Name:	Index Number:	Class:

HUA YI SECONDARY SCHOOL

4E5N Preliminary Examinations 4E5N

SCIENCE (CHEMISTRY/BIOLOGY) 5078/1

Paper 1 Multiple Choice

31 Aug 2021
1 hour

Candidates answer on the Optical Answer Sheet provided.
Additional Materials: Optical Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write your Name, Index Number and Class on all the work you have done.

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 **soft pencil** on the separate Optical Answer Sheet.

Read the instructions on the Optical Answer 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 in this booklet.

A copy of the Data Sheet is printed on page **20**.
A copy of the Periodic Table is printed on page **21**.
The use of an approved scientific calculator is expected, where appropriate.

This document consists of **21** printed pages including the cover page.

[Turn Over

Setter: Mr Leow Guan Sin & Mrs Eleanor Chen

1 The boiling point of water is 100 °C. The melting point of potassium chloride is 770 °C. What is the most likely boiling point of a sample of water that contains a small quantity of dissolved potassium chloride?

A 97 °C
B 103 °C
C 767 °C
D 773 °C

2 20.00 cm^3 of 0.50 mol/dm^3 dilute hydrochloric acid was added to three samples of 25.00 cm^3 aqueous sodium carbonate of different concentrations to compare the rate of carbon dioxide production.

Which apparatus is **not** required to carry out the above experiment?

A burette
B electronic balance
C gas syringe
D stopwatch

3 From which mixture can the underlined substance be obtained by adding water, stirring and filtering?

A barium sulfate and magnesium oxide
B copper(II) sulfate and sodium carbonate
C silver chloride and ammonium chloride
D zinc chloride and magnesium nitrate

4 Hydrogen can form both H^+ ions and H^- ions.

Which statement about these two ions is correct?

A A H^+ ion has more protons than a H^- ion.
B A H^+ ion has no electron in its first shell.
C A H^- ion has one more electron than a H^+ ion.
D A H^- ion is formed when a hydrogen atom loses an electron.

5 What is the number of neutrons and electrons in the ion $^{90}_{38}Sr^{2+}$?

	neutrons	electrons
A	52	36
B	52	38
C	52	40
D	90	52

6 110 g of manganese reacts completely with 72 dm^3 of fluorine gas to form a fluoride of manganese.

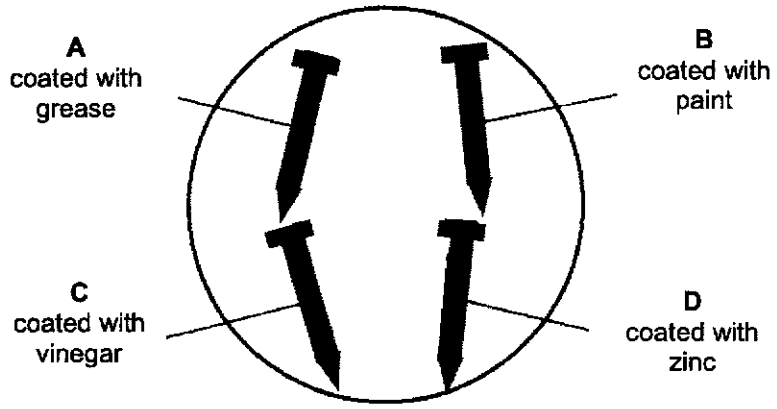
Which of the following correctly represents the reaction?

A $Mn + F_2 \rightarrow MnF_2$
B $Mn + 2F_2 \rightarrow MnF_4$
C $2Mn + 3F_2 \rightarrow 2MnF_3$
D $4Mn + 3F_2 \rightarrow 2Mn_2F_3$

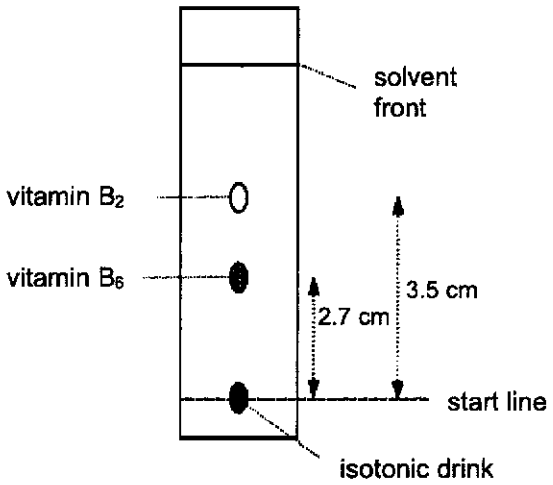
7 Four iron nails were coated with different substances.

The nails were placed in an open dish filled with water and left for a week.

Which iron nail has **no** protection against rusting?



8 A sample of isotonic drink containing two water soluble vitamins was analysed using the method of chromatography with water as a solvent. The following chromatogram (*not drawn to scale*) was obtained.

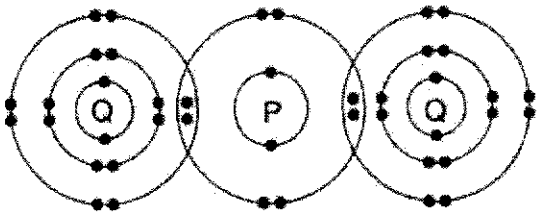


Which of the following statements can be deduced from the chromatogram?

1 The isotonic drink is a mixture.
2 The solvent front is at 10 cm from the start line.
3 Vitamin B_6 is more soluble in ethanol than vitamin B_2.

A 1 only
B 3 only
C 1 and 3
D 1, 2 and 3

9 The diagram shows the bonding in the covalent molecule, PQ_2.



Which row represents the electronic structures of atoms P and Q before combining together to form the above molecule?

	P	Q
A	2.4	2.8.6
B	2.4	2.8.7
C	2.6	2.8.7
D	2.8	2.8.8

10 Aluminium saucepans oxidise on the surface to form a layer of aluminium oxide.

Which substance **cannot** be used to remove the layer of aluminium oxide on the saucepan?

A nitric acid
B sodium hydroxide
C sulfuric acid
D water

11 Lime (calcium hydroxide) is sometimes added to soil to improve crop growth.

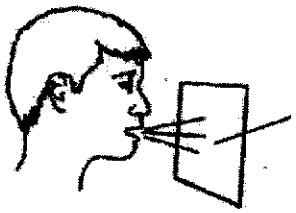
Which statement correctly explains why lime improves crop growth?

A Lime acts as a fertiliser.
B Lime is an effective pesticide and protects the plants from damage.
C Lime is used to reduce the acidity of the soil.
D Lime is used to react with ammonium salts in the soil.

12 Which pair of reagents can be used to prepare a pure insoluble salt?

A calcium nitrate and sodium sulfate
B iron(III) carbonate and dilute sulfuric acid
C lithium carbonate and sodium sulfate
D silver sulfate and dilute nitric acid

13 Acidified potassium manganate(VII) can be used to detect the presence of alcohol vapour in the breath of a person who has consumed alcohol.



filter paper moistened with acidified potassium manganate(VII)

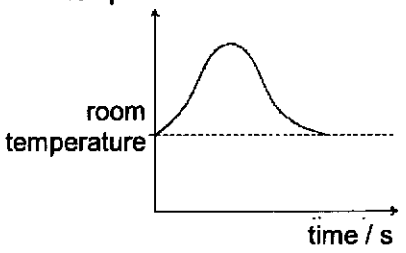
A colour change from purple to colourless is observed if alcohol is present.

Which statement about the alcohol is correct?

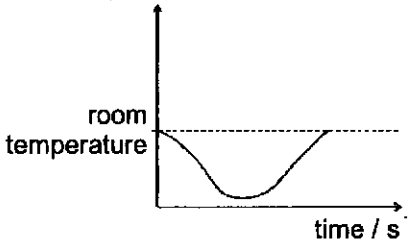
A It is a catalyst.
B It is a reducing agent.
C It is an alkali.
D It is an oxidising agent.

14 Which graph shows how the temperature changes as ammonium chloride is added to water and the resulting solution is then left to stand?

A



B



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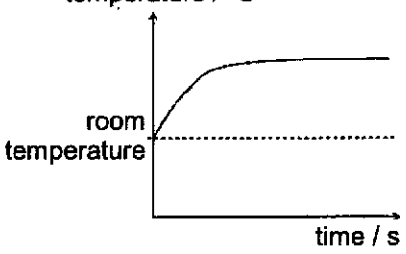
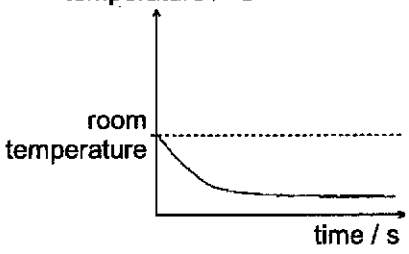


D



15 The reaction between magnesium and hydrochloric acid can be represented by the ionic equation below.

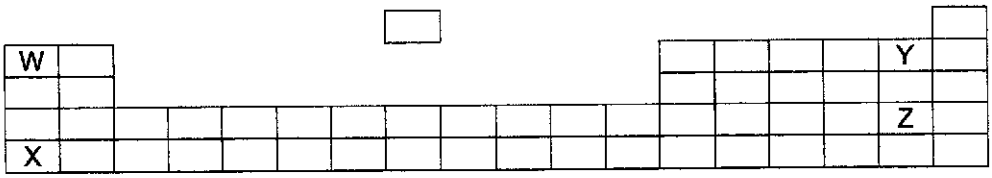
$$Mg(s) + 2H^+(aq) \rightarrow Mg^{2+}(aq) + H_2(g)$$

Which statement about this reaction is true?

A Magnesium is oxidised because it gained electrons.
B Magnesium is oxidised because it lost electrons.
C Magnesium is reduced because it gained electrons.
D Magnesium is reduced because it lost electrons.

16 The diagram shows a part of the Periodic Table.

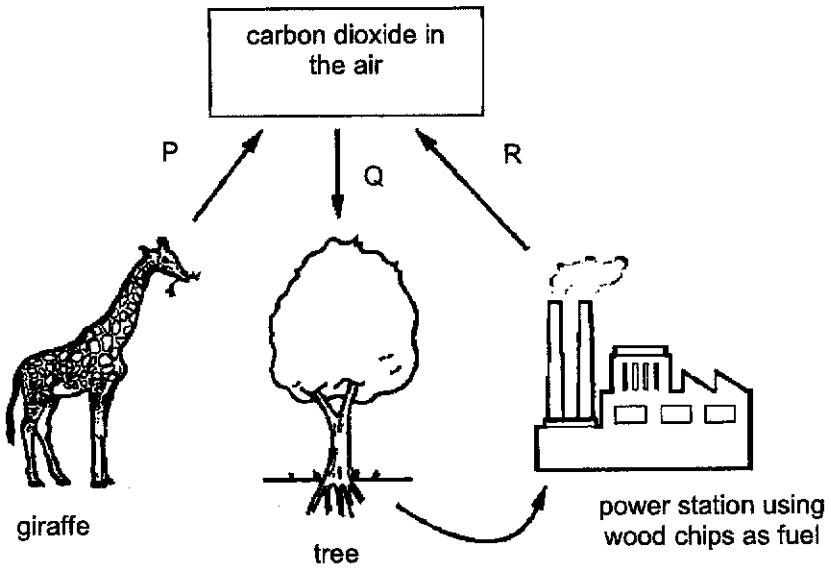
The letters are not symbols of elements.



Which of the following is correct?

A W has a lower melting point than X.
B W and Z form a compound with a formula of WZ_2.
C Z has a higher boiling point than Y.
D Z reacts more vigorously with W than with X.

17 The diagram shows part of the carbon cycle.



Which row correctly identifies P, Q and R as exothermic or endothermic reactions?

	P	Q	R
A	endothermic	exothermic	exothermic
B	exothermic	endothermic	endothermic
C	exothermic	endothermic	exothermic
D	exothermic	exothermic	exothermic

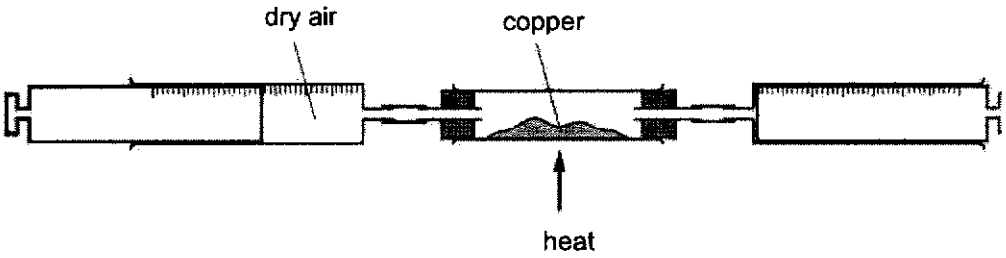
18 Approximately 40% of all iron and steel is produced by recycling.

1 Iron, when obtained by a recycling process produces less carbon dioxide than the blast furnace process.
2 Scrap steel contains a higher percentage of iron than iron ore.
3 Scrap metal, if not recycled, would cause environmental problems due to its disposal by landfill.

Which statements are correct reasons for recycling iron?

A 1 and 2 **B** 1 and 3
C 2 and 3 **D** 1, 2 and 3

19 Dry air is passed over hot copper until all the oxygen has reacted.



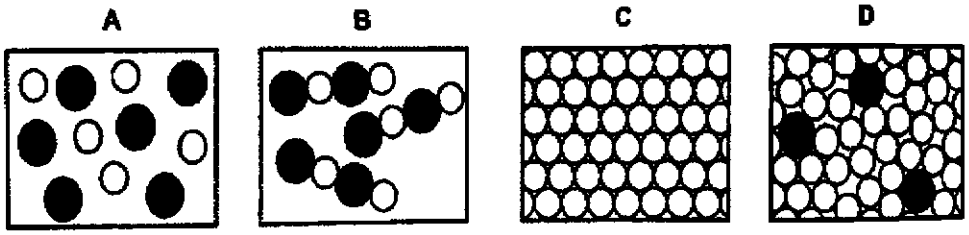
The volume of gas at the end of the reaction is 120 cm^3.

What is the starting volume of dry air?

A 96 cm^3 **B** 120 cm^3
C 150 cm^3 **D** 240 cm^3

20 The diagrams represent different arrangement of atoms.

Which diagram represents an alloy?



8

Colours of Some Common Metal Hydroxides

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

The Periodic Table of Elements

Group I	II											III	IV	V	VI	VII	0
																	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	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	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

1 H hydrogen 1

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.).

Name:	Index Number:	Class:

HUA YI SECONDARY SCHOOL

Preliminary Examination

4E5N

4E5N
5076/5078/3

SCIENCE (CHEMISTRY)

Paper 3

24 August 2021
1 hour 15 minutes

Candidates answer on the Question Paper.
Additional Materials: NIL

READ THESE INSTRUCTIONS FIRST

Write your Name, Class and Index number on **all** the work you have done.
Write in dark blue or black pen.
You may use a pencil for any diagrams, graphs, tables or rough working.
Do not use staples, paper clips, highlighters, 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 any **two** questions.
Write your answers in the spaces provided on the question paper.

A copy of the Data Sheet is printed on page 18.
A copy of the Periodic Table is printed on page 19.
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	
Total	

This document consists of **19** printed pages including the cover page.

[Turn Over]

Setter: Ms Tok Peilin

Section A (45 marks)

Answer **all** questions.

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

1 The following shows a list of elements.

fluorine
bromine
magnesium
nitrogen
iron
oxygen
zinc

(a) Choose from the above elements to answer the questions.

Each element may be used once, more than once, or not at all.

Which element

(i) can displace chlorine from its salt solution,

..... [1]

(ii) forms an oxide that can react with both acid and alkali,

..... [1]

(iii) reacts with water to form an alkali?

..... [1]

(b) **(i)** One of the elements, chlorine, consists of two isotopes, ^{35}Cl and ^{37}Cl.

Define the term '*isotope*'.

.....

..... [1]

(ii) Three students each made a statement about one of the isotopes, ^{37}Cl.

student A: It has the same physical properties as the isotope ^{35}Cl.

student B: It has similar chemical properties to the isotope ^{35}Cl.

student C: It has different chemical and physical properties to the isotope ^{35}Cl.

Comment on the accuracy of the students' statements.

.....

.....

.....

.....

..... [2]

[Total: 6]

2 Table 2.1 shows the melting and boiling points of four substances.

Table 2.1

substance	melting point /°C	boiling point /°C
W	–90	230
X	–79	40
Y	30	621
Z	88	920

(a) Sketch a graph of temperature versus time to show the change in temperature when substance **W** is heated from −100 °C to 150 °C.

[2]

(b) **(i)** Suggest a suitable method to separate a mixture of **W** and **X** at room temperature and pressure.

..... [1]

(ii) Explain your answer to **(b)(i)**.

.....

..... [1]

[Total: 4]

3 Table 3.1 shows some properties of four Group I elements.

Table 3.1

element	melting point /°C	relative thermal conductivity	atomic radius/ nm
lithium	181	84	0.157
sodium		142	0.191
potassium	63		
rubidium	39	58	0.320

(a) (i) Complete the table by estimating:

- the melting point of sodium,
- the atomic radius of potassium. [2]

(ii) Use the information in the table to suggest why it is difficult to predict the relative thermal conductivity of potassium.

.....

..... [1]

(b) Sodium is a metal.

State one physical property of sodium which is different from most other metals.

..... [1]

(c) Hydrated sodium iodate(V) has the formula $NaIO_3.xH_2O$.
It has a relative formula mass of 288.

Calculate the value of x in this formula.

[Relative atomic masses: A_r: H, 1; O, 16; Na, 23; I, 127]

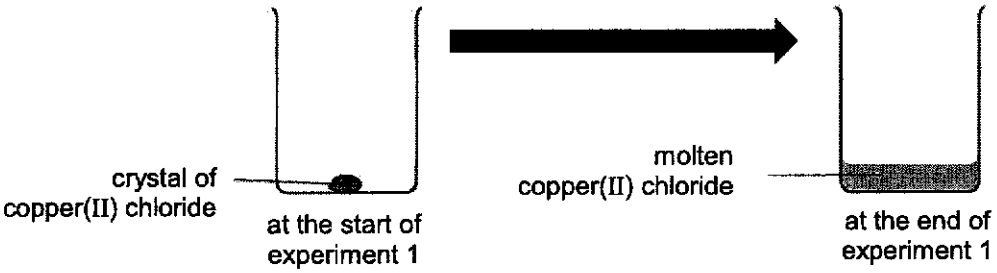
x = ... [2]

[Total: 6]

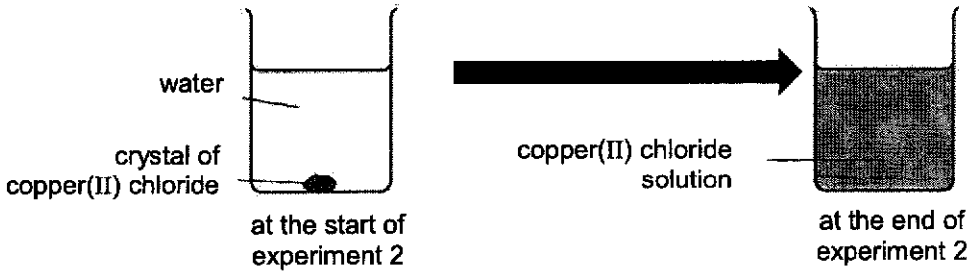
4 Copper(II) chloride is a soluble salt produced from the reaction between copper(II) oxide and hydrochloric acid.

(a) A student performed some experiments on copper(II) chloride crystals.

In experiment 1, he heated some copper(II) chloride crystals until he obtained molten copper(II) chloride.



In experiment 2, some copper(II) chloride crystals was placed at the bottom of a beaker containing water. At the end of the experiment, the crystal had dissolved and copper(II) chloride solution was obtained.



(i) Using the kinetic particle theory, explain the changes in the arrangement and movement of particles in copper(II) chloride in experiment 1.

.....

.....

.....

..... [3]

(ii) Complete the table to compare the substances present in the beaker at the end of experiment 1 and 2.

	substance in beaker at the end of experiment 1	substance in beaker at the end of experiment 2
Is the substance an element, compound or mixture?		
What process can be used to obtain solid copper(II) chloride from the substance?		

[2]

(b) (i) Apart from copper(II) oxide, suggest another substance that can react with hydrochloric acid to form copper(II) chloride.

..... [1]

(ii) Explain, using structure and bonding, why the melting point of copper(II) chloride is high.

.....

.....

.....

..... [2]

[Total: 8]

5 Use the following information to suggest the steps needed to prepare pure lead(II) sulfate by precipitation, starting from powdered lead(II) oxide.

- lead(II) sulfate is insoluble in water
- lead(II) oxide is insoluble in water
- lead(II) nitrate is soluble in water

.....

.....

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.....

.....

..... [3]

[Total: 3]

6 Fig. 6.1 describes some of the reactions of solid **P** and its aqueous solution.

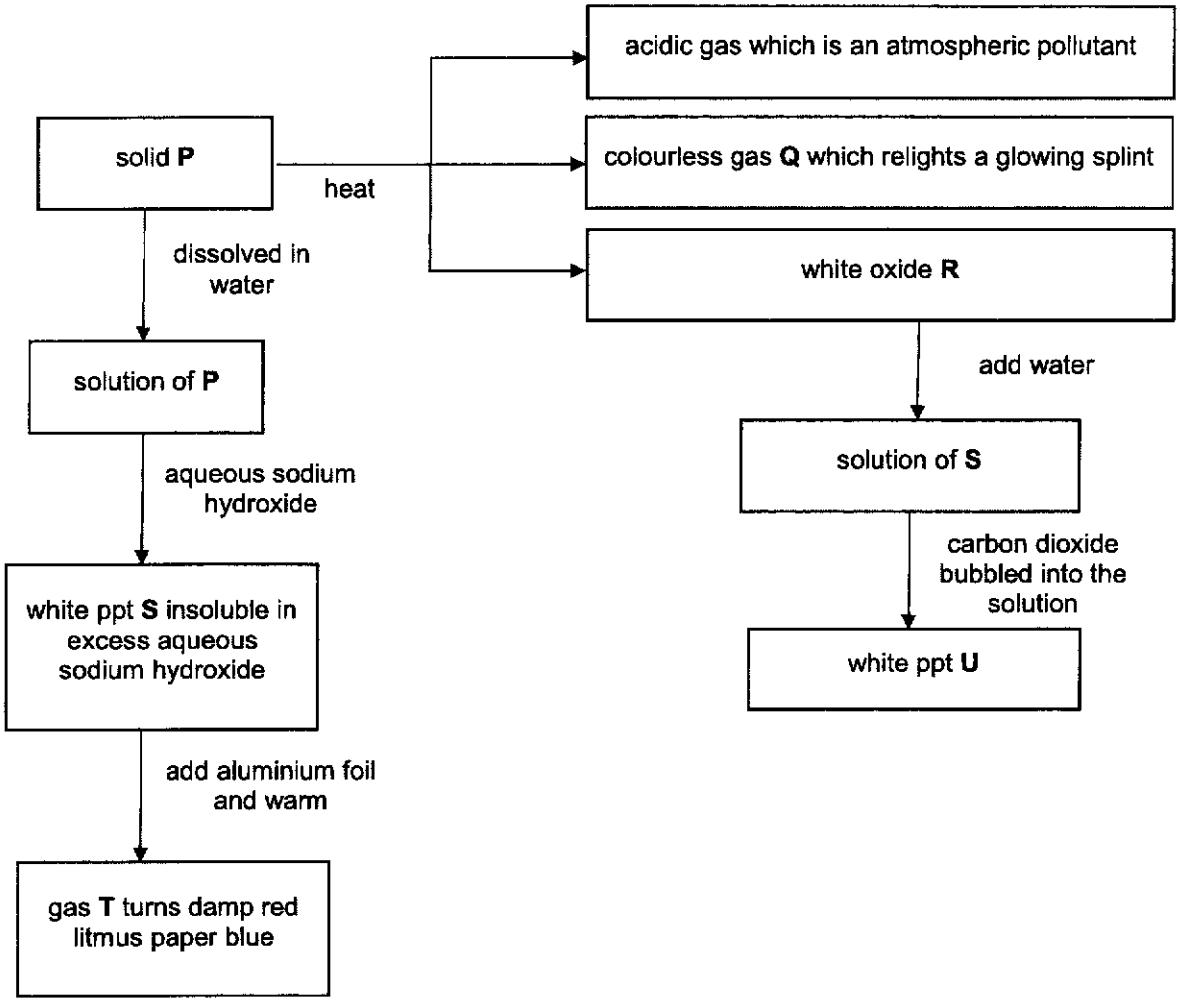


Fig. 6.1

Suggest the identity of substances **P**, **Q**, **R**, **S**, **T** and **U**.

(a) **P**: ..... **S**: .....

Q: ..... **T**: .....

R: ..... **U**: ..... [6]

(b) Write a balanced chemical equation for any **one** of the reactions in Fig. 6.1.

..... [1]

[Total: 7]

7 In an experiment, 16.8 g of magnesium carbonate were added to an excess of 1 mol/dm^3 of dilute hydrochloric acid in a conical flask. The carbon dioxide gas released was collected using the downward displacement of water method.

$$MgCO_3 + 2HCl \rightarrow MgCl_2 + CO_2 + H_2O$$

(a) (i) Calculate the number of moles of 16.8 g of magnesium carbonate.

[Relative atomic masses: A_r: C, 12; O, 16; Mg, 24]

number of moles of magnesium carbonate = ... [1]

(ii) Calculate the volume of carbon dioxide gas collected.

volume of carbon dioxide = ... dm^3 [1]

(iii) Calculate the volume of the 1 mol/dm^3 hydrochloric acid that reacted completely with 16.8 g of magnesium carbonate.

volume of hydrochloric acid = ... dm^3 [2]

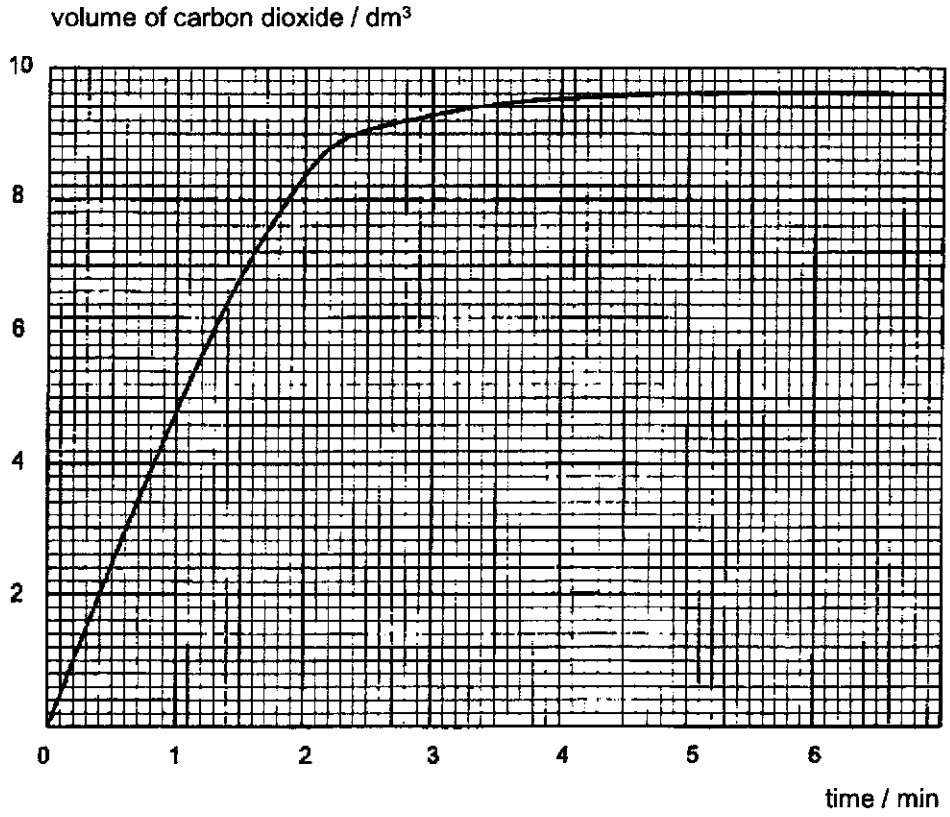
(b) The experiment was repeated with modification made to the original experimental conditions.

The volume and concentration of 1 mol/dm^3 hydrochloric acid used was the same as the first experiment.

The volume of carbon dioxide gas produced was measured at regular intervals.

A graph for the measurements obtained was drawn.

Study the graph and answer the following questions.



(i) Calculate the average speed of reaction in dm^3 / min for the first two minutes of the reaction.

average speed of reaction = ... dm^3 / min [1]

(ii) Suggest the possible modification made to the original experimental conditions.

..... [1]

(c) In order to obtain dry carbon dioxide, the carbon dioxide is passed through a drying agent. However, it is advised not to use calcium oxide as the drying agent. Explain why.

.....

..... [1]

[Total: 7]

8 In December 2019, there was an exceptionally dense fog caused by pollution in a small city, city **Y**. The graph in Fig. 8.1 shows the concentration of sulfur dioxide in the air in city **Y**, and the number of people who died, between 1st and 15th December that year.

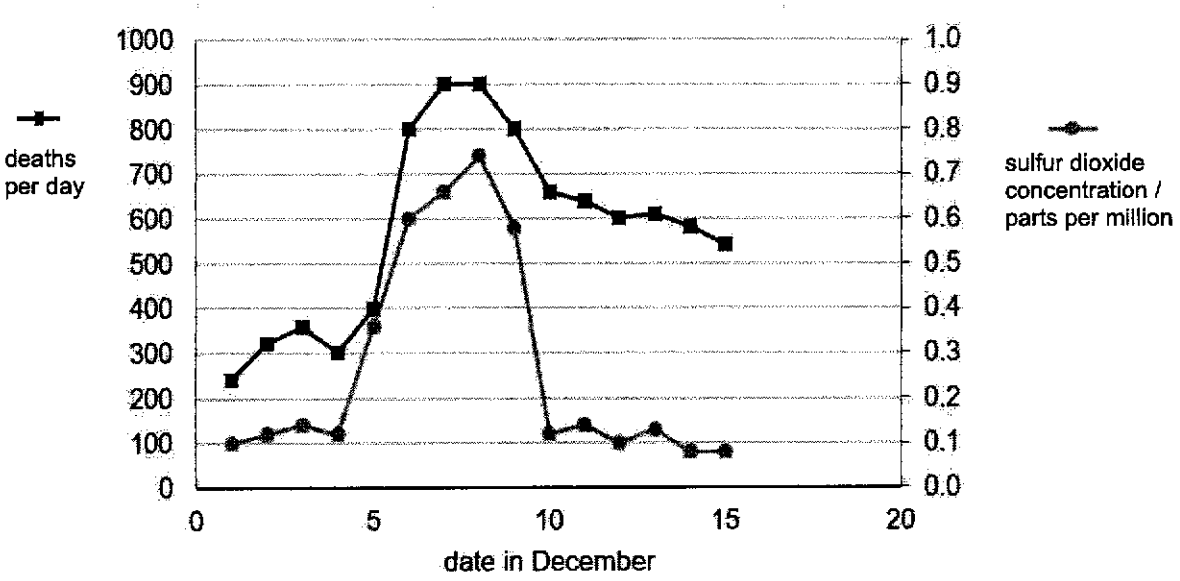


Fig. 8.1

(a) State the number of deaths on the day when the concentration of sulfur dioxide hit 0.74 parts per million.

..... [1]

(b) Using information from the graph, state the relationship between the sulfur dioxide concentration and the number of deaths.

..... [1]

(c) State one man-made source of sulfur dioxide and an effect of sulfur dioxide on human health.

source.....

effect..... [2]

[Total: 4]

Section B (20 marks)

Answer any **two** questions only.

Write your answers in the spaces provided.

9 Titanium is being increasingly used in our modern society.

Titanium is extracted from titanium dioxide in a two stage industrial process. The process is done at high temperature in an atmosphere of the noble gas argon.

Stage 1: $TiO_2 + 2C + 2Cl_2 \rightarrow TiCl_4 + 2CO$

Stage 2: $TiCl_4 + 4Na \rightarrow Ti + 4NaCl$

(a) Suggest one safety concern associated with Stage 1.

.....

..... [1]

(b) Suggest why the reaction in Stage 2 is carried out in an atmosphere of argon and not in air.

.....

..... [1]

(c) What can you infer about the comparative reactivity of sodium and titanium from the equation in Stage 2?

..... [1]

(d) In Stage 2, 40 g of titanium chloride was added to 20 g of sodium.
Identify the limiting reactant. Show your working.

[Relative atomic masses: A_r: Na, 23; Cl, 35.5; Ti, 48]

limiting reactant: ..... [3]

(e) Explain, in terms of oxidation state, why the extraction of titanium in Stage 2 is a redox reaction.

.....

.....

.....

.....

..... [2]

(f) Draw a 'dot and cross' diagram to show the arrangement of electrons in sodium chloride. Show only the valence electrons.

[Proton (atomic) number: Na, 11; C*l*, 17]

[1]

(g) Draw a 'dot and cross' diagram to show the arrangement of electrons in chlorine gas. Show only the valence electrons.

[Proton (atomic) number: C*l*, 17]

[1]

[Total: 10]

10 (a) Table 10.1 shows the results of tests performed on metals **R**, **S**, **T** and **U**.

Table 10.1

key: √: reaction x: no reaction	metal	reaction with water	reaction with steam	reaction with dilute hydrochloric acid
	R	x	√	√
	S	x	x	√
	T	√	√	√
	U	x	x	x

(i) Place the metals in order of decreasing reactivity.

..... [1]

(ii) Which metal, **R**, **S**, **T** or **U**, could be zinc?

..... [1]

(b) The ease of extracting a metal from its ore is related to the metal's position in the reactivity series.

Compare and contrast the extraction methods and the energy needed to extract iron and sodium from their ores.

.....

.....

.....

.....

.....

.....

.....

..... [3]

(c) Name an ore of iron.

..... [1]

(d) Explain, including chemical equations, how iron is extracted from the ore.

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

[Total: 10]

11 (a) (i) Ethanol can be made in a laboratory at room temperature.

.....

.....

.....

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.....

.....

..... [5]

(ii) State why the temperature of the reactants must not be allowed to rise much above 45 °C.

.....

..... [1]

(b) An organic acid is formed when propanol, an alcohol, is left open to the air. Draw the structure of propanol, showing every atom and every bond.

Suggest the formula of the organic acid. Explain, with reasons, whether the propanol has been oxidised or reduced.

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.....

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..... [4]

[Total: 10]

End of Paper

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								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 -

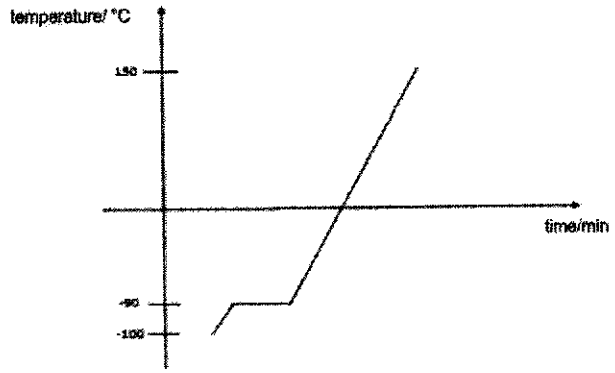
4E5N Science Chemistry Preliminary Examination 2021
Marking Scheme

Paper 1 [Total 20]
MCQ

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

2021 Preliminary Examination Marking Scheme

Paper 3
Section A [45 marks]

1 (a)	(i) (ii) (iii)	fluorine zinc magnesium	1 1 1
(b)	(i)	Isotope are atoms (of the same element) that contain the **same number of protons** but **different number of neutrons**.	1
	(ii)	Student B's statement is correct as the two isotopes have the same number of **valence electrons** which determines chemical properties. Students A and C statements are wrong as isotopes have **different number of neutrons/mass number** which affects physical properties.	1 1
			[Total: 6]
2	(a)	 • correct shape of **graph** – [1] Note: time/sec is not very appropriate as the temp increase would be too fast • Correct axes with **units** and **labelled points** (-100 °C, -90 °C, 150 °C) – [1]	2
(b)	(i)	Fractional distillation	1
	(ii)	At room temperature, P and Q are **liquids** with **different boiling points**.	1
			[Total: 4]
3 (a)	(i)	melting point of sodium: values between 70 °C and 170 °C (inclusive) atomic radius of potassium: values between 0.192 nm and 0.319 nm (inclusive)	1 1
	(ii)	There is no trend. / The values go up and down.	1
	(b)	It is soft./ It has low density./ It has low melting point.	1
	(d)	Mr of $NaIO_3$= 23 + 127 + 3(16) = 198 xH_2O = 288-198 =90 – 1M x= 90/18 x = 5 – 1M	1 1
			[Total: 6]

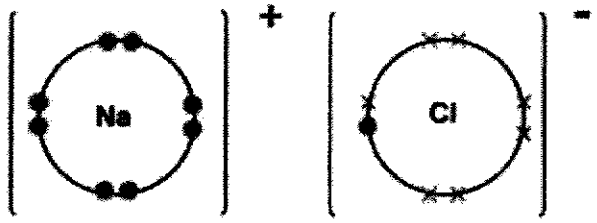
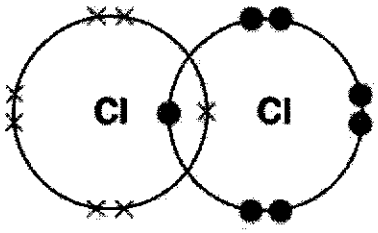
<table>
<tr><td>4(a)</td><td>(i)</td><td>In the solid state, the particles (are closely packed) and vibrate about fixed positions. When the crystals are heated, the particles gain energy and start to vibrate faster.
During melting, the particles use the energy to overcome the forces of attraction between them and get further apart.
The (closely packed) particles are now in a disorderly arrangement and are able to slide past each other easily.</td><td>1

1

1</td></tr>
<tr><td></td><td>(ii)</td><td><table><tr><th></th><th>substance in beaker at the end of experiment 1</th><th>substance in beaker at the end of experiment 2</th></tr><tr><td>Is the substance an element, compound or mixture?</td><td>compound</td><td>mixture</td></tr><tr><td>What process can be used to obtain solid copper (II) chloride from the substance?</td><td>freezing</td><td>crystallisation</td></tr></table>Any 2 correct answers for 1 m.</td><td>2</td></tr>
<tr><td>4b</td><td>(i)</td><td>Copper(II) hydroxide/ copper(II) carbonate</td><td>1</td></tr>
<tr><td></td><td>(ii)</td><td>Copper(II) chloride has a giant lattice structure with strong electrostatic forces of attraction.
Hence, a lot of energy is needed to overcome these forces of attraction.</td><td>1
1</td></tr>
<tr><td></td><td></td><td>[Total: 8]</td><td></td></tr>
<tr><td>5</td><td></td><td>- Excess lead(II) oxide is added to a conical flask with dilute nitric acid (if 'excess' is not mentioned until no more can dissolve)
- Filter the mixture to obtain the filtrate. (filtrate: lead(II) nitrate; residue: excess lead(II) oxide)
- To the filtrate, add an equal volume of (aqueous) sodium sulfate solution (accept other sulfate solution). A white precipitate of lead(II) sulfate would be formed.
- Filter the mixture, and collect the residue of lead(II) sulfate.
- Wash with distilled water.
- Dry between two pieces of filter paper.

Any 2 points for 1 m.</td><td>3</td></tr>
<tr><td></td><td></td><td>[Total: 3]</td><td></td></tr>
<tr><td>6</td><td>(a)</td><td>P: calcium nitrate S: calcium hydroxide
Q: oxygen T: ammonia
R: calcium oxide U: calcium carbonate</td><td>6</td></tr>
<tr><td></td><td>(b)</td><td>R to S: $CaO + H_2O \rightarrow Ca(OH)_2$
S to U: $Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O$
P to S: $Ca(NO_3)_2 + 2NaOH \rightarrow Ca(OH)_2 + 2NaNO_3$
Any one of the equation.</td><td>1</td></tr>
<tr><td></td><td></td><td>[Total: 7]</td><td></td></tr>
</table>

7 (a)	(i)	number of moles of magnesium carbonate = 16.8/ Mr of $MgCO_3$ = 16.8/84 = 0.2	1
	(i)	Volume of CO_2 collected = 0.2 x 24 dm^3 = 4.8 dm^3	1
	(ii)	$MgCO_3$: HCl 1:2 0.2 :0.4 number of moles of hydrochloric acid = 0.4 volume of hydrochloric acid = 0.4/1 = 0.4 dm^3	 1 1
(b)	(i)	Average speed = 8.4 dm^3/2 min = 4.2 dm^3/min	1
	(ii)	Double the mass/amount of magnesium carbonate.	1
(c)		**Carbon dioxide is acidic** and will react with calcium oxide which is basic.	1
			[Total: 7]
8	(a)	900 deaths	1
	(b)	As the sulfur dioxide concentration increases, the number of deaths increases.	1
	(c)	source: burning of fossil fuels in power stations/factories effect: irritate the eyes and lungs and cause breathing difficulties	1 1
			[Total: 4]
9	(a)	Carbon monoxide produced causes breathing difficulties/ leads to suffocation and death.	1
	(b)	Argon is unreactive / inert / will not react with the reactants or products (Oxygen / water vapour (from the air) would react with sodium or titanium)	1
	(c)	Sodium is more reactive titanium.	1
	(d)	**Moles of reactants (1M)** moles of Na = 20 / 23 = 0.870 moles of $TiCl_4$= 40 / 190 = 0.211 Both moles correct = 1M **Working/ explanation (1M)** $TiCl_4 + 4\ Na \rightarrow Ti + 4\ NaCl$ $TiCl_4$: Na 1:4 To completely react 0.211 moles of $TiCl_4$, you need (0.211 x 4) 0.844 moles of Na. 0.870 moles of Na is more than the 0.844 needed to fully react with the $TiCl_4$. Therefore the $TiCl_4$ is the limiting reactant. OR	3

		To completely react 0.870 moles of Na, you need (0.870/4) 0.2175 moles of $TiCl_4$. 0.211 of $TiCl_4$ is less than 0.2175 so there is not enough $TiCl_4$ to fully react with the Na in the reaction.	
		Answer (1M) Limiting reactant: $TiCl_4$	
	(e)	**Titanium** in $TiCl_4$ is **reduced** as the oxidation state of titanium decreases from **+4 in $TiCl_4$ to 0 in Ti**. **Sodium is oxidised** as the oxidation state of sodium increases from **0 in Na to +1 in NaCl** Since oxidation and reduction occurs simultaneously, this is a redox reaction.	1 1
	(f)		1
	(g)		1
			[Total: 10]
10(a)	**(i)**	T, R, S, U	1

	(ii)	R	1
	(b)	Sodium is extracted from its ore by **electrolysis** whereas iron is extracted from its ore by **reduction using carbon**. 1M Sodium is higher up in the reactivity series than iron./ Sodium, being **more reactive** than iron; forms a **more stable** ore. 1M Thus, **more energy** is needed to extract sodium from its ore. 1M OR Iron is lower in the reactivity series. / Iron, being **less reactive** than sodium; forms a **less stable** ore. 1M Thus, **less energy** is needed to extract iron from its ore. 1M Method – 1M Reason with both points – 1M Energy – 1M	3
	(c)	Haematite	1
	(d)	Coke/carbon burns in hot air/reacts with oxygen to form carbon dioxide. 1M • $C + O_2 \rightarrow CO_2$ The carbon dioxide formed reacts with more coke/carbon to produce carbon monoxide. 1M • $CO_2 + C \rightarrow 2CO$ Carbon monoxide **reduces** iron(III) oxide to iron. 1M • $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$ Every accurate description – 1M Every 2 accurate chemical eqn - 1M	4
			[Total: 10]