Register No.	Class

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BENDEMEER SECONDARY SCHOOL
2021 PRELIMINARY EXAMINATION
SECONDARY 4 EXPRESS / 5 NORMAL (ACADEMIC)
SCIENCE (CHEMISTRY, BIOLOGY) PAPER 1
5078/01

DATE : **31 August 2021**
DURATION : **1 hour**

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Write your name, class and register number on the work you hand in.
Do not use paper clips, glue or correction fluid.

There are **forty** questions on this 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 2B pencil on the OTAS sheet.

Read the instructions on the OTAS sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done on the question paper.
A copy of the Periodic Table is printed on page **19**.
The use of an approved scientific calculator is expected, where appropriate.

This document consists of **19** printed pages.

[Turn over

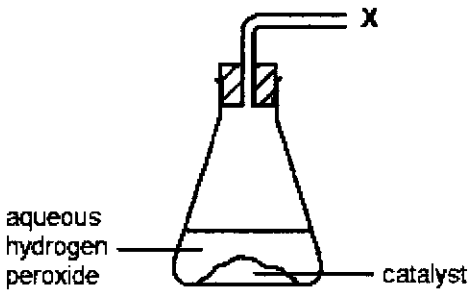
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1 Aqueous hydrogen peroxide undergoes catalytic decomposition as shown in the equation below.

$$2H_2O_2\ (aq) \rightarrow 2H_2O\ (l) + O_2\ (g)$$

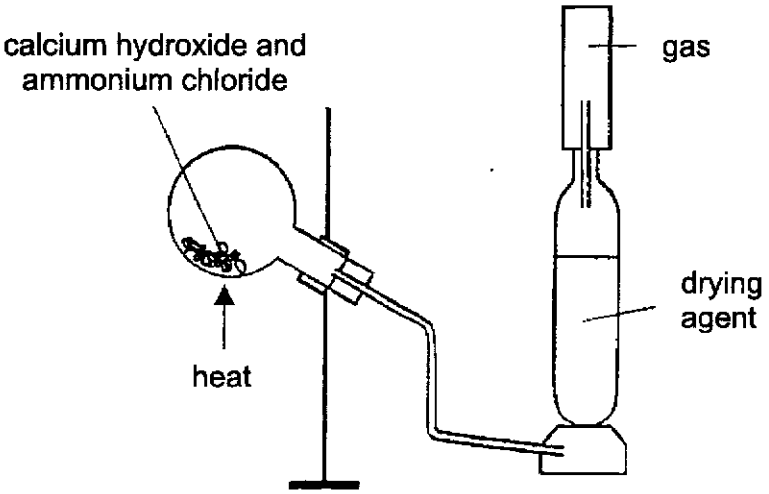
The diagram shows part of the apparatus used to measure the rate of decomposition.



Which piece of apparatus is connected at position X?

A burette
B gas syringe
C measuring cylinder
D pipette

2 A student set up the apparatus as shown.



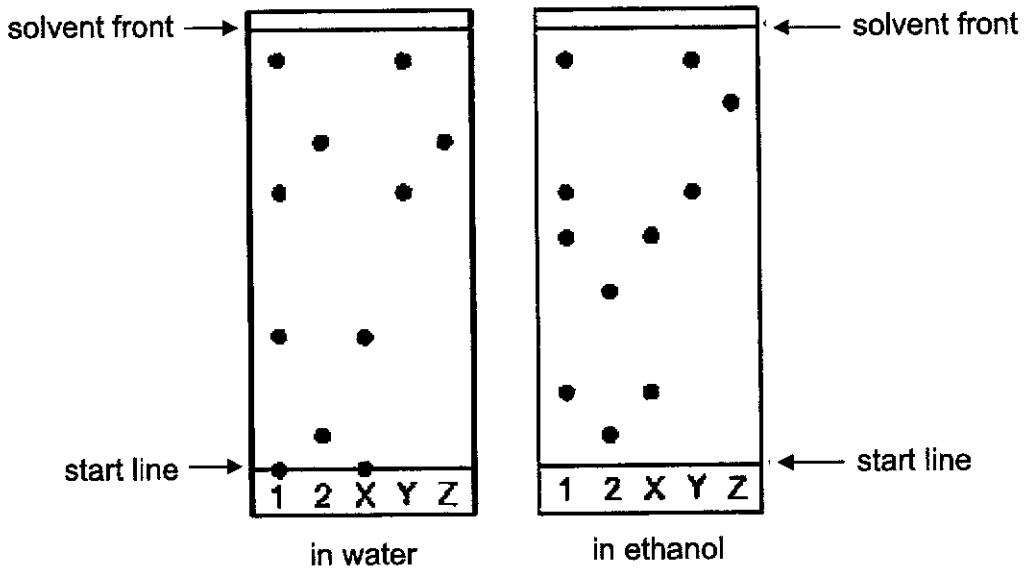
Which gas will be collected and which drying agent should be used?

	name of gas	drying agent
A	ammonia	calcium oxide
B	ammonia	concentrated sulfuric acid
C	chlorine	calcium oxide
D	chlorine	concentrated sulfuric acid

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3 Food dyes, 1 and 2 are known to contain one or more of the three substances X, Y and Z. Two chromatograms are developed; one used water as the solvent, and the other used ethanol. The results are shown in the diagram below.



Which statement(s) is/are correct?

I Substance Z is likely to be pure.
II The component in Z is more soluble in water than in ethanol.
III There is a component in sample 1 that is insoluble in water but soluble in ethanol.

A I only
B I and III only
C II and III only
D All of the above

4 An unknown substance melts at –134 °C and boils at –105 °C.

Which option correctly describes the arrangement and movement of the particles of this substance at –112 °C?

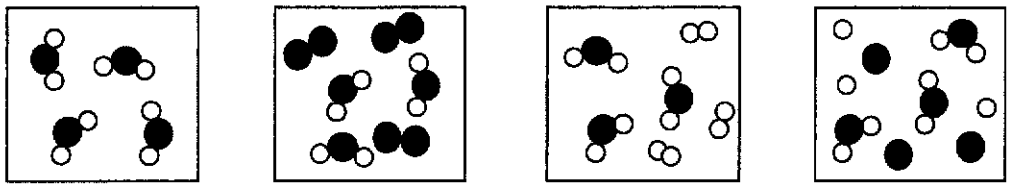
	arrangement	movement
A	closely packed in disorderly manner	slide over one another easily
B	closely packed in orderly manner	slide over one another easily
C	closely packed in orderly manner	vibrate about fixed positions
D	spread far apart in random manner	moves in all direction at high speeds

[Turn over

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5 Hydrogen is mixed and burnt in excess oxygen gas to form water vapour in a reaction vessel.

Which diagram represents the particles that remain in the reaction vessel?



A B C D

6 An element Y reacts with chlorine to form a solid of formula YCl.
What could be the electronic structure of Y?

A 2.6 **B** 2.8.1
C 2.8.2 **D** 2.8.7

7 Which statement about an atom is correct?

A Each element only has one nucleon (mass) number.
B The nucleon (mass) number can be less than the proton (atomic) number.
C The nucleon (mass) number can be equal to the proton (atomic) number.
D The number of neutrons is never the same as the number of electrons.

8 Element G has *n* protons.
Element J has $(n - 3)$ protons and is able to achieve a stable electronic configuration by either sharing or accepting two electrons.

What is the compound formed when element G reacts with element J?

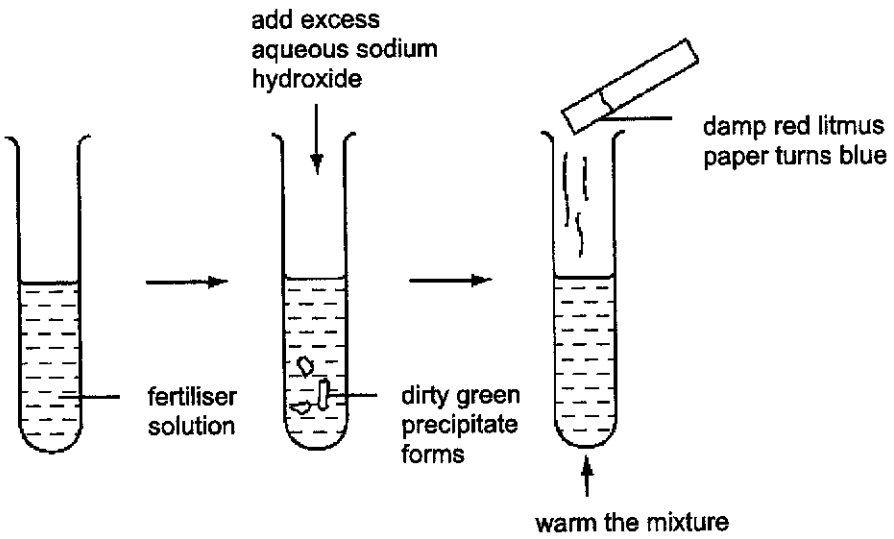
A a covalent compound, GJ_2
B a covalent compound, G_2J
C an ionic compound, GJ_2
D an ionic compound, G_2J

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9 A solution of fertiliser was tested as shown.



What are the ions present in the fertiliser solution?

A Fe^{3+} and SO_4^{2-}
B Fe^{2+} and NO_3^-
C NH_4^+ and NO_3^-
D NH_4^+ and Fe^{2+}

10 The table shows the results of adding dilute nitric acid and aqueous sodium hydroxide to four oxides.

Which oxide is basic?

oxide	dilute nitric acid	aqueous sodium hydroxide
A	no reaction	reaction
B	no reaction	no reaction
C	reaction	reaction
D	reaction	no reaction

11 Which pair of chemicals is most suitable for the laboratory preparations of zinc sulfate?

A zinc carbonate and lead(II) sulfate
B zinc chloride and sulfuric acid
C zinc nitrate and lead(II) sulfate
D zinc oxide and sulfuric acid

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12 Which gas will occupy a volume of 24 dm^3 at room temperature and pressure?

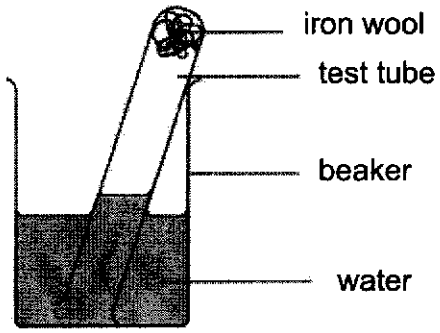
A 4 g of helium
B 14 g of nitrogen
C 24 g of carbon dioxide
D 32 g of sulfur dioxide

13 What is the volume of 0.5 mol/dm^3 hydrochloric acid that would react with 0.24 g of magnesium in the reaction below?

$$Mg + 2HCl \rightarrow MgCl_2 + H_2$$

A 20 cm^3 **B** 40 cm^3
C 50 cm^3 **D** 100 cm^3

14 The apparatus shown below was set up by a student to investigate the effect of air on rusting.



The student discovered that after a few days, the height of the water in the test tube rose by 4 cm, indicating that about 4 cm^3 of air was used in the process of rusting.

What was the original volume of air found in the test tube?

A 4 cm^3 **B** 10 cm^3
C 20 cm^3 **D** 40 cm^3

15 Some properties of elements in the same group of the Periodic Table are listed.

1 charge on the ion
2 number of outer shell electrons
3 number of protons
4 total number of inner shell electrons

Which properties show an increase when moving down a group?

A 1 and 2
B 1 and 3
C 2 and 4
D 3 and 4

[Turn over

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16 Which statement about the production of iron from haematite is correct?

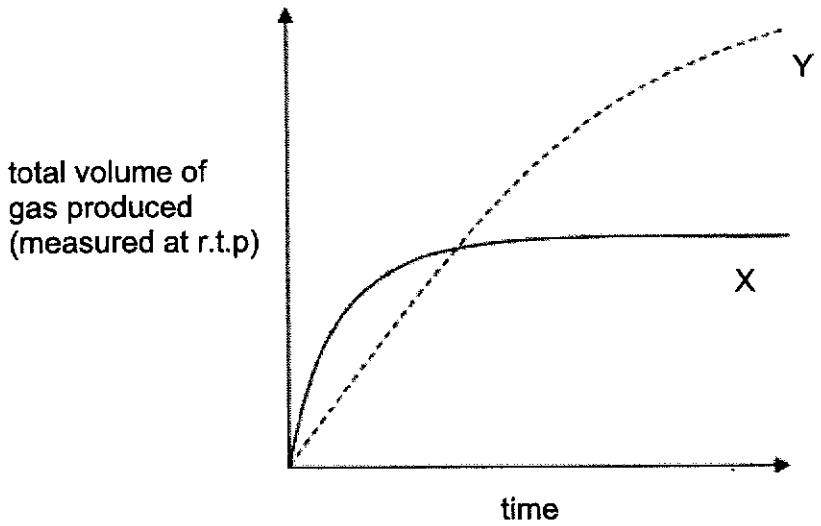
A Carbon monoxide is used as an oxidising agent in the blast furnace.
B Haematite is oxidised by carbon monoxide.
C Limestone is added to the blast furnace to remove acidic impurities.
D Molten iron floats on molten slag at the bottom of the blast furnace.

17 When 0.003 mol of a metal X was reacted with an excess of dilute sulfuric acid, 72 cm^3 of gas was given off, measured at room temperature and pressure. The final temperature of the reaction mixture in the beaker was 40 °C.

Which of the following is correct for the reaction?

	type of reaction	possible identity of metal X
A	endothermic	copper
B	endothermic	magnesium
C	exothermic	copper
D	exothermic	magnesium

18 In the graph below, curve X represents the results of the reaction between 1.0 g of powdered zinc and an excess of 1.0 mol/dm^3 acid at 30 °C.



Which changes will produce curve Y?

A using 1.0 g of powdered zinc with excess of 1.0 mol/dm^3 acid at 15 °C
B using 1.0 g of powdered zinc with excess of 0.5 mol/dm^3 acid at 30 °C
C using 2.0 g of powdered zinc with excess of 0.5 mol/dm^3 acid at 30 °C
D using 2.0 g of powdered zinc with excess of 1.0 mol/dm^3 acid at 30 °C

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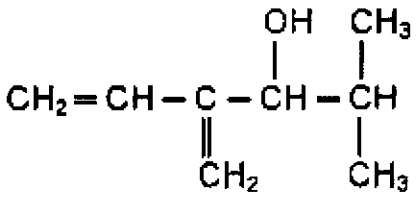
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19 A certain type of margarine is described as 'high in polyunsaturates'.

What does this type of margarine contain?

A long chain alkane molecules
B many alkene molecules joined by addition polymerisation
C molecules containing many C=C bonds
D molecules containing hydrogen and carbon only

20 The compound contained in the sex attractant of the Ips Confusus bark beetle is shown below.



Which statement about this compound is false?

A It decolourises aqueous bromine.
B It has no effect on Universal Indicator.
C It is saturated.
D It turns purple potassium manganate (VII) colourless.

[Turn over

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Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
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
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 –	86 Rn radon –
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 –		

Key

proton (atomic) number
atomic symbol
name
relative atomic mass

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 dm^3 at room temperature and pressure (r.t.p.).

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BENDEMEER SECONDARY SCHOOL
2021 PRELIMINARY EXAMINATION
SECONDARY 4 EXPRESS / 5 NORMAL (ACADEMIC)
SCIENCE (CHEMISTRY) PAPER 3
5076/03, 5078/03

DATE : **24 August 2021**
DURATION : **1 hour 15 minutes**

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number on the work you hand in.
You may use a 2B pencil for any diagrams, graphs, tables or rough working.
Write in dark blue or black pen.
Do not use paper clips, glue or correction fluid.

The use of an approved scientific calculator is expected, where appropriate.
You may lose marks if you do not show your working or if you do not use appropriate units.

Section A
Answer **all** questions.
Write your answers in the spaces provided on the question paper.

Section B
Answer **all** questions.
Write your answers in the spaces provided on the question paper.

A copy of the Data Sheet is printed on page **16**.
A copy of the Periodic Table is printed on page **17**.

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.

65

This document consists of **17** printed pages.

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Section A

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

1 Table 1.1 shows the properties of 4 substances.

Table 1.1

substance	melting point/ °C	boiling point/ °C
W	–112	–50
X	–79	90
Y	10	105
Z	85	920

(a) Which substance(s) exist as gas(es) at 100 °C?

..... [1]

(b) Describe the arrangement and movement of particles in substance W at room temperature.

.....

.....

..... [2]

(c) Substances X and Y are miscible liquids at room temperature.

(i) Suggest why fractional distillation is a good method to separate X and Y.

..... [1]

(ii) Explain which substance, X or Y, will be distilled out first.

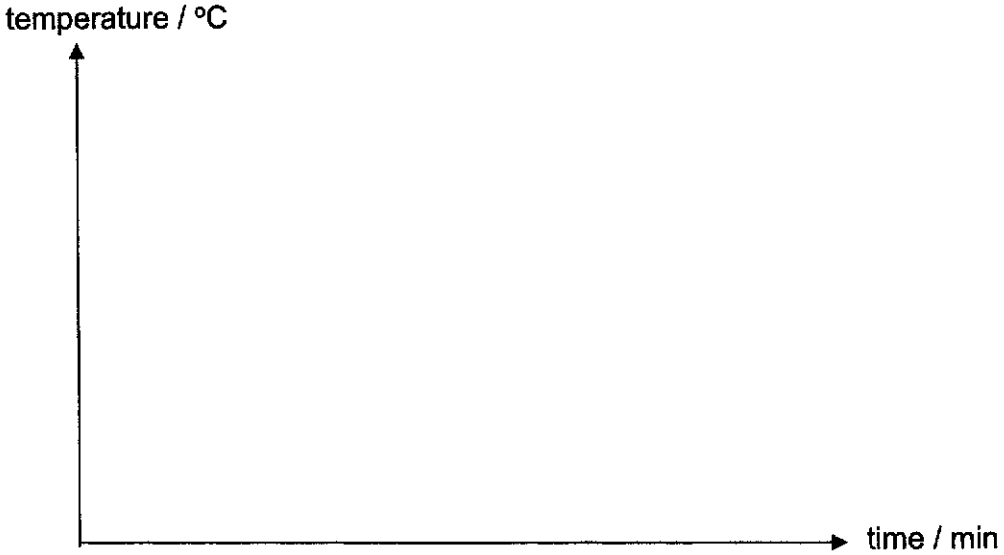
..... [1]

[Turn over]

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(iii) Sketch a temperature-time graph to show the change in temperature when a mixture of X and Y is heated from 25 °C to 120 °C.



[2]

2 Table 2.1 contains some information of six atoms U, V, W, X, Y and Z.

Table 2.1

atom	U	V	W	X	Y	Z
number of neutrons	20	12			7	8
number of protons	17	10	13	6		
mass number			27	13	14	14

(a) Complete Table 2.1. [2]

(b) Which of the atom(s), U – Z,

(i) is a noble gas?

..... [1]

(ii) is a pair of isotopes?

..... [1]

(iii) forms an ion with a charge of 3+?

..... [1]

(iv) form diatomic molecules?

..... [1]

[Turn over]

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(c) In terms of electronic structure, explain why the atom stated in **(b)(i)** is unreactive.

.....

..... [1]

(d) Showing only outer electrons, draw a 'dot and cross' diagram to show the electronic structure of the diatomic molecule in **(b)(iv)**.

[2]

3 Fig. 3.1 shows the structures of 3 substances A, B and C.

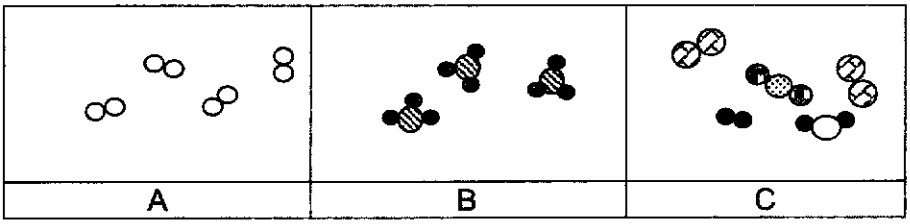


Fig. 3.1

Complete Table 3.2 by

- stating whether each substance is an element, a mixture or a compound, and
- identifying the substance from the list given below.

air	ammonia	oxygen gas	carbon dioxide	steel
zinc	methane	helium	water	

Table 3.2

substance	element, mixture or compound	possible identity of substance
A		
B		
C		

[3]

[Turn over]

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4 Table 4.1 summarises the results of the reactions when Group VII elements are added to solutions of sodium halides.

Table 4.1

Group VII element added	solutions of		
	sodium chloride	sodium bromide	sodium iodide
bromine	X	X	✓
chlorine	X		
iodine			X

(a) Complete the table by adding a tick (✓) if a reaction takes place and a cross (X) if a reaction does not take place.
Some have been done for you. [2]

(b) Bromine, Br_2, reacts with aqueous sodium iodide, NaI.

(i) Predict what you would see in this reaction.

..... [1]

(ii) Write a balanced chemical equation for the reaction between bromine and sodium iodide.

..... [1]

5 Hydrogen gas reacts with fluorine gas to produce hydrogen fluoride gas as shown in the following equation.

$$F_2(g) + H_2(g) \rightarrow 2HF(g)$$

(a) Identify the reducing agent in the reaction.

..... [1]

(b) Explain, using oxidation states, why the above reaction is redox.

.....

.....

..... [2]

[Turn over]

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(c) State the volume of fluorine gas required to produce 75 cm^3 of hydrogen fluoride gas.

volume of fluorine gas required = ... cm^3 [1]

(d) Hydrogen fluoride dissolves in water to form an acidic solution.
Give the chemical formula of the ion which causes the acidity.

..... [1]

6 The statements below give some of the chemical properties of metal X and its compounds.

- X does not react with cold water.
- X fizzes slowly with dilute hydrochloric acid.
- X does not react with aqueous sodium chloride.
- X reacts with aqueous lead(II) nitrate.
- X reacts with aqueous silver nitrate.
- XO reacts with magnesium to form X

(a) Use the information to help arrange the following metals in order of reactivity.

lead, magnesium, silver, sodium, metal X

most reactive .....

.....

.....

.....

least reactive ..... [2]

(b) Suggest a possible identity for metal X.

..... [1]

(c) Write a balanced chemical equation for the reaction between the oxide, XO, and magnesium.

..... [1]

[Turn over]

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7 A solution of hydrochloric acid has a concentration of 1.5 mol/dm^3.
Fig. 7.1 shows how the temperature of the mixture varies with the volume of aqueous sodium hydroxide added to a 25.0 cm^3 sample of the hydrochloric acid.

$$NaOH\ (aq) + HCl\ (aq) \rightarrow NaCl\ (aq) + H_2O\ (l)$$

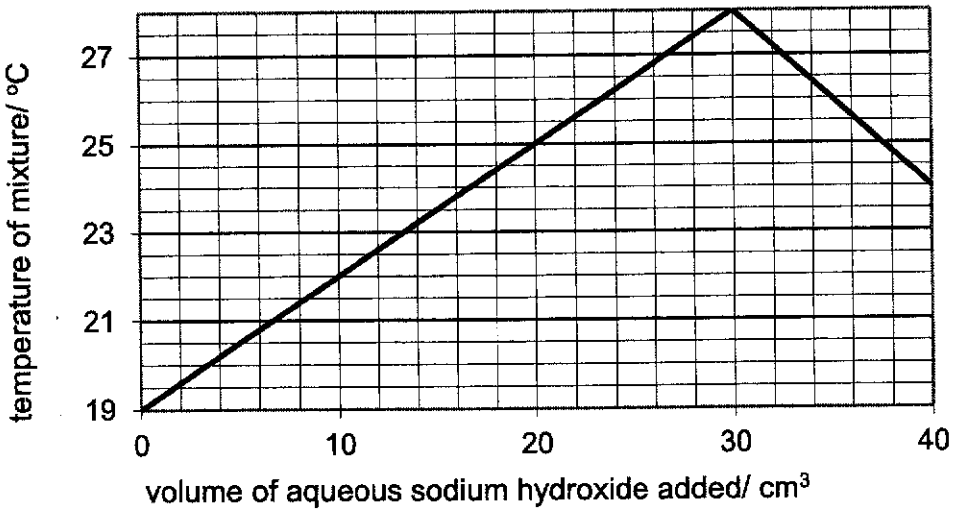


Fig. 7.1

(a) **(i)** Name the type of reaction between hydrochloric acid and sodium hydroxide.

..... [1]

(ii) Write a chemical equation, including state symbols, of the above reaction between aqueous sodium hydroxide and dilute hydrochloric acid.

..... [2]

(b) Is the reaction endothermic or exothermic? Explain your answer.

..... [1]

(c) What is the volume of aqueous sodium hydroxide needed to completely neutralize 25.0 cm^3 of hydrochloric acid?

..... [1]

(d) Explain why the temperature of the mixture falls when more than this volume of aqueous sodium hydroxide is added.

..... [1]

[Turn over]

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(e) **(i)** Calculate the number of moles of hydrochloric acid in 25.0 cm^3 of the given sample.

number of moles of hydrochloric acid = ... moles [1]

(ii) Based on the stoichiometry of the given equation, what is the number of moles of sodium hydroxide which reacted with the number of moles of hydrochloric acid calculated in part **e(i)**?

number of moles of sodium hydroxide = ... moles [1]

(iii) Using the information from **(c)** and **e(ii)**, calculate the concentration of the aqueous sodium hydroxide used to completely react with the hydrochloric acid added.

concentration of sodium hydroxide = ... mol/ dm^3 [1]

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8 Fig. 8.1 shows some carbon compounds.

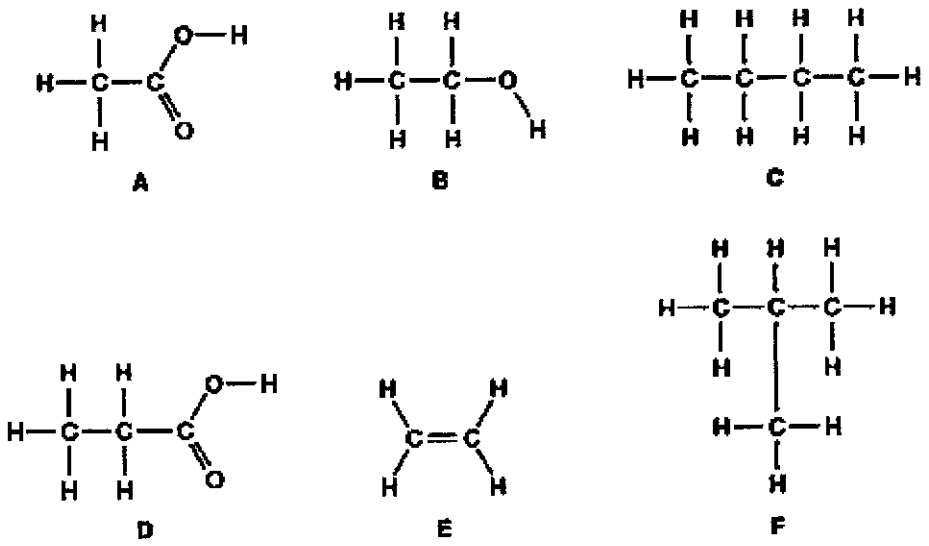


Fig. 8.1

(a) Which compound is a hydrocarbon that forms a single product with bromine?

..... [1]

(b) Which two compounds have the same molecular formula?

..... [1]

(c) When cracked, a molecule of decane, $C_{10}H_{22}$, gives compound E and one other hydrocarbon, X. Deduce the molecular formula of X.

..... [1]

(d) Which of the compounds is formed when compound B is reacted with acidified potassium manganate(VII)?

..... [1]

[Turn over]

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Section B

Answer **any two** questions in the spaces provided.

9 10 g of calcium carbonate were added to 1 mol/dm^3 of 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, including state symbols, for the reaction between calcium carbonate and hydrochloric acid.

..... [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 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/dm^3 hydrochloric acid that reacted completely with 10 g of calcium carbonate.

volume of hydrochloric acid = ... dm^3 [1]

[Turn over]

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(c) The experiment was repeated using an excess of a different amount of calcium carbonate in the same amount of 1 mol/dm^3 hydrochloric acid. The volume of carbon dioxide gas produced was measured over a period of time.
Fig. 9.1 shows the volume of carbon dioxide gas produced at regular time intervals. Study the graph and answer the questions that follow.

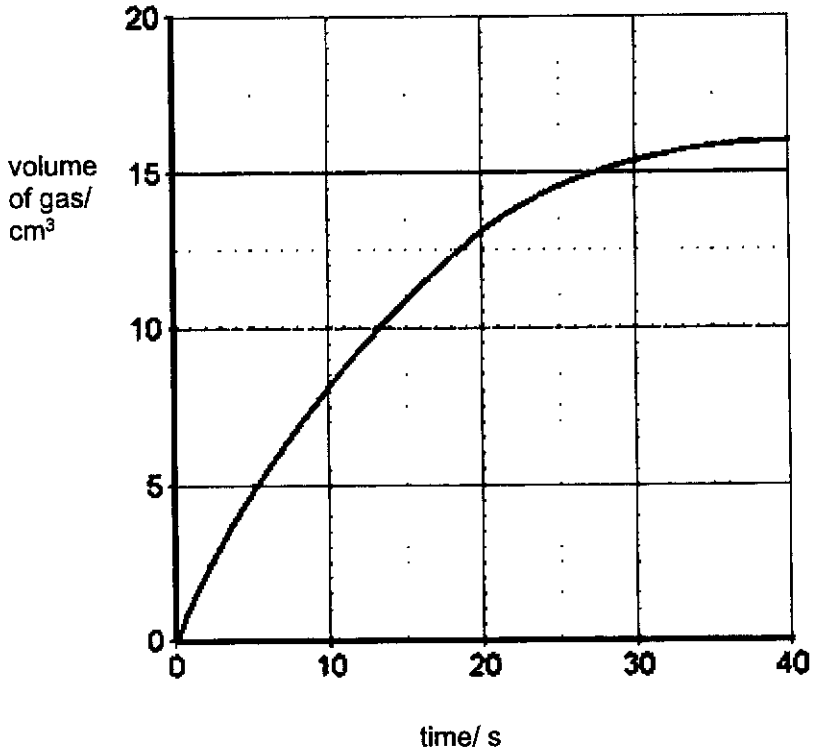


Fig. 9.1

(i) What is the volume of carbon dioxide produced at the end of the reaction?

..... [1]

(ii) Why did the reaction stop?

..... [1]

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

.....

.....

..... [2]

(iv) Suggest a way to increase the rate of production of carbon dioxide gas.

..... [1]

[Turn over]

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10 Z is a nitrate salt containing the cations Ag^+, Fe^{3+}, Cu^{2+} and Zn^{2+}. Fig. 10.1 shows three processes to separate all the cations in solution Z.

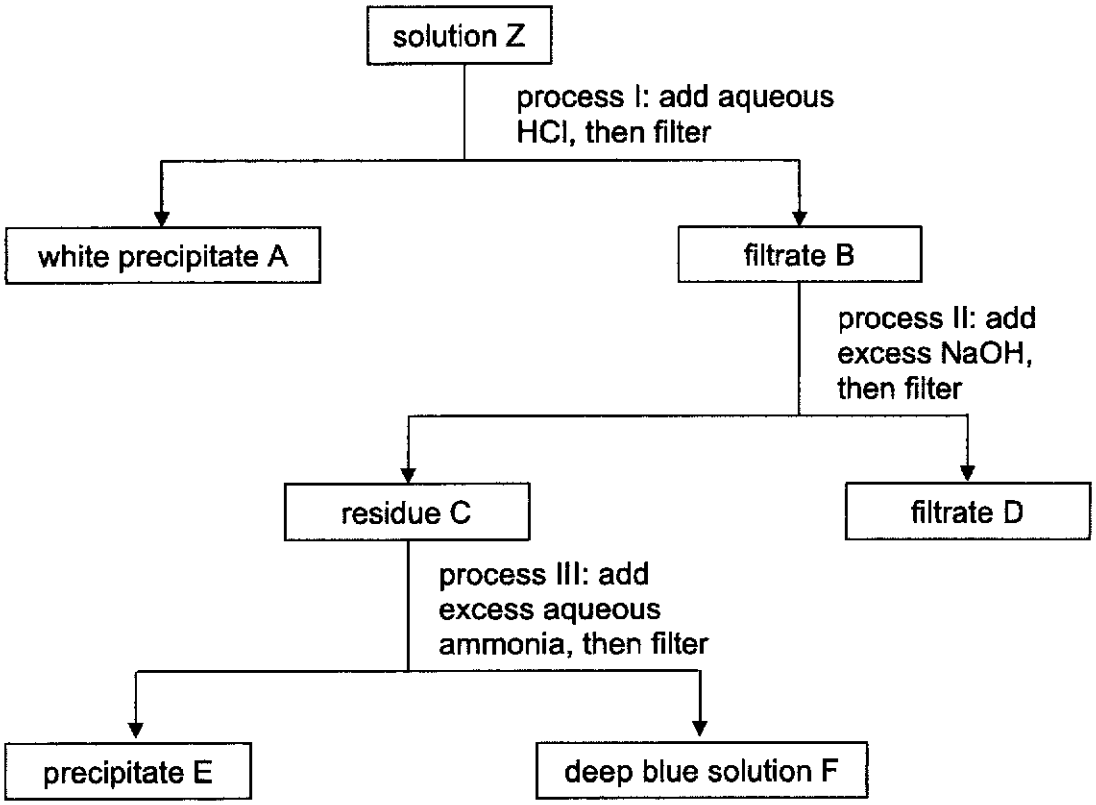


Fig. 10.1

(a) Identify the cation(s) present in

(i) filtrate D, ... [1]

(ii) deep blue solution F. ..... [1]

(b) Name precipitates A and E.

(i) precipitate A ..... [1]

(ii) precipitate E ..... [1]

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(c) Copper(II) nitrate can be prepared using dilute nitric acid and a suitable solid compound.

(i) Name a suitable solid compound that can be used to prepare copper(II) nitrate.

..... [1]

(ii) Write the chemical equation, including state symbols, for the reaction.

..... [2]

(iii) Describe how you would make pure crystals of copper(II) nitrate from the compound named in **(c)(i)**.

.....

.....

.....

.....

.....

..... [3]

[Turn over]

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11 Table 11.1 shows the fractions obtained and the amount produced by fractional distillation compared with the amount required.

Table 11.1

fraction	percentage produced (Supply)	percentage required (Demand)
liquefied petroleum gases (LPG)	3	4
petrol/gasoline	14	25
naphtha	9	3
paraffin/kerosene	15	7
diesel oil	10	22
heavy oil and bitumen	49	39

(a) Which fraction does the demand exceed the supply by the greatest amount?

..... [1]

(b) Suggest how cracking can help match the demand for the fractions with its supply.

..... [1]

(c) Octane, C_8H_{18}, is a hydrocarbon in petrol, it has a relative molecular mass of 114. Hexadecane, $C_{16}H_{34}$, is one of the hydrocarbons in ship fuel, it has a relative molecular mass of 226. By calculating the percentage by mass of carbon for each hydrocarbon, determine which hydrocarbon burns with a smokier flame.

[3]

[Turn over]

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(d) Butene can be made by cracking hexadecane, $C_{16}H_{34}$.

(i) Construct an equation to illustrate the cracking of $C_{16}H_{34}$ to make butene and another hydrocarbon as the only products.

..... [1]

(ii) Butene is an unsaturated hydrocarbon.
Define the term unsaturated and explain how the molecular structure of butene shows that it is unsaturated.

..... [2]

(iii) Describe a chemical test you would carry out to show that butene is an unsaturated compound.

.....

..... [2]

END OF PAPER

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Data Sheet

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

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The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9		Key proton (atomic) number atomic symbol name relative atomic mass									5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
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
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 –	86 Rn radon –
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 dm^3 at room temperature and pressure (r.t.p.).

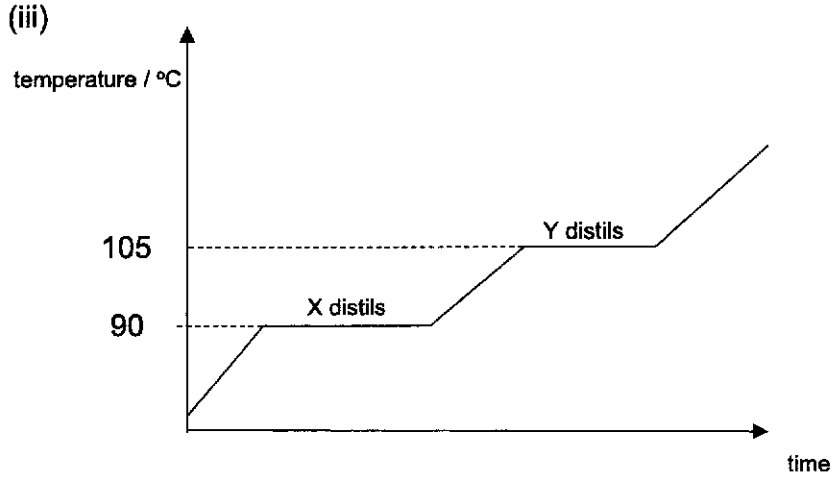
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Bendemeer Secondary School
Science (Chemistry)
2021 Preliminary Examination
Answer Scheme

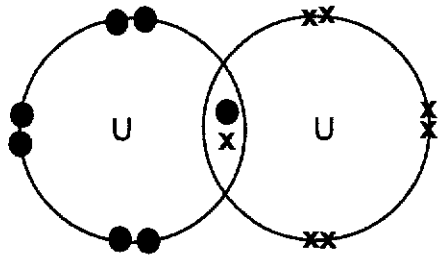
1	B	**2**	A	**3**	B	**4**	A	**5**	C
6	B	**7**	C	**8**	D	**9**	D	**10**	D
11	D	**12**	A	**13**	B	**14**	C	**15**	D
16	C	**17**	D	**18**	C	**19**	C	**20**	C

<table>
<tr><th>Qn</th><th>Answer</th><th>Mks</th></tr>
<tr><td>1</td><td>(a) W, X</td><td>½ m each</td></tr>
<tr><td></td><td>(b) Particles are far apart in disorderly arrangement, moving randomly at high speeds.</td><td>1 , 1</td></tr>
<tr><td></td><td>(c)(i) X and Y have different boiling points.</td><td>1</td></tr>
<tr><td></td><td>(ii) X will distil first as it has a lower boiling point.</td><td>1 (no mark for stating X)</td></tr>
<tr><td></td><td>(iii)

</td><td>Shape 1m
Labelling of temperature, 1m</td></tr>
<tr><td>2</td><td>(a)
<table>
<tr><td>atom</td><td>U</td><td>V</td><td>W</td><td>X</td><td>Y</td><td>Z</td></tr>
<tr><td>number of neutrons</td><td>20</td><td>12</td><td>14</td><td>7</td><td>7</td><td>8</td></tr>
<tr><td>number of protons</td><td>17</td><td>10</td><td>13</td><td>6</td><td>7</td><td>6</td></tr>
<tr><td>Mass number</td><td>37</td><td>22</td><td>27</td><td>13</td><td>14</td><td>14</td></tr>
</table></td><td>3 correct, 1m

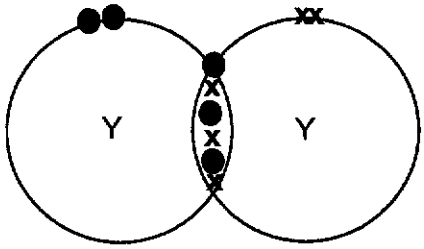
(no ½ m)</td></tr>
<tr><td></td><td>(b)(i) V
(ii) X & Z
(iii) W
(iv) U/ Y</td><td>1m each</td></tr>
<tr><td></td><td>(c) Electronic structure of V is 2.8. It already has a full valence electron shell.</td><td>1m</td></tr>
</table>

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(d)



OR



2m

3

substance	element, mixture or compound	possible identity of substance
A	**element**	**oxygen**
B	**compound**	**ammonia**
C	**mixture**	**air**

½ m each

4

Group VII element added	solutions of		
	sodium chloride	sodium bromide	sodium iodide
bromine	X	X	✓
chlorine	X	✓	✓
iodine	**X**	**X**	X

½ m each

(b)(i) Purple solid formed. 1

(ii) $Br_2 + 2NaI \rightarrow 2NaBr + I_2$ 1

5 (a) Hydrogen, H_2 1

(b) Oxidation state of fluorine decreases from 0 in F_2 to -1 in HF. Hence fluorine is reduced. 1

Oxidation state of hydrogen increased from 0 in H_2 to +1 in HF. Hence hydrogen is oxidised. 1

There is both oxidation and reduction in the reaction. Hence this is a redox reaction.

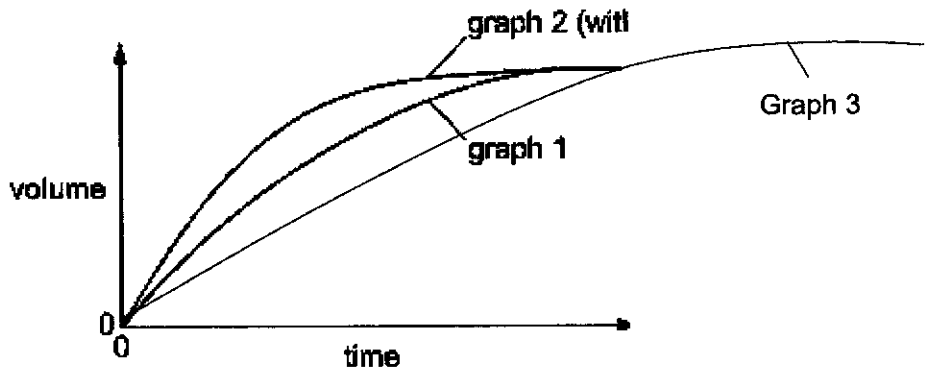
(c) 37.5 cm^3 1

(d) H^+ 1

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6	(a) sodium magnesium metal X lead silver	1m for correct placing of Na, Mg, Pb, Ag 1m for correct placing of X
	(b) zinc/ iron	1
	(c) XO + Mg → MgO + X	1
7	(a) (i) Neutralisation (ii) NaOH (aq) + HCl (aq) → NaCl (aq) + H_2O (l)	1 1m for correct equation, 1m for state symbols
	(b) Exothermic. Temperature increases	½ , ½
	(c) 30 cm^3	1
	(d) All tqqhe hydrochloric acid has been used up and there is no more reaction.	1
	(e)(i) 25/1000 x 1.5 = **0.0375** (ii) **0.0375** (iii) concentration NaOH = mole/vol = 0.0375/0.03 = **1.25 mol/dm^3**	1 1 1
8	(a) E	1
	(b) C & F	1
	(c) C_8H_{18}	1
	(d) A	1
9	(a) $CaCO_3$ (s) + 2HCl (aq) → $CaCl_2$ (aq) + CO_2 (g) + H_2O (l)	2
	(b)(i) 10/ [40 +12+3(16)] = 0.1	1
	(ii) 0.1 x 2 = 0.2	1
	(iii) vol = mol/ conc = 0.2/1 = 0.2 dm^3	1
	(c)(i) 16 cm^3	1
	(ii) Hydrochloric acid is used up. *(reject: reactant/s is/are used up)*	1
	(iii) As the reaction proceeds, the concentration of hydrochloric acid decreases. There are lesser particles per unit volume. This led to a lower number of successful collisions to form products. Hence speed decreases.	1 1
	(iv) Increase concentration of hydrochloric acid/ use powdered calcium carbonate/ increase temperature of the reaction mixture	Any 1 1
10	(a)(i) zinc ions, Zn^{2+}	1
	(ii) copper(II) ions, Cu^{2+}	1
	(b)(i) silver chloride, AgCl	1
	(ii) iron(III) hydroxide, $Fe(OH)_3$	1
	(c)(i) copper(II) oxide/ copper(II) carbonate/ copper(II) hydroxide	Any 1
	(ii) $CuO(s) + 2HNO_3$ (aq) → $Cu(NO_3)_2$ (aq) + H_2O (l) $CuCO_3(s) + 2HNO_3$ (aq) → $Cu(NO_3)_2$ (aq) + CO_2 (g) + H_2O (l) $Cu(OH)_2(s) + 2HNO_3$ (aq) → $Cu(NO_3)_2$ (aq) + $2H_2O$ (l)	1m for equation, 1m for state symbols

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	(iii) - Add excess copper(II) oxide/ copper(II) carbonate/ copper(II) hydroxide to nitric acid - Filter to remove excess copper(II) oxide/ copper(II) carbonate/ copper(II) hydroxide - Heat filtrate to obtain saturated solution of copper(II) nitrate - Cool the hot, saturated copper(II) nitrate solution to form crystals - Wash crystals with a little distilled water and dry in between 2 pieces of filter papers.	1 ½ ½ ½ ½
11	(a)(i) zinc displaces copper metal from copper(II) chloride. $Zn (s) + CuCl_2 (aq) \rightarrow ZnCl_2 (aq) + Cu (s)$	1 1 (no need state symbols)
	(ii) By filtration	1
	(iii) Reaction would be slower as ethanoic acid is a weak acid.  	1 1
	(b) Potassium darts on the surface of water explosively. A lot of heat is given off. $2K (s) + 2H_2O (l) \rightarrow 2KOH (aq) + H_2 (g)$ Zinc has no reaction with water but reacts with steam. $Zn (s) + H_2O (l) \rightarrow ZnO (s) + H_2 (g)$ Copper has no reaction with water or steam. Hence the reactivity is: (most reactive) potassium, zinc, copper (least reactive)	1 1 1 1 1

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