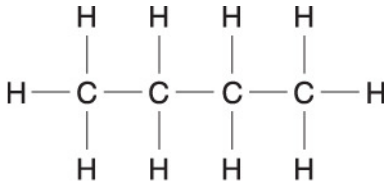
Look at the displayed formulas of some compounds.



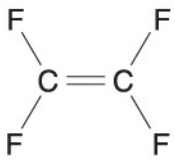
A



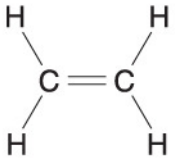
B



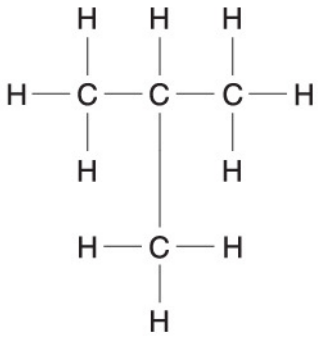
C



D



E



F

Which compound has a molecule with **8 atoms**?

Choose from **A**, **B**, **C**, **D**, **E** or **F**.

_____ **[1]**

(b) Which compound is an **alkene**?

Choose from **A**, **B**, **C**, **D**, **E** or **F**.

_____ **[1]**

(c) Which **two** compounds have the same **molecular** formula?

Choose from **A**, **B**, **C**, **D**, **E** and **F**.

_____ and _____ **[1]**

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(d) Compound **D** is called tetrafluoroethene.

It is a monomer and can be made into a polymer.

What is the name of this polymer?

---

[1]

15 Sodium hydrogencarbonate decomposes when it is heated.

sodium hydrogencarbonate	→	sodium carbonate	+	carbon dioxide	+	water
$2NaHCO_3$	→	Na_2CO_3	+	CO_2	+	H_2O

The table shows the relative formula masses, M_r, of the substances in the equation.

Substance	Relative formula mass
$NaHCO_3$	84
Na_2CO_3	106
CO_2	44
H_2O	18

Use the relative formula masses in the table to show that mass is conserved during this reaction.

---

[2]

16(a) Esters can be used in nail varnish remover.

Look at the table of information about some esters.

Ester	Molecular formula of ester	Melting point in °C	Boiling point in °C	How well it dissolves in water (1 = poor 10 = good)
methyl ethanoate	$C_3H_6O_2$	?98	57	1
ethyl ethanoate	$C_4H_8O_2$	?84	77	8
propyl ethanoate	$C_5H_{10}O_2$	?95	102	2
butyl ethanoate	$C_6H_{12}O_2$	?77	127	1
pentyl ethanoate	$C_7H_{14}O_2$	?71		

Esters are **not** hydrocarbons.

Explain why using information from the molecular formulas.

---

[1]

(b) The solvent in a nail varnish remover needs to have these properties

- liquid at room temperature, 25 °C
- evaporates easily
- fairly soluble in water.

(i) Predict the boiling point for pentyl ethanoate.

_____ °C

[1]

(ii) Use the information in the table to predict if pentyl ethanoate is suitable as a solvent in nail varnish remover.

Explain your answer.

_____

_____

_____

_____ **[2]**

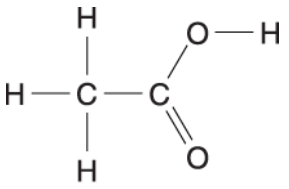
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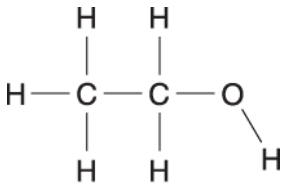
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17 This question is about carbon compounds.

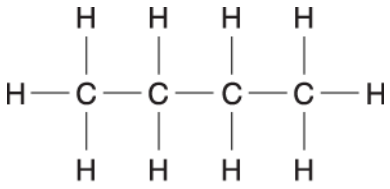
Look at the displayed formulas of some compounds.



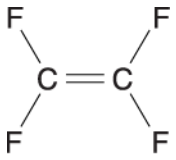
A



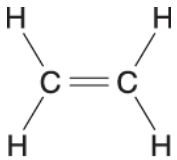
B



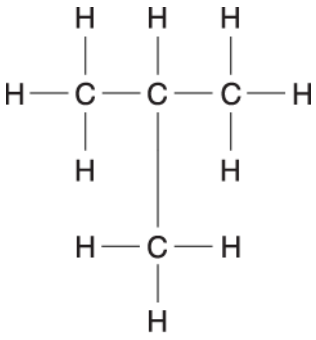
C



D



E



F

Which compound is an **alkene**?

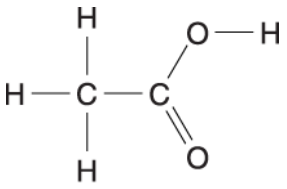
Choose from **A**, **B**, **C**, **D**, **E** or **F**. _____

[1]

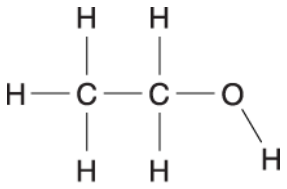
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18(a) This question is about carbon compounds.

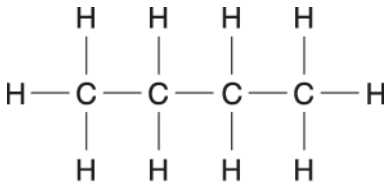
Look at the displayed formulas of some compounds.



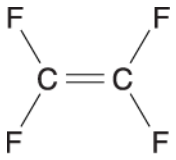
A



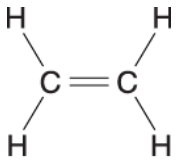
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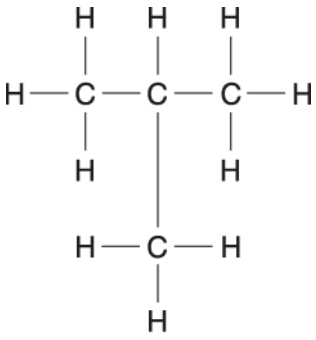
C



D



E



F

Which **two** compounds have the same **molecular formula**?

Choose from **A**, **B**, **C**, **D**, **E** and **F**.

_____ and _____

[1]

(b) A molecule of dodecane, $C_{10}H_{22}$, can be cracked to give compound **E** and one other hydrocarbon, **X**.

Deduce the **molecular** formula for **X**.

[1]

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(c) Compound **D** is a monomer and makes an addition polymer.

Draw the **displayed** formula for this polymer.

[1]

19 Look at these symbols and formulas.

Na^+ H_2O Mg N

(i) Which formula is a **molecule**?

answer _____

[1]

(ii) Which formula is an **ion**?

answer _____

[1]

20 Lindsay is heating some copper carbonate, $CuCO_3$.

(i) How many different **elements** are there in copper carbonate?

answer _____

[1]

(ii) What is the total number of **atoms** in the formula, $CuCO_3$?

answer _____

[1]

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21(a) Ammonia has the formula, NH_3.

The electronic structure of nitrogen is 2.5.

The electronic structure of hydrogen is 1.

Draw a 'dot and cross' diagram to show the **covalent** bonding in ammonia.

Show all the electrons.

[2]

(b) Sodium chloride is an **ionic** compound.

Sodium chloride

- will not conduct electricity when it is a solid
- will conduct electricity when it is dissolved in water.

Explain these two observations in terms of structure and bonding.

---

[2]

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22 Describe **metallic bonding** and explain why metals are good conductors of electricity.

You may wish to draw a labelled diagram.

---

[3]

23 Look at the table. It shows information about the Group 1 metals.

Element	Symbol	Electronic structure	Melting point in °C	Boiling point in °C	Atomic radius in nm
lithium	Li	2.1	181	1342	0.152
sodium	Na	2.8.1	_____	883	0.185
potassium	K	2.8.8.1	64	760	0.227
rubidium	Rb	2.8.18.8.1	39	688	_____

Sodium reacts with fluorine. Sodium ions and fluoride ions are made.

The electronic structure of fluorine is 2.7.

Draw a 'dot and cross' diagram to show the electronic structure of a sodium ion and of a fluoride ion. Include the charges on the ions.

[2]

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24 Describe, using a labelled diagram, what is meant by metallic bonding.

---

[2]

25(a) This question is about magnesium, Mg.

Use the Periodic Table to help you answer these questions.

Write down the name of an element in the same **group** as magnesium.

---

[1]

(b) Write down the name of an element in the same **period** as magnesium.

---

[1]

(c) The electronic structure of magnesium is 2.8.2.

What does this tell you about the **group** and the **period** that magnesium is in?

---

[2]

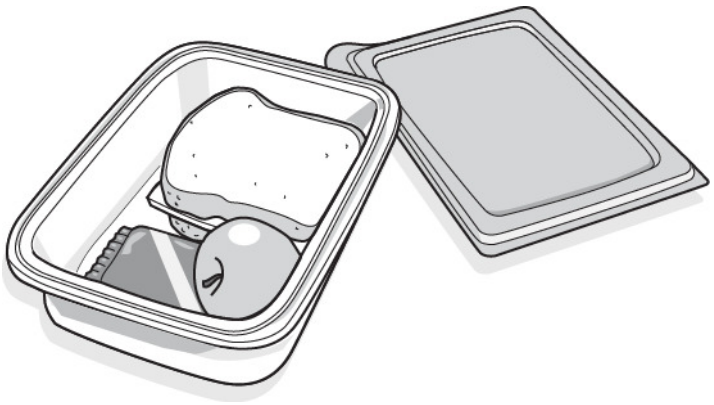
26 Poly(propene) is used to make sandwich boxes.

Look at Anna's sandwich box. It contains the sandwiches for her lunch.

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One of the properties of poly(propene) is that it is flexible.

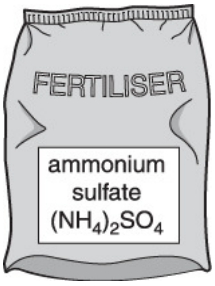
Explain **why** poly(propene) is flexible and suggest, with reasons, two **other** properties needed by poly(propene) to be suitable for making a sandwich box.

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

[6]

27 This question is about fertilisers.

Ammonium sulfate is used as a fertiliser.



The formula for ammonium sulfate is $(NH_4)_2SO_4$.

(i) Write down the number of **different elements** in ammonium sulfate.

answer _____

[1]

(ii) Write down the number of **atoms** in this formula.

answer _____

[1]

28 Hydrogen peroxide, H_2O_2, is used in some spacecraft to provide oxygen.

Hydrogen peroxide is a compound.

How can you tell from its molecular formula?

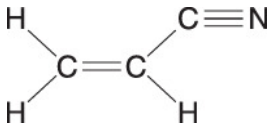
---

[1]

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29 Stowmarket Synthetics is a chemical company that makes polymers.

They make a polymer from a monomer called propenenitrile.



How many covalent bonds are shown in the displayed formula of propenenitrile?

Tick (?) the correct box.

three ☐

four ☐

five ☐

eight ☐

nine ☐

[1]

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30(a) 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	

Which compound has a molecule with **20 atoms**?

Choose from the table.

_____

[1]

(b) Propane is a **hydrocarbon**.

What is meant by a hydrocarbon?

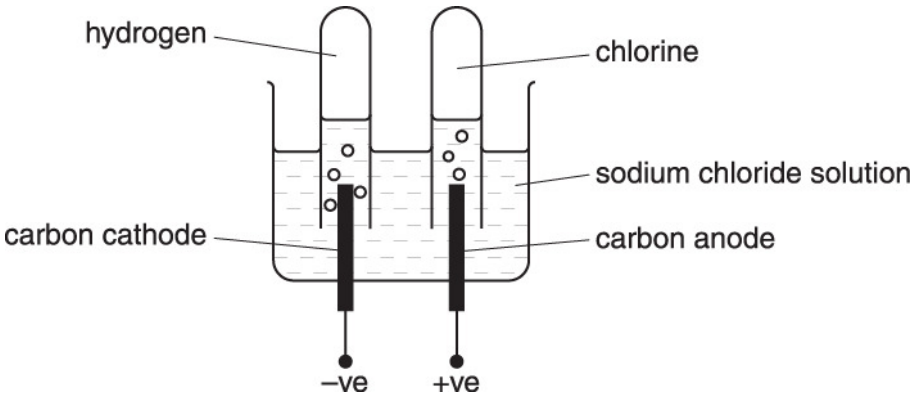
_____

_____

_____ **[2]**

31(a) Molly investigates passing an electric current through sodium chloride solution.

Look at the apparatus she uses.



Look at the list. It shows the particles in sodium chloride solution.

H^+

H_2O

$OH^?$

$Cl^?$

Na^+

Which particle is a **molecule**?

Choose from the list.

answer _____

[1]

(b) Chlorine is made in this experiment.

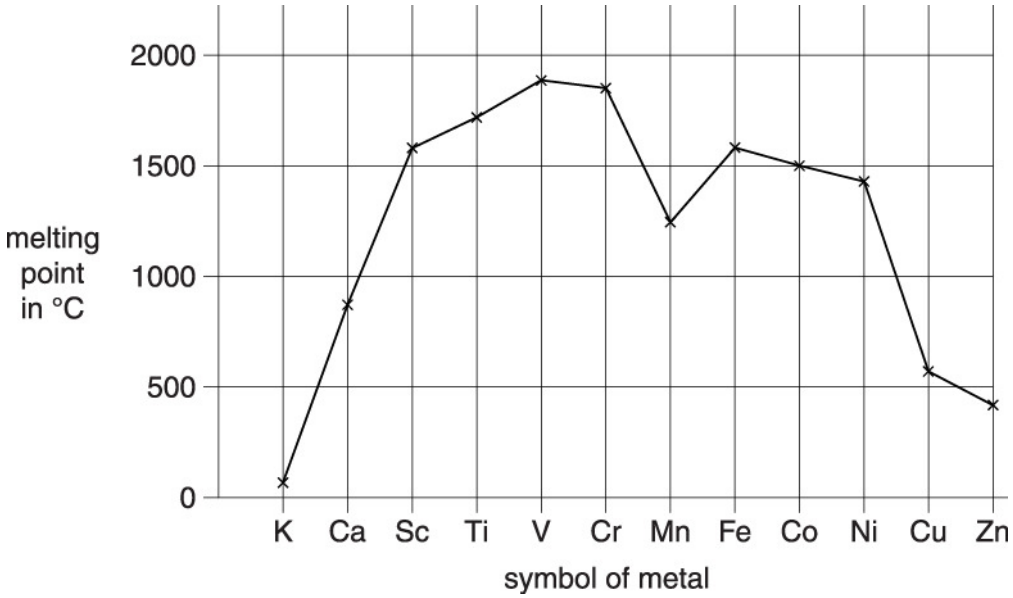
What is the **test** for chlorine gas?

---

[2]

32(a) Most metals have high melting points.

Look at the graph. It shows the melting points of some metals.



Write the **symbol** of the metal which has the **weakest** metallic bonds.

---

[1]

(b) One property of metals is that they often have high melting points.

Write about **other** properties of metals.

---

[2]

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33(a) The table shows the electronic structures of the atoms of some elements.

Element	Symbol	Electronic structure
helium	He	2
oxygen	O	2.6
neon	Ne	2.8
magnesium	Mg	2.8.2
chlorine	Cl	2.8.7
calcium	Ca	2.8.8.2

Write down the symbols for two elements in the same **group** of the periodic table.

Choose from the table above.

_____ and _____

[1]

(b) Write down the symbols for two elements in the same **period** of the periodic table.

Choose from the table above.

_____ and _____

[1]

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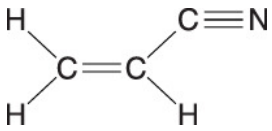
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34 Stowmarket Synthetics is a chemical company that makes polymers.

They make a polymer from a monomer called propenenitrile.

Look at the displayed formula for the monomer propenenitrile.



How many covalent bonds are shown in the displayed formula of propenenitrile?

Tick (?) the correct box.

three ☐

four ☐

five ☐

eight ☐

nine ☐

[1]

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35(a) This question is about some of the hydrocarbons found in crude oil.

The table shows some information about four 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

Propane is a **hydrocarbon**.

What is meant by a hydrocarbon?

---

[2]

(b) Propane is a saturated compound.

What is meant by a **saturated** compound?

---

[1]

36 Most metals have these physical properties.

shiny

high melting point

high boiling point

Write down **two** other physical properties that most metals have.

---

[2]

37 Look at the names of some elements.

aluminium
caesium
carbon
chlorine
copper
tin

Which two elements are in the same **group** of the periodic table?

Explain your answer.

Use the periodic table on the back page to help you.

---

[2]

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38(a) Look at the formulas.

CO_2 Na Mg^{2+} Zn F^-

Which formula represents a metal ion?

.... [1]

(b) Use the formulas to write down the formula of magnesium fluoride.

.... [1]

(c) The electronic structure of lithium is 2.1.

Lithium is a reactive metal.

Explain **how** and **why** a lithium atom forms a lithium ion.

....

....

.... [2]

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(d) Sodium reacts with oxygen to make sodium oxide, Na_2O.

Draw a 'dot and cross' diagram to show the ionic bonding in sodium oxide.

Show all of the electrons in each ion.

The electronic structure of sodium is 2.8.1.

The electronic structure of oxygen is 2.6.

Show the charges on each ion.

[3]

39 An atom of an element has an electronic structure of 2.8.6.

To which **group** of the periodic table does the element belong?

[1]

40 Sodium is an element that can be found in the Periodic Table.

A sodium atom contains 11 electrons.

Which statement about sodium is **true**?

A Sodium is in Group 2 of the Periodic Table.
B Sodium is in Period 2 of the Periodic Table.
C Sodium is in Period 3 of the Periodic Table.
D Sodium is in Group 3 of the Periodic Table.

Your answer ☐ **[1]**

41 Mendeleev's arrangement of elements led to our modern Periodic Table.

How did Mendeleev arrange the elements in his Periodic Table?

A In order of decreasing atomic mass and similar physical properties.
B In order of increasing atomic number and similar physical properties.
C In order of decreasing atomic number and similar chemical properties.
D In order of increasing atomic mass and similar chemical properties.

Your answer [ ] [1]

42 What is the electronic structure of sulfur?

A 2
B 2, 6
C 2, 8, 6
D 2, 8, 8, 6

Your answer [ ] [1]

43 Which of these substances has a **giant covalent structure**?

A Carbon dioxide
B Magnesium oxide
C Sulfur dioxide
D Silicon dioxide

Your answer [ ] [1]

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44 Lithium is a metal found in Group 1 of the Periodic Table.

(i) Describe the structure and bonding in a metal.

You may include a diagram in your answer.

[2]

(ii) Lithium is **malleable** even though metallic bonds are strong.

Explain why metals are malleable.

[1]

(iii) Lithium can conduct electricity in the solid and liquid state.

Explain why metals can conduct electricity.

[2]

45(a) Metal elements and non-metal elements have different physical properties.

The table shows the physical properties of some elements.

Element	Melting point (°C)	Density (g / cm^3)	Electrical conductivity	Thermal conductivity	Cost
A	high	high	good	good	high
B	low	low	good	poor	high
C	high	low	good	good	low
D	high	high	poor	poor	low

(i) Which element, **A**, **B**, **C** or **D**, would be best to use for cables in overhead pylons to transfer electricity?

Tick (✓) **one** box.

A ☐

B ☐

C ☐

D ☐

Explain your answer.

---

[2]

(ii) What is meant by **physical** property?

---

[1]

(b) Element **C** burns in oxygen to make white clouds of its oxide.

Describe how you could test the oxide to find out if the element is a metal.

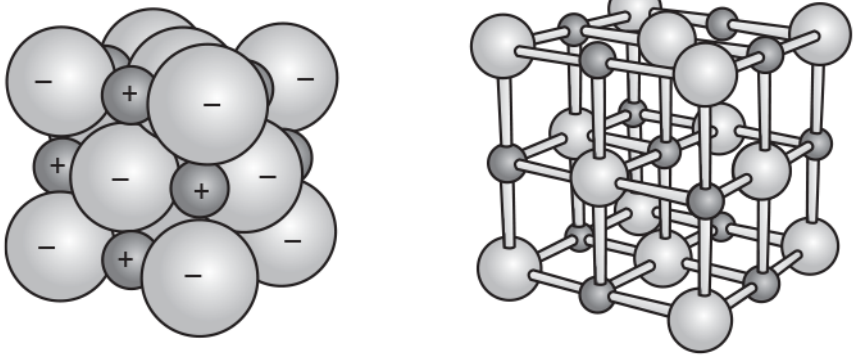
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[3]

46 Sodium chloride, NaC*l*, is an ionic compound.

Sodium chloride forms a giant ionic lattice that can be represented using different models.

Look at the diagrams. They show two models of sodium chloride.



Space-filling model **Ball-and-stick model**

(i) A scientist thinks the ball-and-stick model should be used to model ionic compounds.

Describe **two limitations** of using the ball-and-stick model for ionic compounds.

---

[2]

(ii) Ionic compounds can also be modelled using a dot-and-cross diagram.

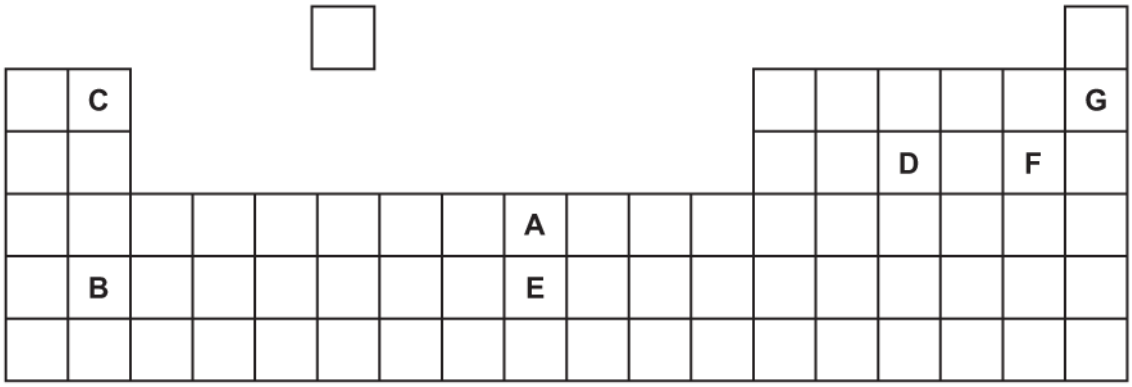
Draw a dot and cross diagram to show the ions in sodium chloride.

[2]

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47 The positions of some elements in the Periodic Table are shown by the letters **A** to **G**.

The letters shown are **not** the symbols of the elements.



Which elements are in Period 2?

A **A** and **E**

B **C** and **B**

C **C** and **G**

D **D** and **F**

Your answer [1]

48 Which substance has **ionic** bonding?

A Carbon dioxide

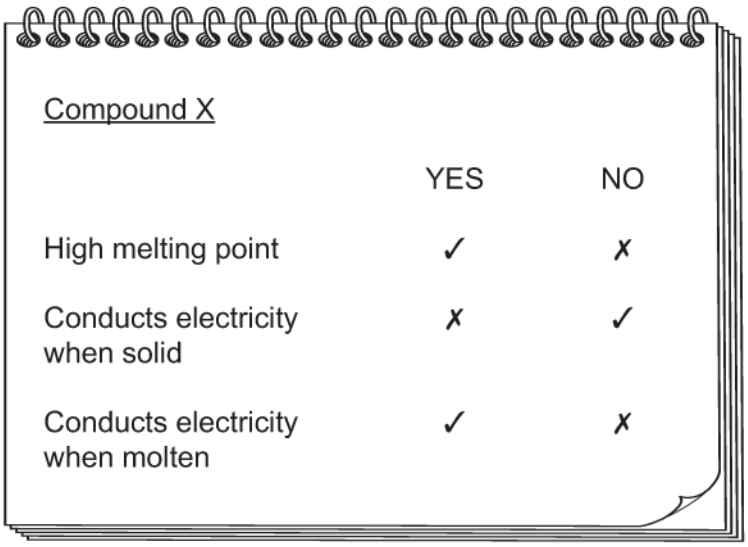
B Carbon monoxide

C Magnesium oxide

D Oxygen

Your answer [1]

49 *Scientists find out some information about a new compound called compound **X**.



Compound X

	YES	NO
High melting point	✓	✗
Conducts electricity when solid	✗	✓
Conducts electricity when molten	✓	✗

Describe and explain the type of bonding found in compound **X**.

Use all the information above to justify your answer.

[6]

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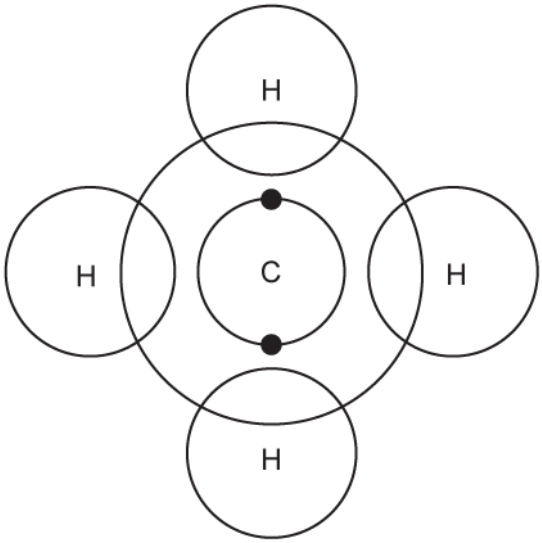
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50

(i) Carbon reacts with hydrogen to make methane, CH_4.

Complete the dot and cross diagram to show the bonding in methane.



[2]

(ii) Methane has a low melting point.

Explain why methane has a low melting point.

Use ideas about structure and bonding in your answer.

---

[2]

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51 Lithium is a metal found in Group 1 of the Periodic Table.

(i) Describe the structure and bonding in a metal.

You may include a diagram in your answer.

[2]

(ii) Lithium is **malleable** even though metallic bonds are strong.

Explain why metals are malleable.

[1]

(iii) Lithium can conduct electricity in the solid and liquid state.

Explain why metals can conduct electricity.

[2]

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52 What is the position of **carbon** in the Periodic Table?

A Period 1, Group 4
B Period 2, Group 4
C Period 4, Group 1
D Period 4, Group 2

Your answer ☐ **[1]**

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53(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]

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

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

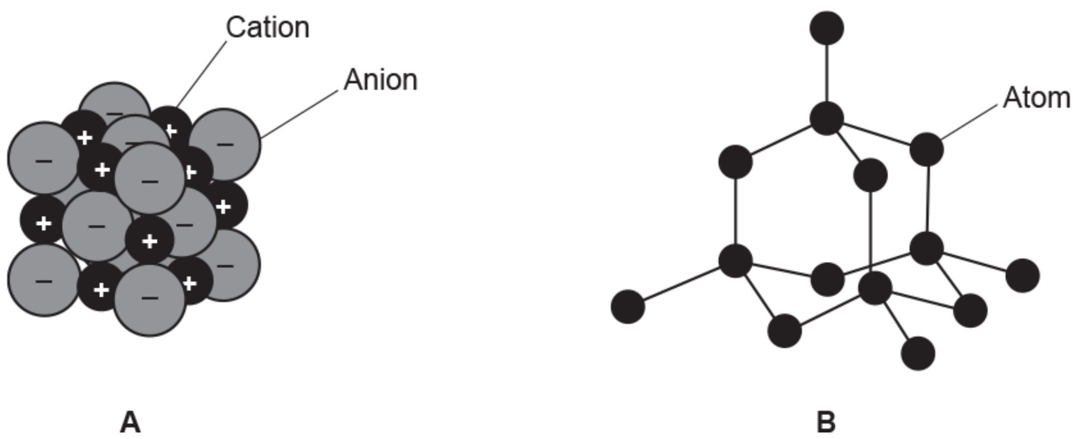


Fig. 22.1

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(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.

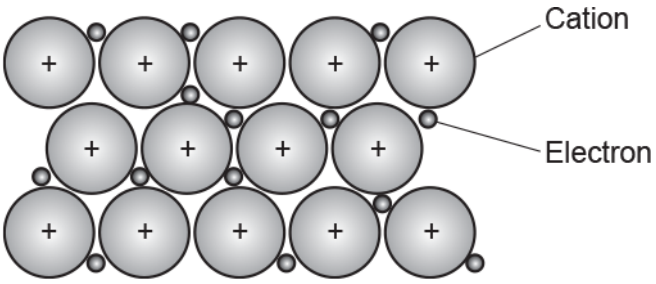


Fig. 22.2

Explain why metals are **malleable**.

---

[2]

55(a) Dmitri Mendeleev produced a Periodic Table of elements which is the basis for our modern Periodic Table. He left gaps for elements that had not been discovered yet as shown in **Fig. 23.1**.

I	II	III	IV	V	VI	VII
H						
Li	Be	B	C	N	O	F
Na	Mg	Al	Si	P	S	Cl
K	Ca		Ti	V	Cr	Mn
Cu	Zn			As	Se	Br
Rb	Sr	Y	Zr	Nb	Mo	
Ag	Cd	In	Sn	Sb	Te	I
Ce	Ba	La		Ta	W	
Au	Hg	Tl	Pb	Bi		

Fig. 23.1

Describe **two** ways Mendeleev arranged the elements in his Periodic Table.

1 ---

---

2 ---

---

[2]

(b) Describe how the elements are arranged in the modern Periodic Table.

---

[1]

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(c) Mendeleev left gaps in his Periodic Table for undiscovered elements. He predicted properties of these elements.

Table 23.1 shows the predicted properties for one of these elements in one of the gaps.

Mendeleev called this element 'eka-silicon'.

Appearance	Grey metal
Melting point (°C)	Over 800
Relative atomic mass	72
Density (g / cm^3)	5.5

Table 23.1

Table 23.2 shows some of the elements that were discovered after Mendeleev published his Periodic Table.

	Scandium (Sc)	**Gallium (Ga)**	**Germanium (Ge)**	**Technetium (Tc)**
Appearance	Silver-white metal	Silver-blue metal	Grey-white metal	Grey metal
Melting point (°C)	1541	30	947	2157
Relative atomic mass	45.0	69.7	72.6	98.0
Density (g / cm^3)	3.0	5.9	5.35	11.0

Table 23.2

(i) Which element matches Mendeleev's predictions for 'eka-silicon'?

Tick (✓) **one** box.

Scandium ☐

Gallium ☐

Germanium ☐

Technetium ☐

[1]

(ii) Give **two** reasons for your answer to **(c)(i)**.

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1 ----------

---

2 ----------

---

[2]

(d)

(i) Mendeleev did not predict the existence of argon, neon, krypton or xenon.

The electron arrangement of argon is 2,8,8.

What does this tell you about the reactivity of argon?

Explain your answer.

---

[2]

(ii) Neon is an element that has isotopes. Two of the isotopes are shown below.

$^{20}_{10}Ne$ $^{22}_{10}Ne$

Complete **Table 23.3** to show the number of protons, neutrons and electrons in each neon isotope.

	$^{20}_{10}Ne$	$^{22}_{10}Ne$
Proton		
Neutron		
Electron		

Table 23.3

[3]

56 Which Period 3 element is in Group 2?

A Aluminium
B Boron
C Calcium
D Magnesium

Your answer [1]

57 Which equation shows the formation of a Group 2 metal ion?

M represents a Group 2 metal and e^- represents an electron.

A $M + e^- \rightarrow M^+$
B $M + 2e^- \rightarrow M^{2+}$
C $M \rightarrow M^+ + e^-$
D $M \rightarrow M^{2+} + 2e^-$

Your answer [1]

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

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

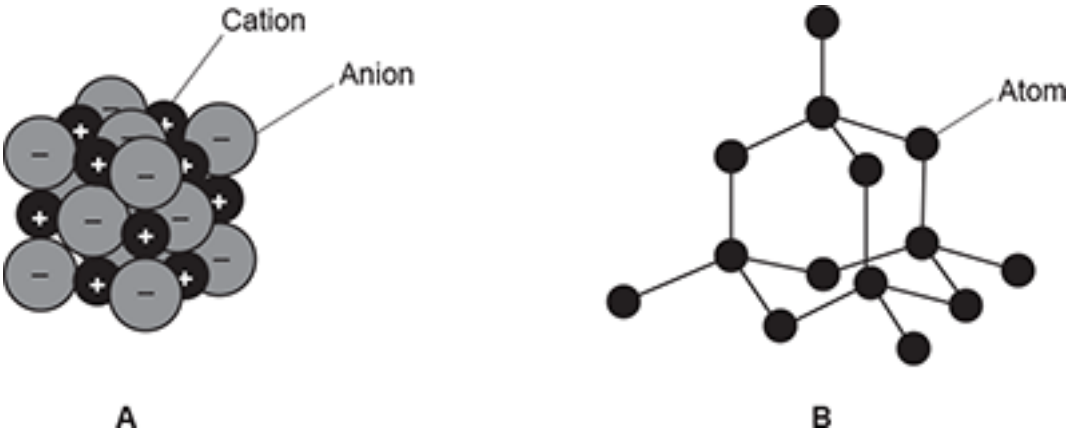


Fig. 16.1

(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]**

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(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.

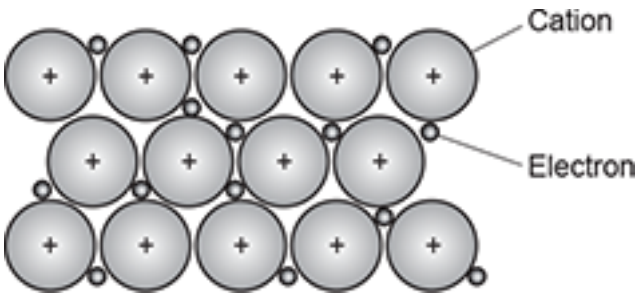


Fig. 16.2

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.

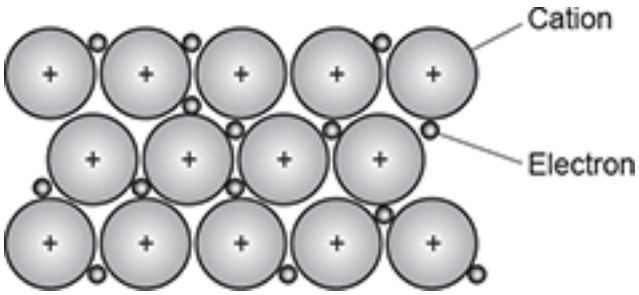


Fig. 16.2

Explain why metals are **malleable**.

---

[2]

59(a) Dmitri Mendeleev produced a Periodic Table of elements which is the basis for our modern Periodic Table. He left gaps for elements that had not been discovered yet as shown in **Fig. 17.1**.

I	II	III	IV	V	VI	VII
H						
Li	Be	B	C	N	O	F
Na	Mg	Al	Si	P	S	Cl
K	Ca		Ti	V	Cr	Mn
Cu	Zn			As	Se	Br
Rb	Sr	Y	Zr	Nb	Mo	
Ag	Cd	In	Sn	Sb	Te	I
Ce	Ba	La		Ta	W	
Au	Hg	Ti	Pb	Bi		

Fig. 17.1

Describe **two** ways Mendeleev arranged the elements in his Periodic Table.

1 ---

---

2 ---

---

[2]

(b) Describe how the elements are arranged in the modern Periodic Table.

---

[1]

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(c) Mendeleev left gaps in his Periodic Table for undiscovered elements. He predicted properties of these elements.

Table 17.1 shows the predicted properties for one of these elements in one of the gaps.

Mendeleev called this element 'eka-silicon'.

Appearance	Grey metal
Melting point (°C)	Over 800
Relative atomic mass	72
Density (g / cm^3)	5.5

Table 17.1

Table 17.2 shows some of the elements that were discovered after Mendeleev published his Periodic Table.

	Scandium (Sc)	Gallium (Ga)	Germanium (Ge)	Technetium (Tc)
Appearance	Silver-white metal	Silver-blue metal	Grey-white metal	Grey metal
Melting point (°C)	1541	30	947	2157
Relative atomic mass	45.0	69.7	72.6	98.0
Density (g / cm^3)	3.0	5.9	5.35	11.0

Table 17.2

(i) Which element matches Mendeleev's predictions for 'eka-silicon'?

Tick (✓) **one** box.

Scandium ☐

Gallium ☐

Germanium ☐

Technetium ☐

[1]

(ii) Give **two** reasons for your answer to **(i)**.

1 _____

2 _____

_____

[2]

(d)

(i) Mendeleev did not predict the existence of argon, neon, krypton or xenon.

The electron arrangement of argon is 2,8,8.

What does this tell you about the reactivity of argon?

Explain your answer.

_____

_____

_____ [2]

(ii) Neon is an element that has isotopes. Two of the isotopes are shown below.

$^{20}_{10}Ne$ $^{22}_{10}Ne$

Complete **Table 17.3** to show the number of protons, neutrons and electrons in each neon isotope.

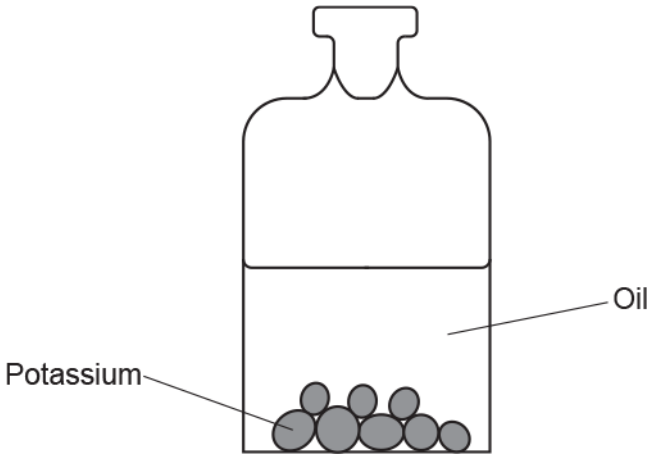
	$^{20}_{10}Ne$	$^{22}_{10}Ne$
Proton		
Neutron		
Electron		

Table 17.3 [3]

60 Group 1 is a group of elements in the Periodic Table.

(i) Potassium is a Group 1 metal.

Potassium is stored under oil because it is very reactive.



What does the oil stop the potassium reacting with?

---

[1]

(ii) Sodium is another Group 1 metal.

Sodium reacts in a similar way to potassium.

Explain why.

Use ideas about atomic structure in your answer.

---

[1]

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61 Sodium oxide, Na_2O, is a white solid.

Draw a dot and cross diagram to show the ions in sodium oxide.

[2]

END OF QUESTION PAPER

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