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Class	Register Number	Name
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BARTLEY SECONDARY SCHOOL

O-LEVEL PRELIMINARY EXAMINATIONS

SCIENCE (CHEMISTRY/BIOLOGY)

5078/01

Sec 4 Express/ 5 Normal (Academic)

Paper 1 Multiple Choice

23 September 2019

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, highlighters, glue or correction fluid.

Write your name, register number and class on the Answer Sheet in the spaces provided.

There are **forty** questions in paper. Answer **all** questions. For each question there are four possible answers, **A, B, C** and **D**. Choose the **one** you consider correct and record your choice in soft pencil on the separate Answer Sheet.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

The use of an approved scientific calculator is expected, where appropriate.

A copy of the Data Sheet is printed on page 17.

A copy of the Periodic Table is printed on page 18.

This document consists of **18** printed pages.

Set by: YBH, LMY

[Turn over

- 1 A test-tube containing a white solid, Q, is heated to 100°C. A colourless liquid is seen during the process.

What can we conclude from this observation?

- A Q boils at 100°C.
- B Q is soluble in water.
- C Q sublimates at 100°C.
- D Q has a melting point below 100°C.

- 2 Which group consists of mixtures only?

- A air, naphtha, steel
- B crude oil, methane, vinegar
- C francium, nickel, polyethene,
- D glucose, limewater, limestone

- 3 The table shows the melting and boiling points of four substances, **A**, **B**, **C** and **D**.

Which substance comprises particles that vibrate about their fixed points at room temperature?

	melting point / °C	boiling point / °C
A	-110	-55
B	-10	62
C	-133	420
D	744	1214

- 4 A man claims to have discovered a new element. He decides that the element is a halogen and is positioned below astatine in the Periodic Table based on four observations made.

Which observation about the new element is incorrect?

- A It displaces iodine from potassium iodide solution.
- B It has a higher melting and boiling point than astatine.
- C It is a black solid.
- D It is a poor electrical and heat conductor.

5 What ions are produced by iron(III) sulfate, $\text{Fe}_2(\text{SO}_4)_3$?

- A Fe^{2+} and SO_4^{2-}
- B Fe^{2+} and SO_4^{3-}
- C Fe^{3+} and SO_4^{2-}
- D Fe^{3+} and SO_4^{3-}

6 The elements W, X and Y have consecutive, increasing atomic numbers. If element Y is a noble gas, what is the chemical nature and chemical formula of the compound formed between W and X?

	chemical nature	chemical formula
A	covalent compound	WX
B	ionic compound	WX
C	covalent compound	WX_2
D	ionic compound	W_2X

7 The table shows some properties of four elements.

Which element is an alkali metal?

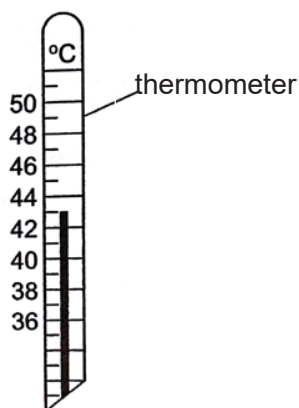
element	melting point	density	hardness	electrical conductivity
A	low	low	soft	poor
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D	high	high	hard	good

8 Sodium reacts with fluorine to form a white solid of sodium fluoride.

Which statement is true about sodium fluoride?

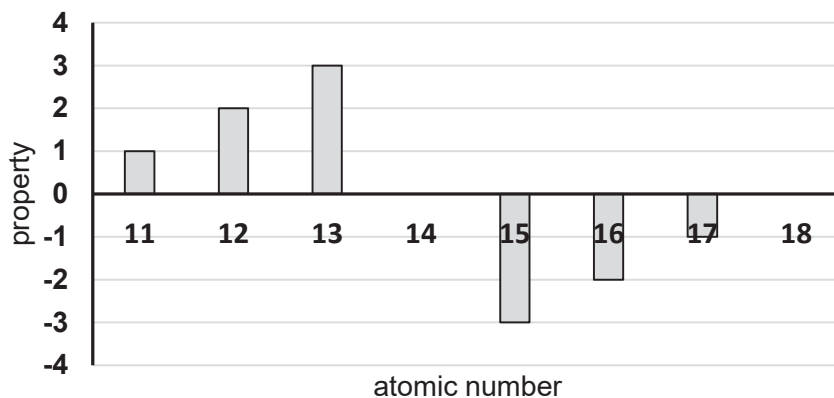
- A It cannot dissolve in water.
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- C It has strong covalent bonds
- D It has weak ionic bonds throughout the solid.

- 9 A thermometer was placed in a mixture of substances at room temperature at the beginning of an experiment. The temperature is shown in the diagram below after a short while.



What conclusion can be drawn from the experiment?

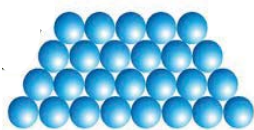
- A Neutralisation has taken place.
B The reaction is exothermic.
C The mixture takes in heat from the surroundings.
D The thermometer is a good heat conductor.
- 10 The diagram shows the trend of a property of the elements in Period 3 of the Periodic Table.



Which is the property?

- A charge of their ions
B number of valence electrons
C proton number
D relative atomic mass

- 11 The diagram shows the structure of pure copper.

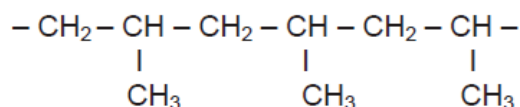


Which statement explains why pure copper sheets are easily bent.

- A The atoms have spaces for them to move in between when a force is applied.
 - B The atoms are soft and easily bent.
 - C The layers of atoms can slide past one another.
 - D The atoms have weak intermolecular forces.
- 12 Sulfur dioxide is a pollutant that dissolves in rainwater to produce acid rain. In order to remove the sulfur dioxide from the waste gases produced from a power station, the waste gases are first passed through a scrubber which showers water down on them. The mixture produced then flows out of the scrubber and is then mixed with a powdered compound to neutralize it.

Which compound will **not** be able to neutralize the aqueous mixture of sulfur dioxide?

- A calcium carbonate
 - B carbon dioxide
 - C magnesium oxide
 - D zinc oxide
- 13 What is true about the substance that has the chemical formula, $\text{C}_2\text{H}_5\text{NHCOOH}$?
- A It consists of 8 elements.
 - B It has 12 atoms within a molecule.
 - C It is a mixture.
 - D It is a covalent compound.
- 14 A polymer has a structure as shown.



Which statement is true about the polymer?

- A It is formed from the polymerisation of C_2H_4 monomers.
- B It is likely a solid at room temperature and pressure.
- C It is soluble in water.
- D It turns bromine solution from brown to colourless.

- 15** A mixture containing 2 moles of ethene and 7 moles of oxygen is ignited in a sealed container at 100 °C. The chemical equation representing the reaction is shown below.



What is the total number of moles of gases at the end of the reaction?

- A** 4 moles
B 8 moles
C 9 moles
D 13 moles
- 16** Aqueous potassium iodide is a reducing agent. Potassium manganate(VII) solution is an oxidising agent.
- If solution X shows no reaction with aqueous potassium iodide but turns acidified potassium manganate(VII) solution from purple to colourless, which statement is true of solution X?
- A** X is a reducing agent.
B X is an oxidising agent.
C X is both an oxidising and a reducing agent.
D X is neither an oxidising nor a reducing agent.
- 17** Which statement about organic compounds is true?
- A** Alkanes burn in air to form oxygen and water.
B All alcohols have the same structural formula.
C Methane is a gas at room temperature.
D Organic compounds consist of hydrogen and carbon atoms only.
- 18** Which statement correctly describes the use of each fraction obtained from the fractional distillation of petroleum?
- A** Bitumen is used to make polishes.
B Diesel is used to surface roads.
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D Petroleum gas is used as a petrochemical feedstock to make other substances.

- 19 Olive oil is described as polyunsaturated and is healthy for consumption.

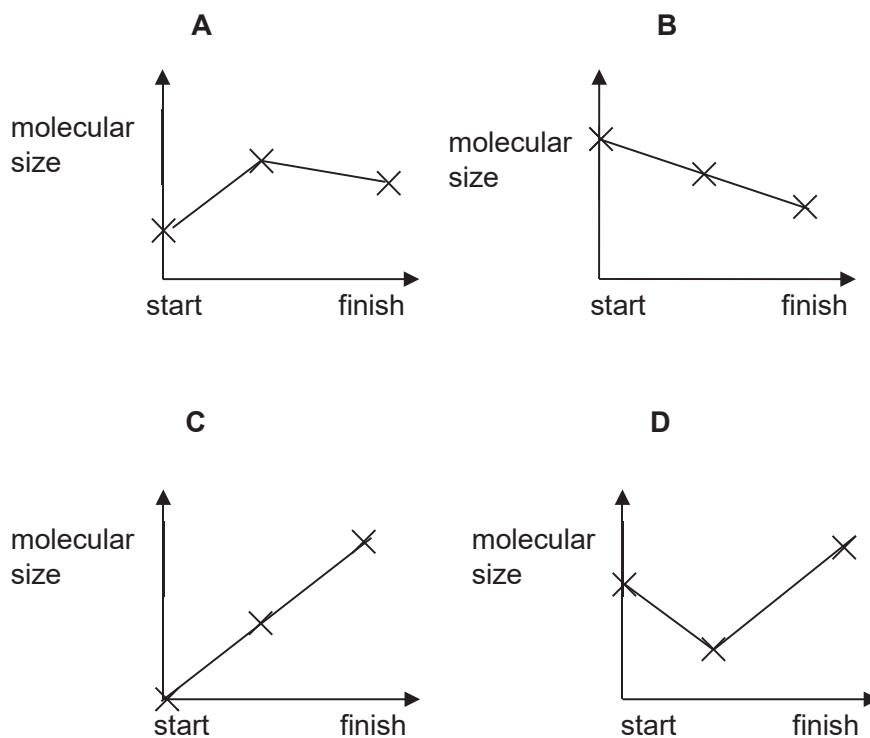
What makes the oil polyunsaturated?

- A It contains many C-C bonds.
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- 20 Poly(ethene) can be manufactured by the processes shown below.



Which diagram illustrates the change in molecular sizes correctly?



Colours of Some Common Metal Hydroxides

calcium hydroxide	white
copper(II) hydroxide	light blue
iron(II) hydroxide	green
iron(III) hydroxide	red-brown
lead(II) hydroxide	white
zinc hydroxide	white

The Periodic Table of Elements

Group																					
I	II	1 H hydrogen 1										III	IV	V	VI	VII	0				
		Key proton (atomic) number atomic symbol name relative atomic mass																			
3 Li lithium 7	4 Be beryllium 9																				
11 Na sodium 23	12 Mg magnesium 24																				
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84				
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131				
55 Cs caesium 133	56 Ba barium 137	lanthanoids 57 – 71					72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium -	85 At astatine -	86 Rn radon -
87 Fr francium -	88 Ra radium -	actinoids 89 – 103					104 Rf rutherfordium -	105 Db dubnium -	106 Sg seaborgium -	107 Bh bohrium -	108 Hs hassium -	109 Mt meitnerium -	110 Ds darmstadtium -	111 Rg roentgenium -	112 Cn copernicium -	114 Fl flerovium -	116 Lv livermorium -				

lanthanoids

57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium -	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
89 Ac actinium -	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium -	94 Pu plutonium -	95 Am americium -	96 Cm curium -	97 Bk berkelium -	98 Cf californium -	99 Es einsteinium -	100 Fm fermium -	101 Md mendelevium -	102 No nobelium -	103 Lr lawrencium -

actinoids

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).

Class	Register Number	Name
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BARTLEY SECONDARY SCHOOL

O-LEVEL PRELIMINARY EXAMINATIONS

SCIENCE (PHYSICS/CHEMISTRY)

5076/01

Sec 4 Express/ 5 Normal (Academic)

Paper 1 Multiple Choice

23 September 2019

1 hour

Additional Materials: Multiple Choice Answer Sheet

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Set by: OGK/ YBH

[Turn over

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What can we conclude from this observation?

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- 22** Which group consists of mixtures only?

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- 23** The table shows the melting and boiling points of four substances, **A**, **B**, **C** and **D**.

Which substance comprises particles that vibrate about their fixed points at room temperature?

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- 24** A man claims to have discovered a new element. He decides that the element is a halogen and is positioned below astatine in the Periodic Table based on four observations made.

Which observation about the new element is incorrect?

- A** It displaces iodine from potassium iodide solution.
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- A** Fe^{2+} and SO_4^{2-}
- B** Fe^{2+} and SO_4^{3-}
- C** Fe^{3+} and SO_4^{2-}
- D** Fe^{3+} and SO_4^{3-}

26 The elements W, X and Y have consecutive, increasing atomic numbers. If element Y is a noble gas, what is the chemical nature and chemical formula of the compound formed between W and X?

	chemical nature	chemical formula
A	covalent compound	WX
B	ionic compound	WX
C	covalent compound	WX_2
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27 The table shows some properties of four elements.

Which element is an alkali metal?

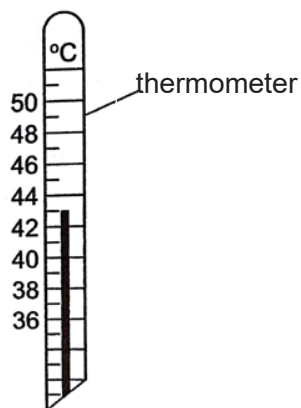
element	melting point	density	hardness	electrical conductivity
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Which statement is true about sodium fluoride?

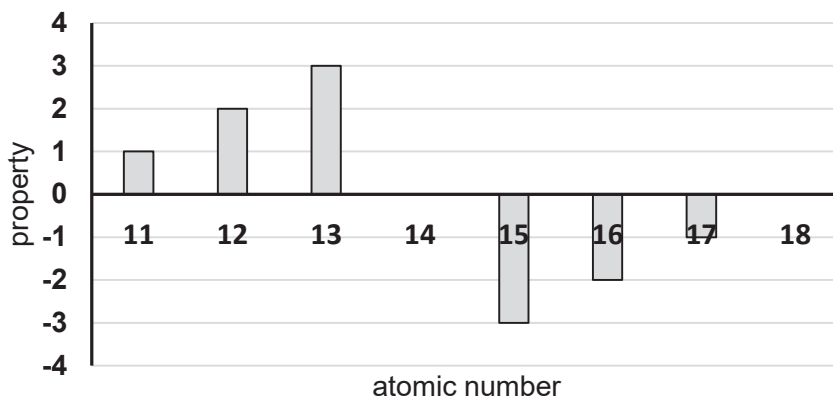
- A** It cannot dissolve in water.
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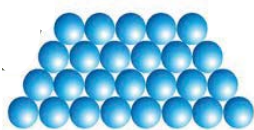
- A** Neutralisation has taken place.
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D The thermometer is a good heat conductor.
- 30** The diagram shows the trend of a property of the elements in Period 3 of the Periodic Table.



Which is the property?

- A** charge of their ions
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- 31 The diagram shows the structure of pure copper.

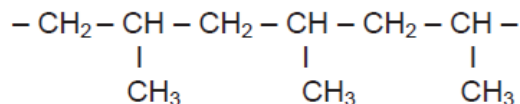


Which statement explains why pure copper sheets are easily bent.

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Which statement is true about the polymer?

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- 35** A mixture containing 2 moles of ethene and 7 moles of oxygen is ignited in a sealed container at 100 °C. The chemical equation representing the reaction is shown below.



What is the total number of moles of gases at the end of the reaction?

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- 39 Olive oil is described as polyunsaturated and is healthy for consumption.

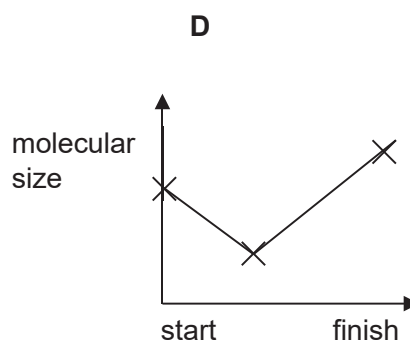
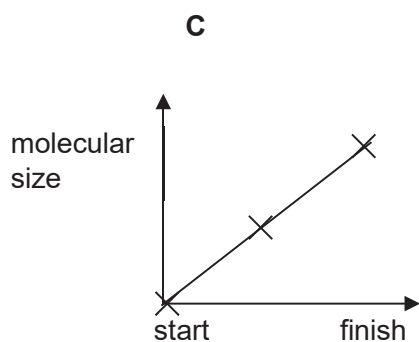
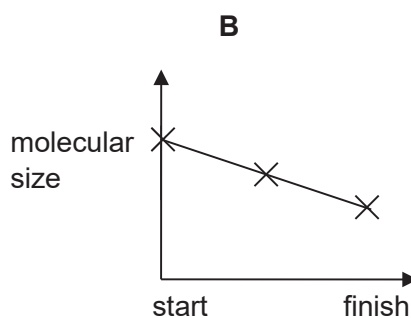
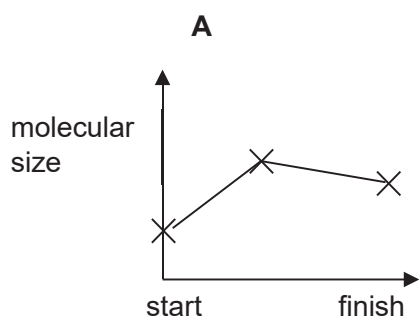
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Which diagram illustrates the change in molecular sizes correctly?



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Colours of Some Common Metal Hydroxides

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The Periodic Table of Elements

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11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40												
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actinoids																													
89 Ac actinium -		90 Th thorium 232		91 Pa protactinium 231		92 U uranium 238		93 Np neptunium -		94 Pu plutonium -		95 Am americium -		96 Cm curium -		97 Bk berkelium -		98 Cf californium -		99 Es einsteinium -		100 Fm fermium -		101 Md mendelevium -		102 No nobelium -		103 Lr lawrencium -	

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).

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BARTLEY SECONDARY SCHOOL

O-LEVEL PRELIMINARY EXAMINATIONS

SCIENCE

5076/03, 5078/03

Sec 4 Express / 5 Normal (Academic)

Paper 3 Chemistry

16 Sep 2019

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your class, register number and name on all the work you hand in.

Write in dark blue or black pen.

You may use a soft pencil for any diagrams, graphs, tables or rough working.

Do not use staples, paper clips, glue or correction fluid.

Section A

Answer **all** questions.

Write your answers in the spaces provided on the question paper.

Section B

Answer any **two** questions.

Write your answers in the spaces provided on the question paper.

A copy of the Data Sheet is printed on page 15.

A copy of the Periodic Table is printed on page 16.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [] at the end of each question or part question.

For Examiner's Use	
Section A	
Section B	

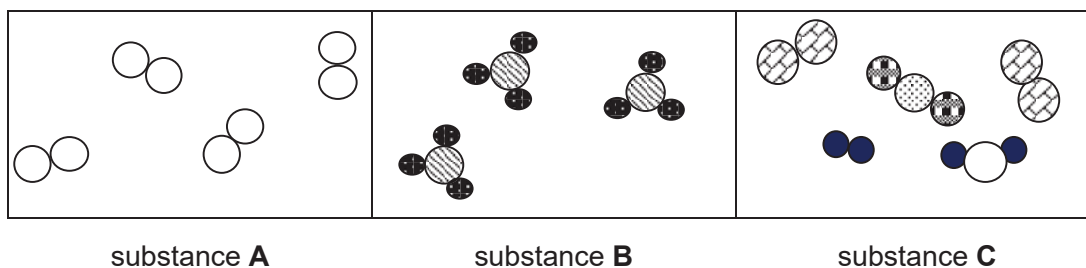
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This document consists of **15** printed pages and **1** blank page.

Section A

Answer **all** the questions in the spaces provided

- 1 The diagrams below show the particles present in three types of substances.



Choose the substance, **A**, **B** or **C**, that shows the following properties.

- (a) breaks down chemically to form two elements _____
- (b) consists of molecules of a pure halogen _____
- (c) is a pure compound _____
- (d) shows variable boiling points _____

[4]

- 2 The table below shows the symbols of some isotopes of elements in the Periodic Table.

isotope name	carbon-13	fluorine-21	magnesium-25	neon-22	strontium-92	iodine-129
isotope symbol	$^{13}_6\text{C}$	$^{21}_9\text{F}$	$^{25}_{12}\text{Mg}$	$^{22}_{10}\text{Ne}$	$^{92}_{38}\text{Sr}$	$^{129}_{53}\text{I}$

- (a) What is an *isotope*?

 _____ [1]

- (b) Which **two** isotopes shown above have the same number of neutrons?

_____ and _____ [1]

- (c) Give the symbol of another isotope of carbon that is used to standardise the relative atomic mass, A_r , of an element.

_____ [1]

- (d) Why are magnesium and strontium placed in the same group in the Periodic Table?

_____ [1]

- (e) Which isotope belongs to a non-metal from Period 5?

_____ [1]

- (f) Why is neon-22 an unreactive isotope?

_____ [1]

- 3 The table below shows properties of two oxides, X_2O and ZO_2 .

formula of oxide	melting point / °C	boiling point / °C	solubility in water
X_2O	722	1302	soluble
ZO_2	-15	68	insoluble

- (a) Name the type of chemical bond within the substance X_2O .

_____ [1]

- (b) The oxide, ZO_2 , is believed to be carbon dioxide gas.

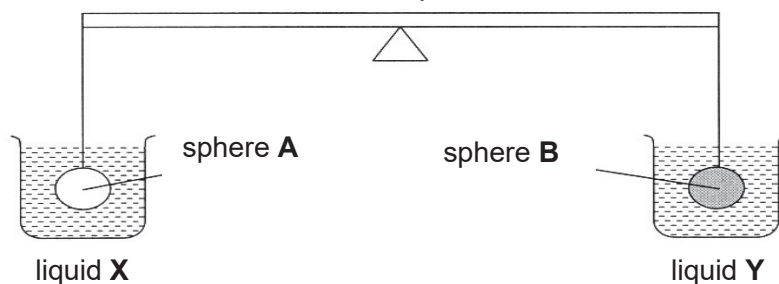
- (i) Describe the test for carbon dioxide gas and the observation that is expected.

_____ [2]

- (ii) Draw a 'dot and cross' diagram to show the arrangement of all the electrons in a molecule of carbon dioxide.

[2]

- 4 Two spheres, **A** and **B**, of equal mass were hung on either side of a beam balance in a laboratory. Spheres **A** and **B** are made of either similar or different materials. Each sphere was immersed in two separate liquids **X** and **Y** in separate beakers at the same time for a fixed period. The spheres were then removed from both liquids and dripped dry while they were still hung on the beam balance. Observations about both spheres were made and recorded at the end of the experiment.



In the table below, circle the correct observation made at the end of each experiment.

metal A	metal B	liquid X	liquid Y	observation at end of experiment
iron	iron	water	water	sphere A heavier/ both have same mass / sphere B heavier
magnesium	magnesium	water	dilute hydrochloric acid	sphere A heavier/ both have same mass / sphere B heavier
iron	steel	dilute hydrochloric acid	dilute hydrochloric acid	sphere A heavier/ both have same mass / sphere B heavier
zinc	zinc	dilute hydrochloric acid	water	sphere A heavier/ both have same mass / sphere B heavier
copper	zinc	dilute hydrochloric acid	dilute hydrochloric acid	sphere A heavier/ both have same mass / sphere B heavier
carbon	carbon	dilute hydrochloric acid	water	sphere A heavier/ both have same mass / sphere B heavier

[4]

- 5 The table shows the number of protons, electrons and neutrons in seven particles, **A**, **B**, **C**, **D**, **E**, **F** and **G**.

particles	number		
	electrons	neutrons	protons
A	12	12	12
B	15	16	15
C	17	18	17
D	17	20	17
E	18	16	16
F	18	22	18
G	18	20	20

- (a) (i) Identify the two particles which have the same mass number.

_____ and _____ [1]

- (ii) Do the particles named in (i) belong to the same element? Explain your answer.

_____ [1]

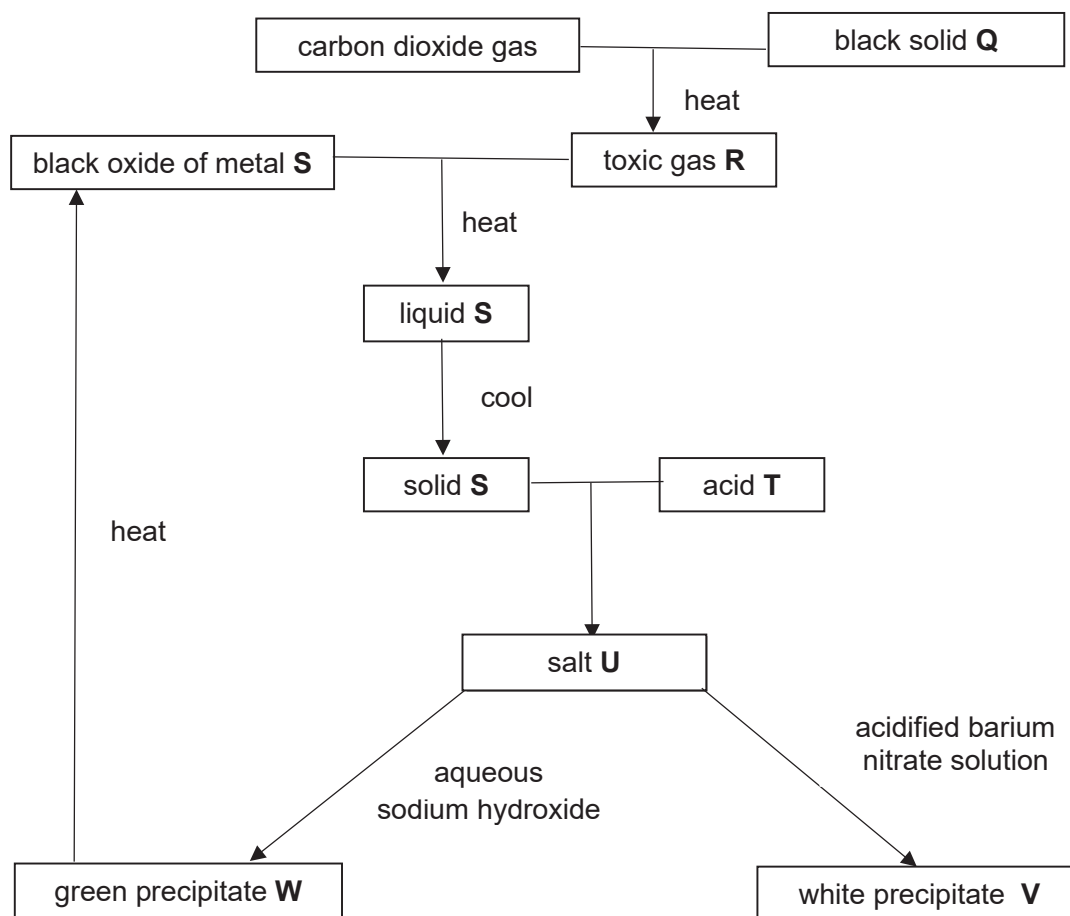
- (b) Identify the particle that belongs to a Group 0 element.

_____ [1]

- (c) Which particle has a charge of +2?

_____ [1]

- 6 The figure below describes reactions involving carbon dioxide and a black solid **Q**.



- (a) Identify the substances, **Q**, **R**, **S**, **T**, **U** and **V**.

Q _____
R _____
S _____
T _____
U _____
V _____

[6]

- (b) Instead of using aqueous sodium hydroxide, name another chemical substance you can use to confirm the identity of the cation of salt **U**.

_____ [1]

- (c) Write the ionic equation representing the reaction between salt **U** and sodium hydroxide solution to form the green precipitate, **W**.

_____ [1]

- 7 Sugar cane juice is used for the manufacture of ethanol which can be consumed as wine. The ethanol can also be concentrated to make fuel for use in vehicles.

- (a) What physical process is used to increase the concentration of ethanol?

_____ [1]

- (b) (i) Name the process used to manufacture ethanol from cane sugar.

_____ [1]

- (ii) State **two** conditions required for the process named in (b)(i).

_____ [1]

- (c) Draw the structural formula of ethanol.

[1]

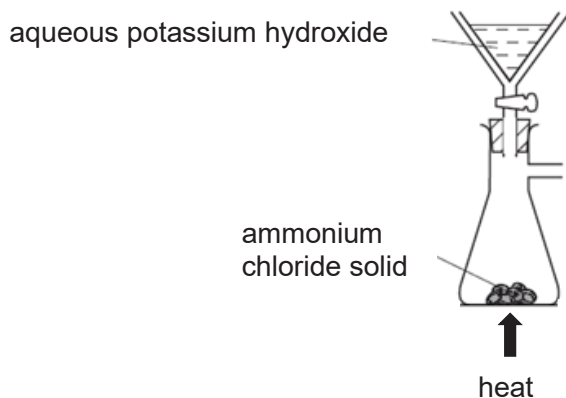
- (d) (i) Explain why wine tastes sour if it is left uncovered for many days.

_____ [2]

- (ii) Describe a test to verify that the change in (d)(i) has taken place.

_____ [2]

- 8 Excess aqueous potassium hydroxide is added dropwise to a lump of ammonium chloride solid in a conical flask as shown in the diagram below.



- (a) Name the gas produced in the reaction.

_____ [1]

- (b) Complete and label the diagram to show how the gas produced in (a) can be collected and measured.

[2]

- (c) What are **two** ways of increasing the rate of reaction without affecting the final volume of the gas collected.

_____ [2]

- (d) What difference in observation would you make if the ammonium chloride is replaced with sodium chloride?

_____ [1]

Section B

Answer any **two** questions in this section.

Write your answers in the spaces provided.

- 9** 10 g of calcium carbonate was added to 1 mol/ dm³ hydrochloric acid in a conical flask. The carbon dioxide gas released was collected in a measuring cylinder using the downward displacement of water method.

(a) Write a balanced chemical equation that represents the reaction between hydrochloric acid and calcium carbonate, including the state symbols.

_____ [2]

(b) (i) Calculate the number of moles in 10 g of calcium carbonate.

number of moles of calcium carbonate = _____ [1]

(ii) Calculate the number of moles of the hydrochloric acid that reacted completely with 10 g of calcium carbonate.

number of moles of hydrochloric acid = _____ [1]

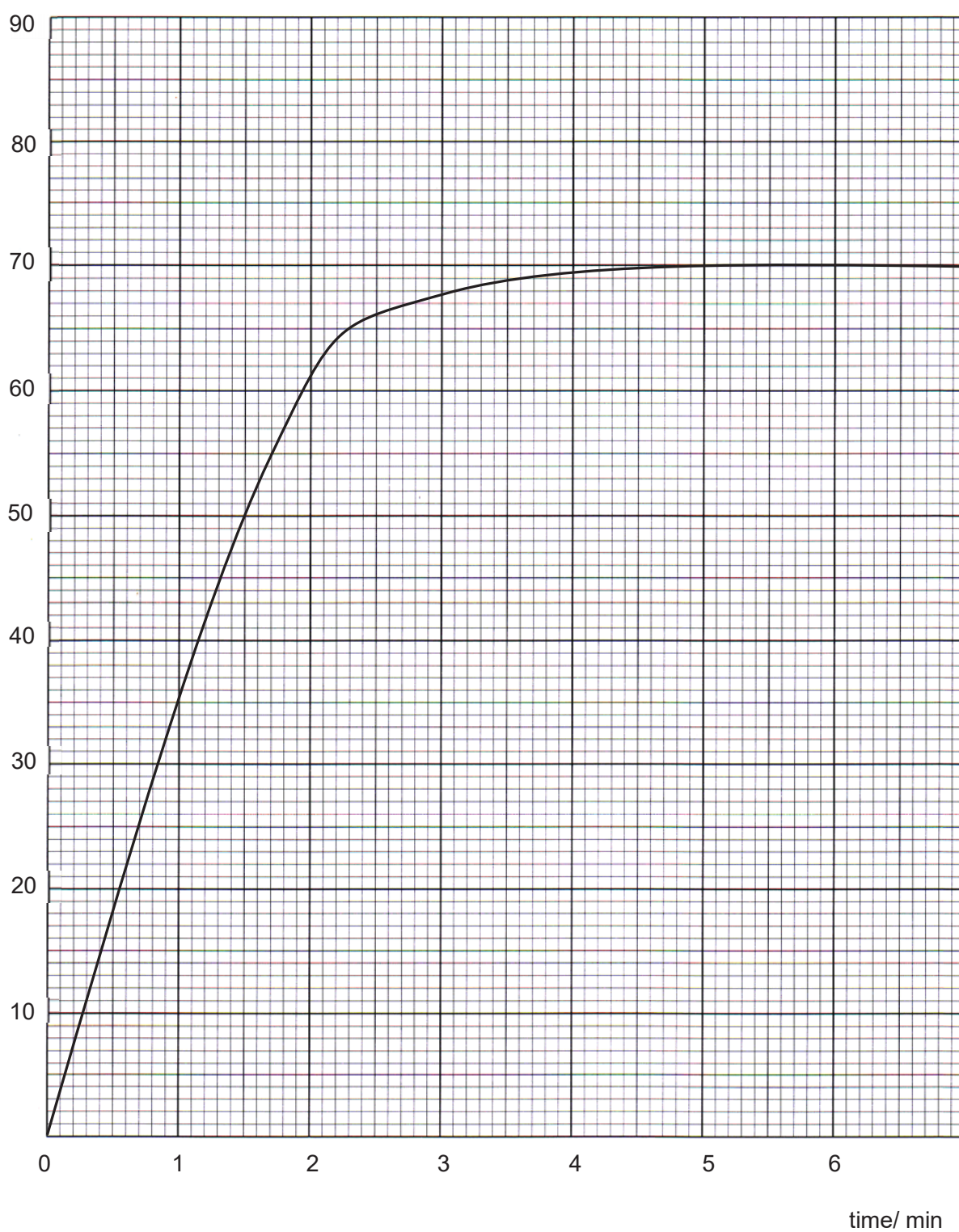
(iii) Calculate the volume of the 1 mol/ dm³ hydrochloric acid that reacted completely with 10 g of calcium carbonate.

volume of hydrochloric acid = _____ [1]

(c) The experiment was repeated using an excess of a different amount of calcium carbonate in the same 1 mol/dm³ hydrochloric acid. The volume of carbon dioxide gas produced was measured over a period of time.

The graph on page 10 shows the volume of carbon dioxide gas produced at regular time intervals.

Study the graph and answer the questions that follow.

volume/ cm^3 

- (i) What volume of carbon dioxide measured at room temperature and pressure was formed at the end of the reaction?

_____ [1]

- (ii) When did the reaction stop?

_____ [1]

- (iii) What was the average speed of reaction at the first 1.5 minutes?

_____ [1]

- (iv) Using your understanding of the Kinetic Particle Theory, explain why the reaction slowed down towards the end of the experiment.

_____ [2]

- 10 Copper reacts with dilute nitric acid to form the products as shown in the chemical equation below.



- (a) (i) State the oxidation number of copper before the reaction occurs.

_____ [1]

- (ii) Calculate the oxidation number of copper in copper(II) nitrate, $\text{Cu}(\text{NO}_3)_2$.

_____ [1]

- (iii) Is copper oxidised, reduced, or neither oxidised nor reduced? Explain your answer using oxidation numbers.

_____ [1]

- (b) Describe what is observed if a sample of copper(II) nitrate solution is added to excess aqueous ammonia.

_____ [1]

(c) Copper(II) nitrate crystals, $\text{Cu}(\text{NO}_3)_2$, can also be prepared in the laboratory using an insoluble base mixed with dilute nitric acid.

(i) Name a suitable insoluble base that can be used for this reaction.

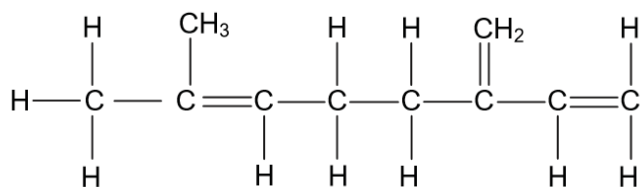
_____ [1]

(ii) Describe how a sample of dry pure copper(II) nitrate crystals can be prepared in the laboratory using the insoluble base and aqueous nitric acid.

 _____ [5]

11 Perfume is a mixture of essential oils dissolved in a solvent. One of the essential oils used in making perfume is called myrcene.

The structural formula of a molecule of myrcene is shown below.



(a) Explain why myrcene is a hydrocarbon.

_____ [1]

(b) An experiment is carried out using two samples of myrcene.

(i) The first sample is tested with a few drops of aqueous bromine.

What change if any, will be observed?

_____ [1]

- (ii) Hydrogen gas was passed through the second sample of myrcene in an addition reaction before being tested with aqueous bromine.

What change if any, will be observed?

_____ [1]

- (iii) Explain the difference in observations between both samples.

_____ [1]

- (c) Explain why myrcene is a liquid and not a solid at room temperature.

_____ [2]

- (d) Myrcene can be cracked to form smaller molecules.

- (i) State the conditions for cracking.

_____ [1]

- (ii) Name an element that may be obtained from the cracking process.

_____ [1]

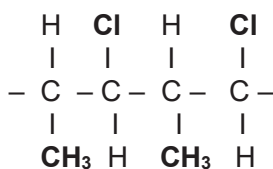
- (iii) The chemical equation below shows an example of a cracking process of myrcene.



Name substance X.

_____ [1]

- (e) The structural formula of an addition polymer is shown below.



Draw the structure of its monomer.

[1]

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Colours of Some Common Metal Hydroxides

calcium hydroxide	white
copper(II) hydroxide	light blue
iron(II) hydroxide	green
iron(III) hydroxide	red-brown
lead(II) hydroxide	white
zinc hydroxide	white

The Periodic Table of Elements

Group																	
I	II	1 H hydrogen 1										III	IV	V	VI	VII	0
		Key proton (atomic) number atomic symbol name relative atomic mass															
3 Li lithium 7	4 Be beryllium 9																
11 Na sodium 23	12 Mg magnesium 24																
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids		72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium -	85 At astatine -
87 Fr francium -	88 Ra radium -	89 – 103 actinoids		104 Rf rutherfordium -	105 Db dubnium -	106 Sg seaborgium -	107 Bh bohrium -	108 Hs hassium -	109 Mt meitnerium -	110 Ds darmstadtium -	111 Rg roentgenium -	112 Cn copernicium -	114 Fl flerovium -	116 Lv livermorium -			
lanthanoids																	
57 La lanthanum 139		58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium -	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175		
actinoids																	
89 Ac actinium -		90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium -	94 Pu plutonium -	95 Am americium -	96 Cm curium -	97 Bk berkelium -	98 Cf californium -	99 Es einsteinium -	100 Fm fermium -	101 Md mendelevium -	102 No nobelium -	103 Lr lawrencium -		

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).

