Name and Index Number: ( )	Class:

SENG KANG SECONDARY SCHOOL
PRELIMINARY EXAMINATION

SCIENCE (CHEMISTRY/BIOLOGY) 5078/01

Secondary 4 Express

31 August 2020

Paper 1 Multiple Choice

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write your index number and name on all the work you hand in.
You may use a soft pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

There are **forty** questions in 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 Multiple Choice Answer Sheet.

Read the instructions on the 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 question paper.
The use of an approved scientific calculator is expected, where appropriate.

A copy of the Date Sheet is printed on page 8.
A copy of the Periodic Table is printed on page 9.

Parent's / Guardian's Signature: .....

This document consists of **9** printed pages and **1** blank page.

Do not turn over the page until you are told to do so

[Turn over

1 John was provided with only a 100 cm^3 beaker, an electronic balance and a stopwatch.

What could John accurately measure?

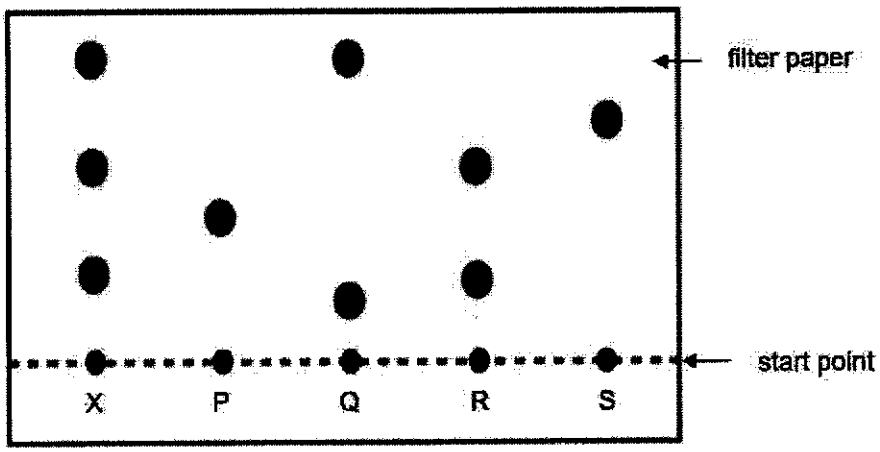
A 20 cm^3 solution and 4 g solid

B 4 g solid and 30 seconds

C 30 seconds and 20 cm^3 solution

D 20 cm^3 solution, 4 g solid and 30 seconds

2 A student carried out a chromatography experiment to investigate the identities of dyes used in food colouring, X. The dyes were compared against four dyes labelled P, Q, R and S. The figure below shows the chromatogram obtained at the end of the experiment.



Which statement is correct?

A Dye Q has a component that is least soluble in the solvent.

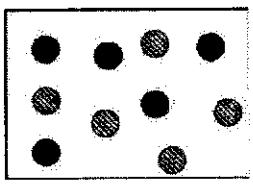
B Mixing dyes P and S will produce dye R.

C None of the dyes are pure substances.

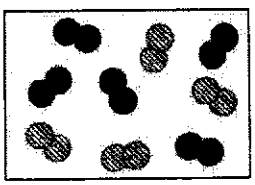
D X is a mixture of dyes Q and R.

3 Which diagram represents a pure substance?

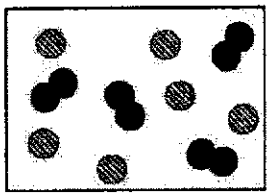
A



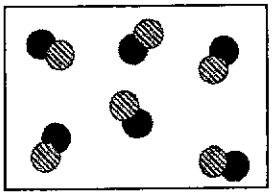
C



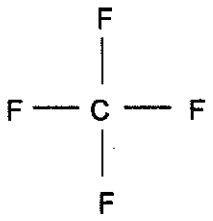
B



D

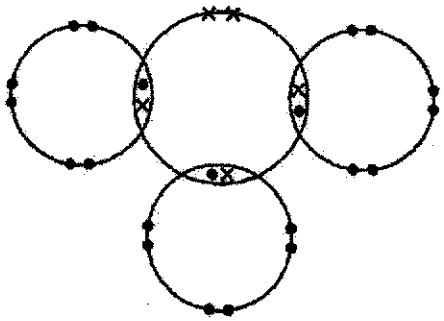


4 How many pairs of electrons, in a molecule of tetrafluoromethane, CF_4, are involved in bonding?



A 2
B 4
C 8
D 16

5 The diagram below shows the valence electrons in a molecule of a substance.



Which statement about the substance is true?

A It can conduct electricity in solid state.
B It has a low boiling point.
C It is an ionic compound.
D It can soluble in water.

6 Beryllium, Be, is present in the Earth's crust in small amounts.
It is found in the mineral, Beryl, $Be_3Al_2Si_6O_y$, which has a relative formula mass of 505.

What is the value of *y*?

A 4
B 8
C 16
D 32

7 Methane, CH_4, burns completely in oxygen to produce carbon dioxide and water.

What volume of gas would be formed at room temperature and pressure when 20 cm^3 of methane burns in 40 cm^3 of oxygen?

A 20 cm^3
B 40 cm^3
C 60 cm^3
D 80 cm^3

8 Why is calcium hydroxide added to soil?

A to decrease pH and neutralise acidity
B to decrease pH and neutralise alkalinity
C to increase pH and neutralise acidity
D to increase pH and neutralise alkalinity

9 Which substance does **not** react with acids or bases?

A aluminium oxide
B carbon monoxide
C magnesium oxide
D sulfur dioxide

10 The oxides of three elements, T, U and V, are added to water.

	oxide of T	oxide of U	oxide of V
water added	dissolved to form a solution of pH 2	insoluble	dissolved to form a solution of pH 10

The oxide of U, is yellow when hot and white when cold.

What are T, U and V?

	T	U	V
A	calcium	zinc	sulfur
B	calcium	carbon	sulfur
C	sulfur	zinc	calcium
D	sulfur	carbon	calcium

11 Which salt is insoluble in water?

A calcium nitrate
B calcium sulfate
C sodium carbonate
D sodium chloride

12 Which substance can be added to distinguish dilute hydrochloric acid from dilute nitric acid?

A calcium carbonate
B lead(II) carbonate
C sodium hydroxide
D Universal Indicator

13 A drop of solution M turns acidified potassium manganate(VII) from purple to colourless.

What must solution M contain?

A an acid
B an amphoteric oxide
C an oxidising agent
D a reducing agent

14 Which Group I element reacts most violently with water?

A lithium
B potassium
C rubidium
D sodium

15 Which gas is used to fill a light bulb?

A argon
B hydrogen
C neon
D oxygen

16 The ionic equations below represent the reaction between the metals, copper, lead, magnesium and X with solutions of the salts of the same metals.

$$Cu + X^{2+} \rightarrow \text{no reaction}$$
$$Pb + Cu^{2+} \rightarrow Pb^{2+} + Cu$$
$$X + Mg^{2+} \rightarrow \text{no reaction}$$
$$Mg + Cu^{2+} \rightarrow Mg^{2+} + Cu$$
$$Mg + Pb^{2+} \rightarrow Mg^{2+} + Pb$$
$$Mg + X^{2+} \rightarrow Mg^{2+} + X$$

What is the correct order, in increasing reactivity, of the metals?

A Cu, Mg, Pb, X
B Cu, Pb, X, Mg
C Mg, X, Pb, Cu
D Pb, Cu, Mg, X

17 Which statement explains why recycling ensures that metals will be available in the future?

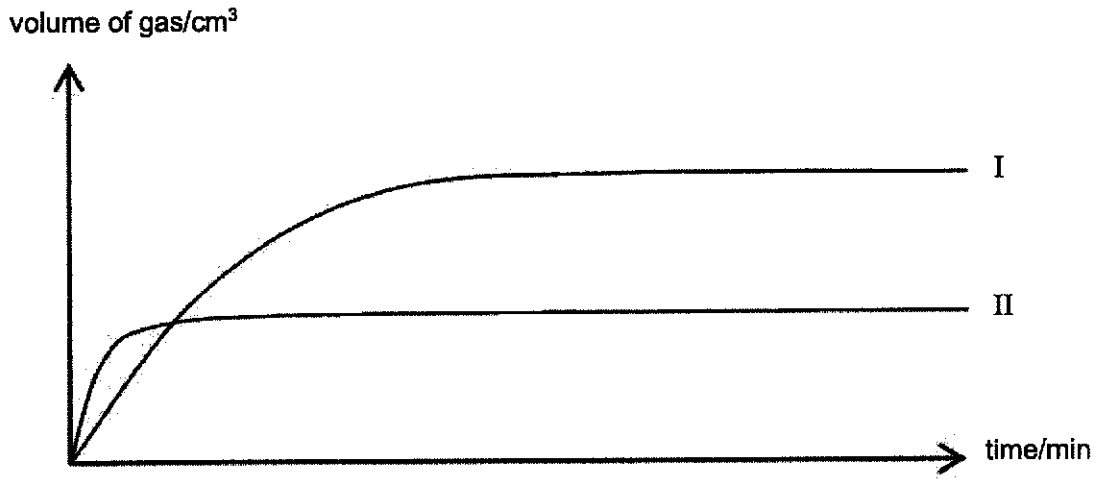
A Dumping metals in landfill sites is unsightly.

B Recycling avoids the environmental damage caused by opening new mines.

C Recycling costs less than obtaining metals from their ore.

D There are only limited amount of metals in the Earth's surface.

18 In two separate experiments, calcium carbonate was added to an excess of dilute hydrochloric acid.



Which set of conditions would give rise to the graphs above?

	I	II
A	2g of large lumps	4g of fine powder
B	2g of fine powder	4g of large lumps
C	4g of large lumps	2g of fine powder
D	4g of fine powder	2g of large lumps

19 Countries have measures to reduce the allowable amount of sulfur in petrol and diesel fuels.

Which of the following could be the reason for such a move?

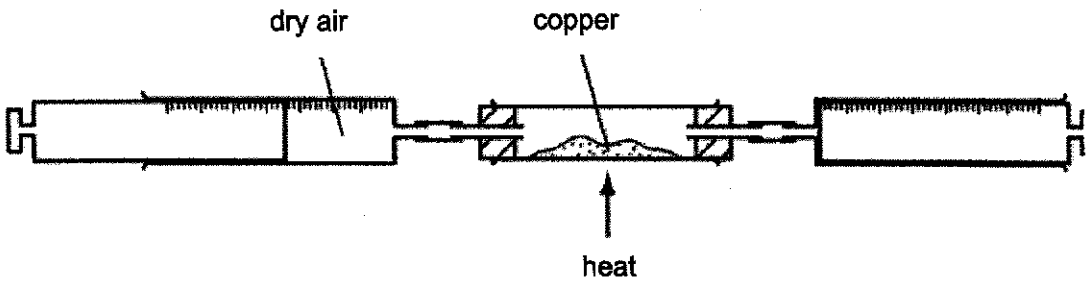
A to reduce the acidity of rain

B to reduce the amount of carbon dioxide released into the atmosphere

C to reduce the amount of fuel used in vehicles

D to reduce the exposure to ultraviolet rays in the atmosphere

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



The volume of air remaining at the end of the reaction is 237 cm^3.

What is the initial volume of dry air?

A 40 cm^3

B 160 cm^3

C 300 cm^3

D 550 cm^3

END OF PAPER

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

The Periodic Table of Elements

Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group 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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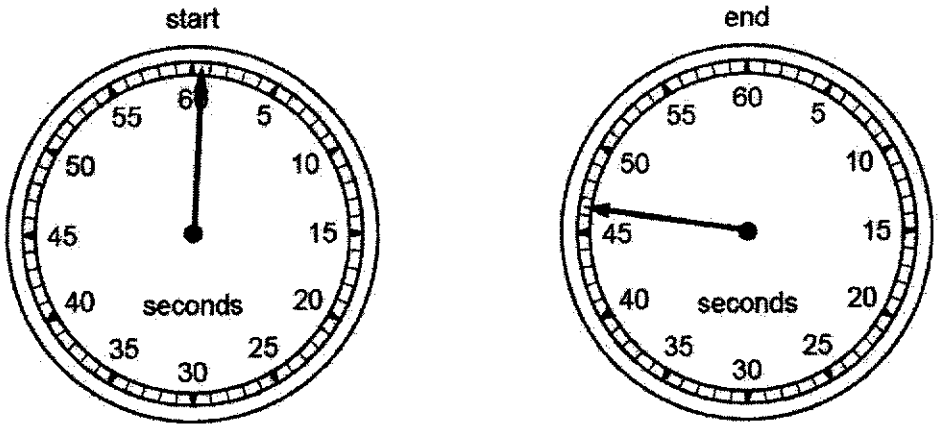
[Turn over

1 A stopwatch is used to time a race. The diagrams show the watch at the start and at the end of the race.

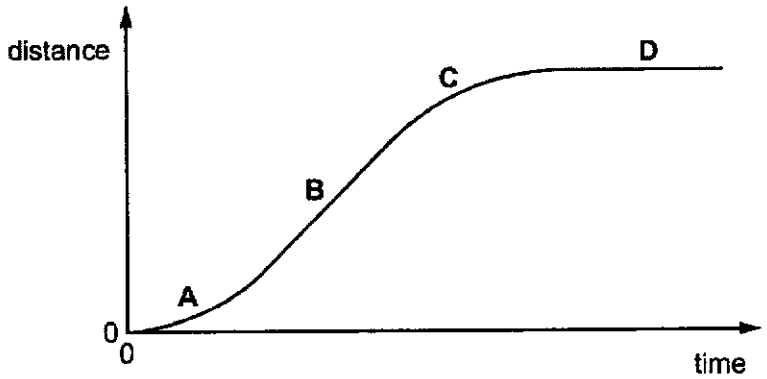


How long did the race take?

A 45.7 s **B** 46.0 s **C** 46.5 s **D** 47.0 s

2 The graph shows a distance-time graph for a car travelling in a straight line.

In which region is the car decelerating?

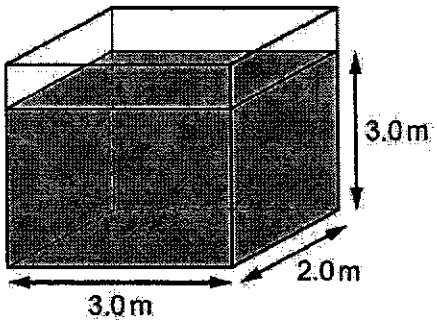


3 A force of 20 N acts on an object of mass 5.0 kg in the forward direction. A second force also acts on the object. The forward acceleration of the object is 3.0 m/s^2.

What is the size and direction of the second force?

	size of force / N	direction of force
A	5.0	backwards
B	15	backwards
C	15	forwards
D	35	forwards

4 The base of a rectangular storage tank is 2.0 m by 3.0 m. The tank is filled with paraffin to a depth of 3.0 m.

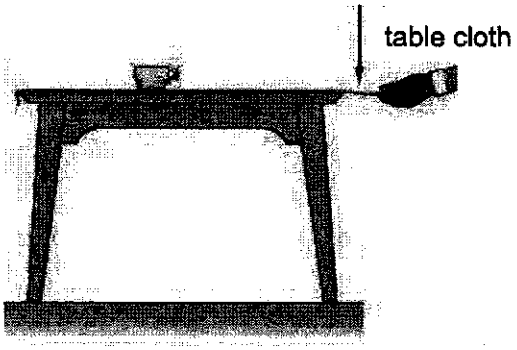


The density of paraffin is 800 kg/m^3 and the gravitational field strength is 10 N/kg.

What is the pressure at the bottom of the tank due to the paraffin?

A 2400 Pa **B** 14 400 Pa **C** 24 000 Pa **D** 144 000 Pa

5 Jonathan places a cup on a table cloth which covers the top of the table. When he pulls the table cloth quickly, the cup stays on the table without falling off.



Which of the following provides the most likely explanation?

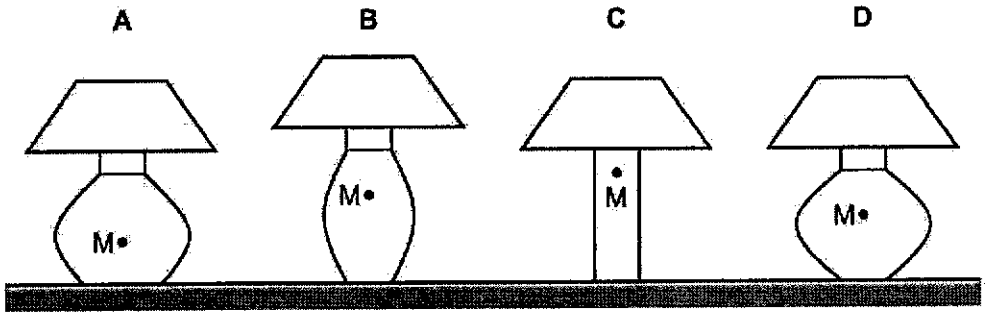
A The atmospheric pressure keeps the cup from falling off.

B The cup makes a tight seal with the table due to difference in pressure.

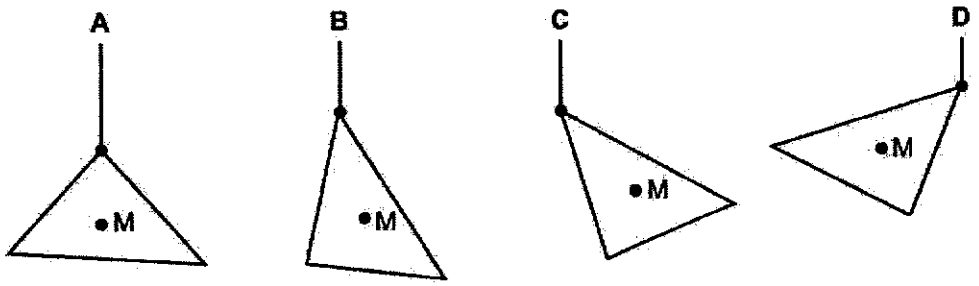
C The mass of the cup keeps it in position due to inertia.

D The weight of the cup is larger than the weight of the table cloth.

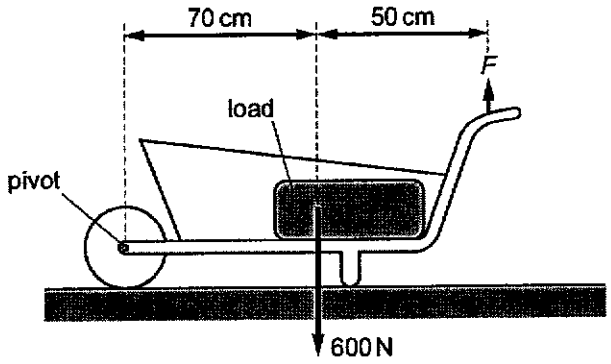
6 Four table lamps are shown along with the position M of the centre of gravity in each case.
Which lamp is the most stable?



7 A piece of card has its centre of gravity at M.
Which diagram shows how it hangs when suspended by a thread?



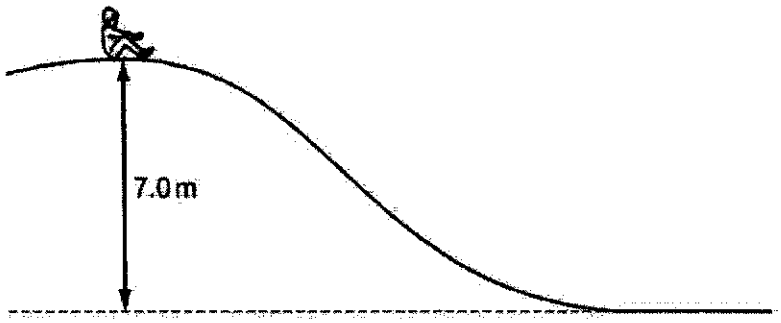
8 The total weight of the load and the wheelbarrow shown is 600 N.



What is the size of force *F* needed to just lift the loaded wheelbarrow?

A 350 N **B** 430 N **C** 600 N **D** 840 N

9 A child slides down a slide.



The weight of the child is 250 N. The height of the slide is 7.0 m. The work done against friction as the child travels down the slide is 1300 J.

What is the change in gravitational potential energy and what is the final kinetic energy of the child?

	change in gravitational potential energy	final kinetic energy
A	1750	450
B	1750	1750
C	17500	16200
D	17500	17500

10 A builder lifts eight slabs from the ground on to the back of a lorry 1.5 m high. The total time taken is 48 s and each slab weighs 200 N.

How much useful power does the builder produce?

A 50 W **B** 400 W **C** 2400 W **D** 3200 W

11 A balloon is inflated in a cold room. When the room becomes much warmer, the balloon becomes larger.

How does the behaviour of the air molecules in the balloon explain this?

A The molecules become larger.

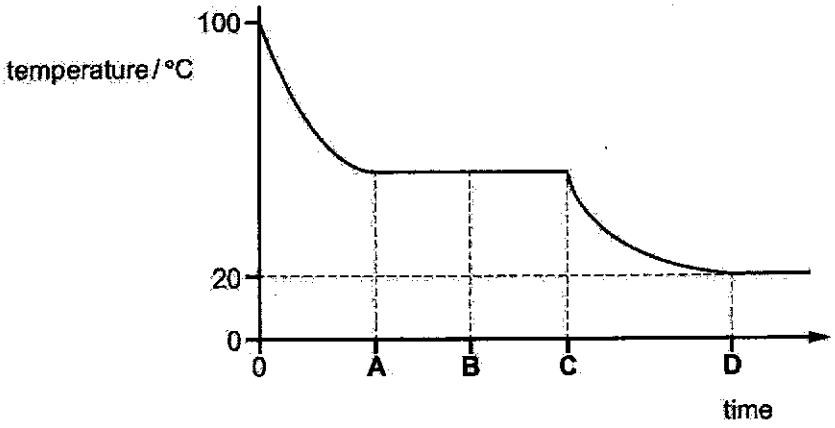
B The molecules evaporate.

C The molecules move more quickly.

D The molecules repel each other.

12 A sample of liquid at 100 °C is allowed to cool to a room temperature of 20 °C. The diagram shows how the temperature changes with time during the cooling process.

At which time does the sample become completely solid?



13 Which statement(s) is/are true about evaporation and boiling?

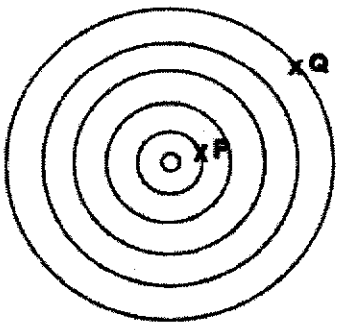
I Evaporation occurs at a faster rate compared to boiling.

II Evaporation occurs at any temperature, but boiling occurs at a fixed temperature.

III Evaporation occurs at the surface of a liquid, but boiling occurs throughout the liquid.

A III only **B** I & II only **C** II & III only **D** I, II & III

14 The diagram below shows wavefronts generated by a source of 2 Hz. The distance between points **P** to **Q** is 10 cm.

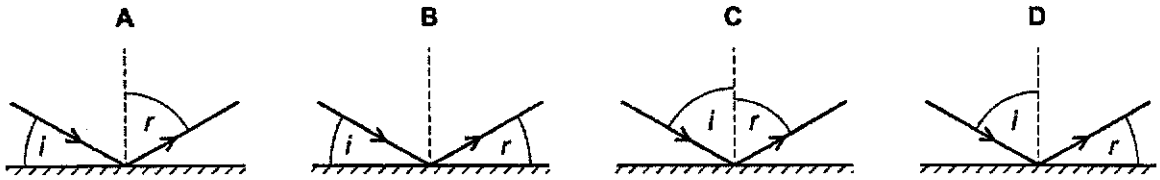


Determine the wavelength of the waves generated by the source.

A 0.5 cm **B** 2.0 cm **C** 2.5 cm **D** 10.0 cm

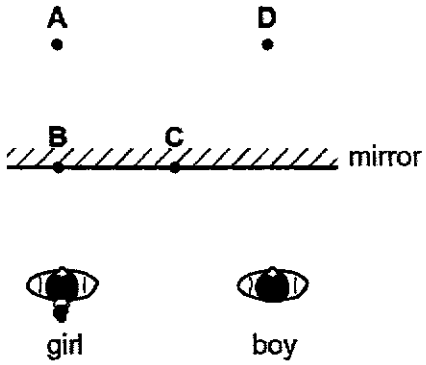
15 Light is incident on a mirror. The light is reflected from the mirror. The angle of incidence is *i* and the angle of reflection is *r*.

Which diagram correctly shows *i* and *r*?



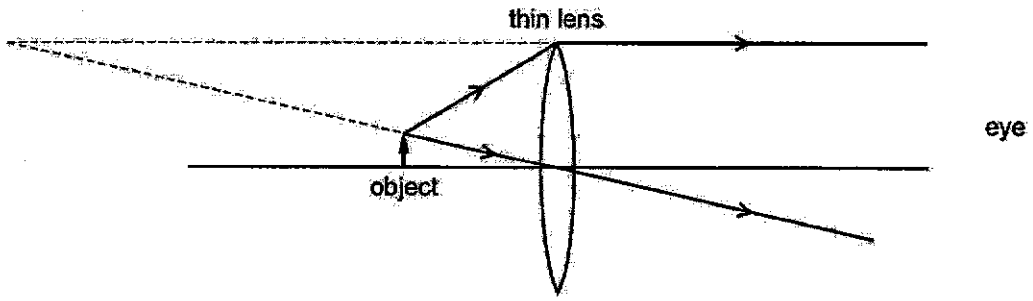
16 A boy stands beside a girl in front of a large plane mirror. They are both the same distance from the mirror, as shown.

Where does the boy see the girl's image?



17 An object is viewed through a converging lens.

The diagram shows the paths of two rays from the top of the object to an eye.



How does the image compare with the object?

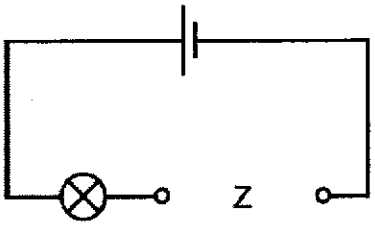
A It is larger and inverted.

B It is larger and upright.

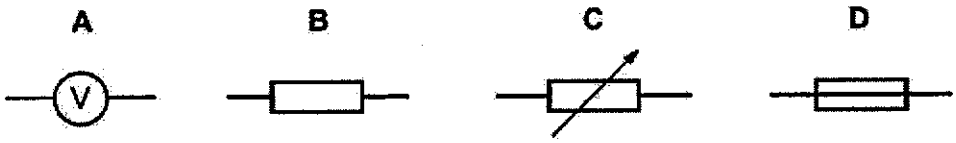
C It is smaller and inverted.

D It is smaller and upright.

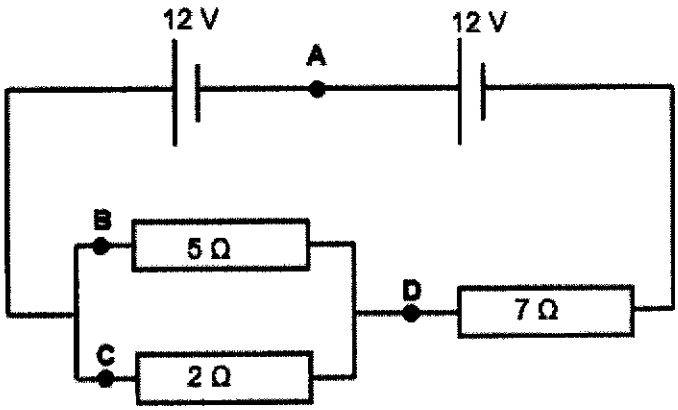
18 An electrical component is to be placed in the circuit at Z, to allow the brightness of the lamp to be varied from bright to dim.



What should be connected at Z?

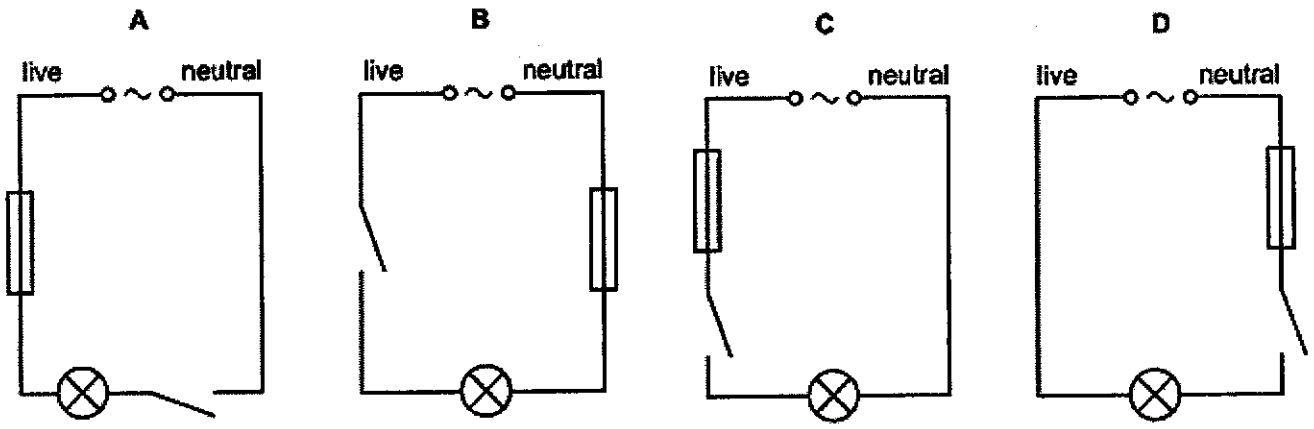


19 In the circuit shown below, at which point is the current the smallest?



20 A lamp is connected to the a.c. mains supply in series with a switch and a fuse.

Which circuit shows these components wired correctly?



21 John was provided with only a 100 cm^3 beaker, an electronic balance and a stopwatch.

What could John accurately measure?

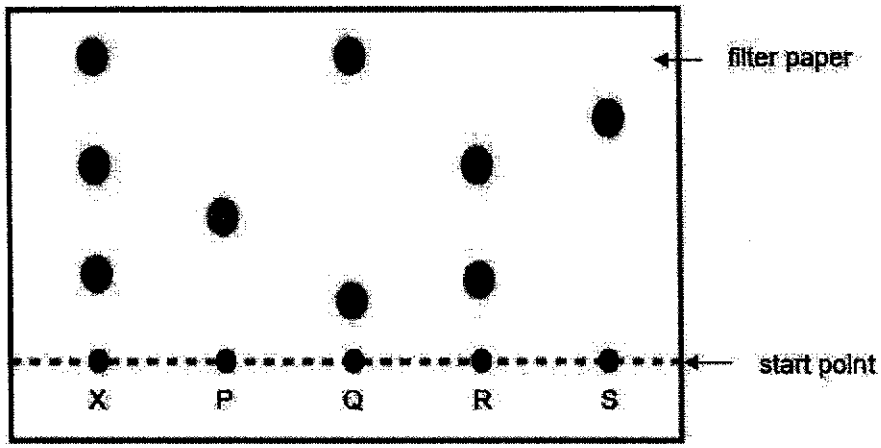
A 20 cm^3 solution and 4 g solid

B 4 g solid and 30 seconds

C 30 seconds and 20 cm^3 solution

D 20 cm^3 solution, 4 g solid and 30 seconds

22 A student carried out a chromatography experiment to investigate the identities of dyes used in food colouring, X. The dyes were compared against four dyes labelled P, Q, R and S. The figure below shows the chromatogram obtained at the end of the experiment.



Which statement is correct?

A Dye Q has a component that is least soluble in the solvent.

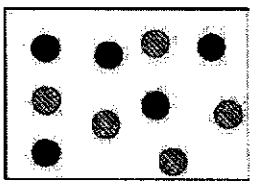
B Mixing dyes P and S will produce dye R.

C None of the dyes are pure substances.

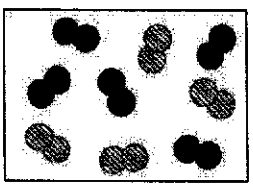
D X is a mixture of dyes Q and R.

23 Which diagram represents a pure substance?

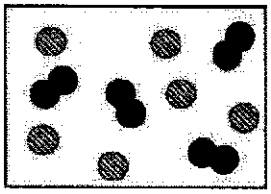
A



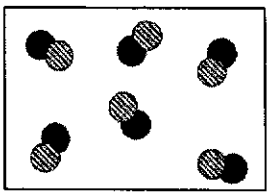
C



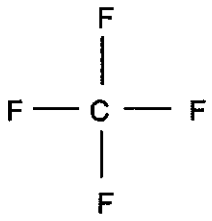
B



D

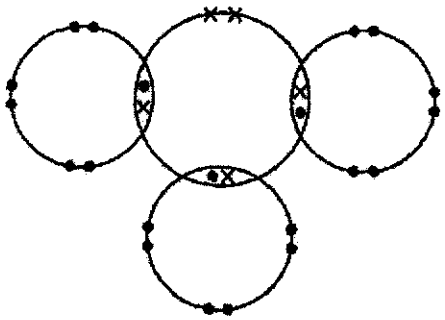


24 How many pairs of electrons, in a molecule of tetrafluoromethane, CF_4, are involved in bonding?



A 2
B 4
C 8
D 16

25 The diagram below shows the valence electrons in a molecule of a substance.



Which statement about the substance is true?

A It can conduct electricity in solid state.
B It has a low boiling point.
C It is an ionic compound.
D It can soluble in water.

26 Beryllium, Be, is present in the Earth's crust in small amounts.
It is found in the mineral, Beryl, $Be_3Al_2Si_6O_y$, which has a relative formula mass of 505.

What is the value of *y*?

A 4
B 8
C 16
D 32

27 Methane, CH_4, burns completely in oxygen to produce carbon dioxide and water.

What volume of gas would be formed at room temperature and pressure when 20 cm^3 of methane burns in 40 cm^3 of oxygen?

A 20 cm^3
B 40 cm^3
C 60 cm^3
D 80 cm^3

28 Why is calcium hydroxide added to soil?

A to decrease pH and neutralise acidity
B to decrease pH and neutralise alkalinity
C to increase pH and neutralise acidity
D to increase pH and neutralise alkalinity

29 Which substance does **not** react with acids or bases?

A aluminium oxide
B carbon monoxide
C magnesium oxide
D sulfur dioxide

30 The oxides of three elements, T, U and V, are added to water.

	oxide of T	oxide of U	oxide of V
water added	dissolved to form a solution of pH 2	insoluble	dissolved to form a solution of pH 10

The oxide of U, is yellow when hot and white when cold.

What are T, U and V?

	T	U	V
A	calcium	zinc	sulfur
B	calcium	carbon	sulfur
C	sulfur	zinc	calcium
D	sulfur	carbon	calcium

31 Which salt is insoluble in water?

A calcium nitrate
B calcium sulfate
C sodium carbonate
D sodium chloride

32 Which substance can be added to distinguish dilute hydrochloric acid from dilute nitric acid?

A calcium carbonate
B lead(II) carbonate
C sodium hydroxide
D Universal Indicator

33 A drop of solution M turns acidified potassium manganate(VII) from purple to colourless.

What must solution M contain?

A an acid
B an amphoteric oxide
C an oxidising agent
D a reducing agent

34 Which Group I element reacts most violently with water?

A lithium
B potassium
C rubidium
D sodium

35 Which gas is used to fill a light bulb?

A argon
B hydrogen
C neon
D oxygen

36 The ionic equations below represent the reaction between the metals, copper, lead, magnesium and X with solutions of the salts of the same metals.

$$Cu + X^{2+} \rightarrow \text{no reaction}$$
$$Pb + Cu^{2+} \rightarrow Pb^{2+} + Cu$$
$$X + Mg^{2+} \rightarrow \text{no reaction}$$
$$Mg + Cu^{2+} \rightarrow Mg^{2+} + Cu$$
$$Mg + Pb^{2+} \rightarrow Mg^{2+} + Pb$$
$$Mg + X^{2+} \rightarrow Mg^{2+} + X$$

What is the correct order, in increasing reactivity, of the metals?

A Cu, Mg, Pb, X
B Cu, Pb, X, Mg
C Mg, X, Pb, Cu
D Pb, Cu, Mg, X

37 Which statement explains why recycling ensures that metals will be available in the future?

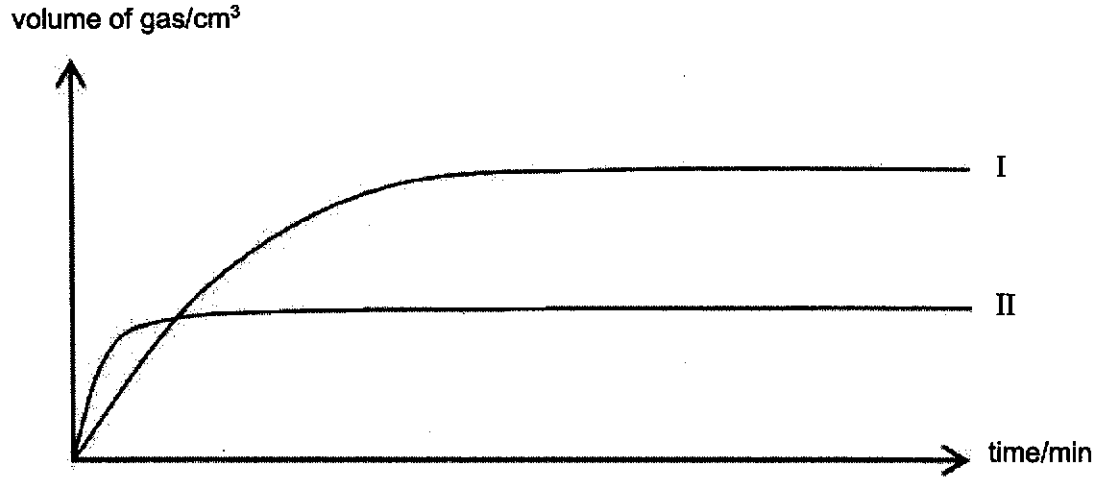
A Dumping metals in landfill sites is unsightly.

B Recycling avoids the environmental damage caused by opening new mines.

C Recycling costs less than obtaining metals from their ore.

D There are only limited amount of metals in the Earth's surface.

38 In two separate experiments, calcium carbonate was added to an excess of dilute hydrochloric acid.



Which set of conditions would give rise to the graphs above?

	I	II
A	2g of large lumps	4g of fine powder
B	2g of fine powder	4g of large lumps
C	4g of large lumps	2g of fine powder
D	4g of fine powder	2g of large lumps

39 Countries have measures to reduce the allowable amount of sulfur in petrol and diesel fuels.

Which of the following could be the reason for such a move?

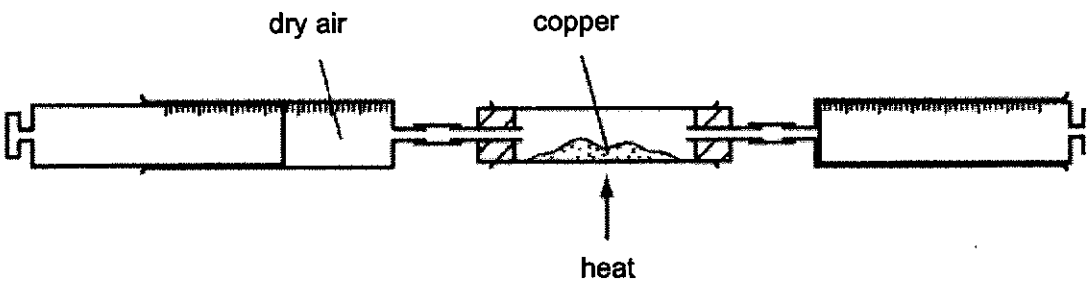
A to reduce the acidity of rain

B to reduce the amount of carbon dioxide released into the atmosphere

C to reduce the amount of fuel used in vehicles

D to reduce the exposure to ultraviolet rays in the atmosphere

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



The volume of air remaining at the end of the reaction is 237 cm^3.

What is the initial volume of dry air?

A 40 cm^3

B 160 cm^3

C 300 cm^3

D 550 cm^3

END OF PAPER

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

The Periodic Table of Elements

Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group 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 –

lume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

Name and Index Number: ( )	Class:

SENG KANG SECONDARY SCHOOL
PRELIMINARY EXAMINATION

SCIENCE (CHEMISTRY) 5076, 5078/03

Secondary 4 Express/5 Normal (Academic)

26 August 2020

Paper 3 Theory

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your index number and name on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
You may use a soft pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

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

Section B
Answer any **two** questions.
Write your answers in the spaces provided.

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.

A copy of the Data Sheet is printed on page 17.
A copy of the Periodic Table is printed on page 18.
The use of an approved scientific calculator is expected, where appropriate.

For Examiner's use	
Section A	**/ 45**
1	/ 7
2	/ 8
3	/ 10
4	/ 5
5	/ 9
6	/ 6
Section B	**/ 20**
7	/ 10
8	/ 10
9	/ 10
Total	**/ 65**
Total %	**/ 100**

Parent's / Guardian's Signature: .....

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

Do not turn over the page until you are told to do so.

[Turn over

Section A

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

1 Some elements have many isotopes.

Table 1.1 shows information about three isotopes of element **X**.

Table 1.1

	element **X**		
isotope	**1**	**2**	**3**
number of protons	16	16	16
number of neutrons	13	14	15
number of electrons	16	16	16
number of electrons in outer shell	6	6	6

(a) Use data from Table 1.1, to show that **1**, **2** and **3** are isotopes of the same element.

.....

.....

.....

..... [2]

(b) Explain how the data suggests that the three isotopes have the same chemical reactions.

.....

..... [1]

(c) Element **Y** and **Z** also have isotopes.

Table 1.2 shows information about an isotope of element **Y** and an isotope of element **Z**.

Table 1.2

	isotope of element **Y**	isotope of element **Z**
number of protons	8	30
number of neutrons	7	34
number of electrons	8	30
number of electrons in outer shell	6	2

(i) Use the information in Table 1.1, Table 1.2 and the Periodic Table, to identify the elements **X**, **Y** and **Z**.

X .....

Y .....

Z .....

[2]

(ii) Which of the elements **X**, **Y** or **Z** reacts with acids to make salts?

Explain your reasoning.

.....

..... [2]

2 Table 2.1 shows information of four elements **T**, **U**, **V** and **W**. These four elements are in the same period of the Periodic Table.

Table 2.1

element	appearance	chemical formula of its oxide	oxidation state of the underlined element
T	yellow solid	$\underline{T}O_3$	
U	black solid	$\underline{U}O_2$	
V	silver solid	$\underline{V}_2O$	+1
W	silver solid	$\underline{W}_2O_3$	

(a) Complete Table 2.1. [2]

(b) **(i)** Which element is likely to be in Group III?

..... [1]

(ii) Arrange the elements in the order (from left to right) in which they appear in the period of the Periodic Table.

..... [1]

(c) **(i)** Draw a 'dot-and-cross' diagram to show the arrangement of the outer shell electrons in V_2O.

[2]

(ii) Explain, in terms of bonding, why V_2O is a solid at room temperature and pressure.

.....

.....

..... [2]

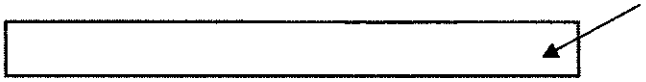
[Turn over

3 **(a)** State **two** trends, in the physical properties of halogens, going down the Group.

.....

..... [2]

(b) A jet of chlorine gas is aimed at the filter paper soaked in a solution of potassium iodide solution.



(i) State and explain what you would observe on the filter paper.

observation: .....

explanation: .....

.....

..... [3]

(ii) Identify the reducing agent in **(b)(i)**.

..... [1]

(c) State **two** ways in which chlorine molecules behave differently when temperature of chlorine molecules is above its boiling point and when it is below its melting point.

You should refer to the kinetic particle theory in your answer.

1. .....

.....

.....

2. .....

.....

..... [2]

(d) Write the name and chemical formula of a compound formed when an element from Group II combines with an element from Group VII.

name .....

chemical formula ..... [2]

4 Euro is the currency used by countries in the European Union. Euro coins are made out of Nordic gold. It has a composition of 89% copper, 5% aluminium, 5% zinc and 1% tin.

(a) Stacy makes a comment about Euro coins.

'Euro coins are classified as an alloy.'

Do you agree with Stacy? Explain your answer.

.....

..... [1]

(b) **(i)** Suggest why coins made out of Nordic gold is harder and stronger than coins made out of pure metals.

.....

.....

.....

.....

..... [3]

(ii) How would the malleability of Euro coin be affected if the aluminium and zinc components of Nordic gold were increased?

..... [1]

5 Pete investigated the temperature change when sodium hydrogencarbonate was added to excess dilute hydrochloric acid, as shown in Fig. 5.1.

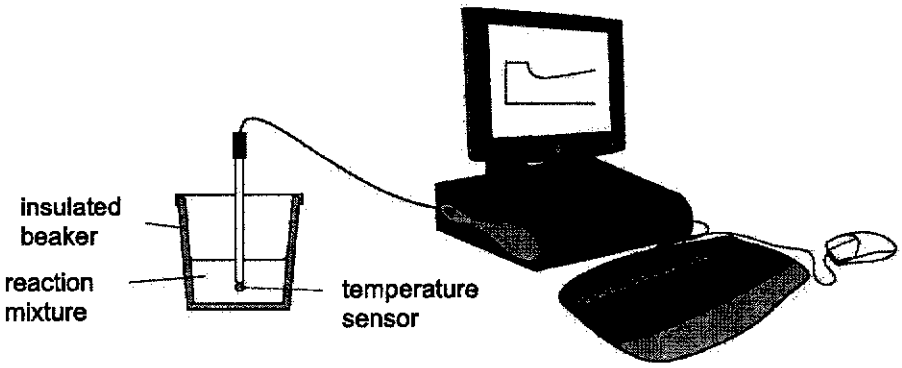


Fig. 5.1

Temperature measurements were displayed on the computer screen as a graph of temperature against time. This graph is shown in Fig. 5.2.

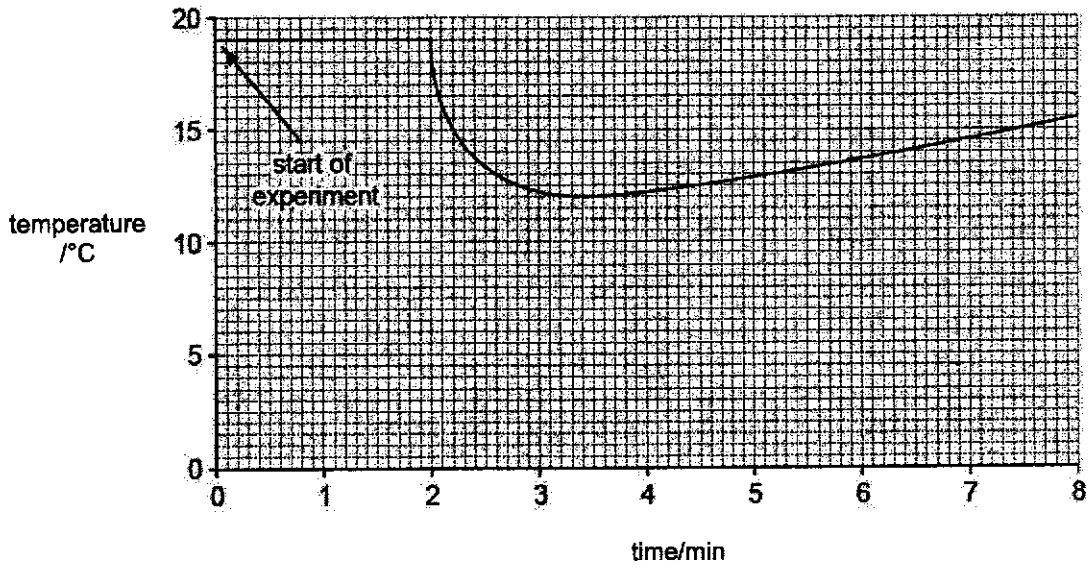


Fig. 5.2

(a) On the graph in Fig. 5.2, mark with an '**X**' the point where sodium hydrogencarbonate was added to dilute hydrochloric acid [1]

(b) Calculate the temperature change that occurred during the reaction.

..... [1]

(c) Using your answer in **(b)**, state the type of energy change that took place during the reaction. Justify your answer.

.....

..... [2]

[Turn over

(d) Sodium hydrogencarbonate decomposes on heating, as shown by the equation.

$$2NaHCO_3 \rightarrow Na_2CO_3 + H_2O + CO_2$$

In an experiment, a 420 g sample of sodium hydrogencarbonate was heated.

(i) Calculate the relative formula mass of sodium hydrogencarbonate, $NaHCO_3$.

[Relative atomic mass: A_r: C, 12; H, 1; Na, 23; O, 16]

relative formula mass = ... [1]

(ii) Calculate the mass of sodium carbonate produced.

mass of sodium carbonate = ... g [2]

(iii) Calculate the volume of carbon dioxide evolved at room temperature and pressure.

volume of carbon dioxide = ... dm^3 [2]

[Turn over

6 Fig. 6.1 describes some of the reactions of substance **A**.

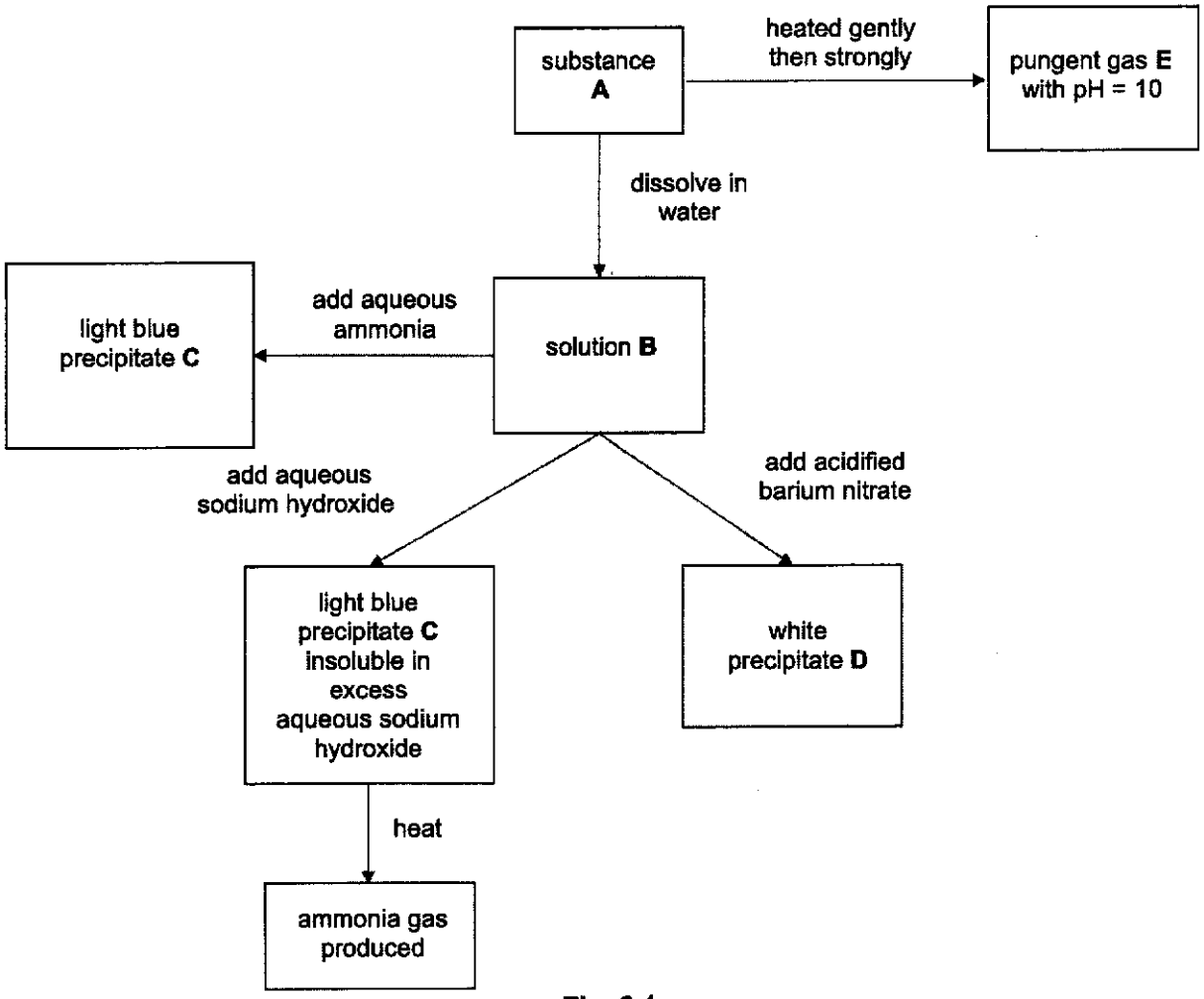


Fig. 6.1

(a) Identify **C**, **D** and **E**.

C .....

D .....

E .....

[3]

(b) Identify the two cations present in substance **A**.

..... and ..... [2]

(c) Write an ionic equation, with state symbols, for the formation of **D**.

..... [1]

[Turn over

Section B

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

7 A blast furnace is used in the extraction of iron.

(a) The blast furnace is a huge, steel stack lined with refractory brick, where raw materials are deposited into the top and preheated air is blown in from the bottom.

(i) What is the chemical name of the ore from which iron is extracted from?

..... [1]

(ii) State two other raw materials used in the extraction of iron.

..... [1]

(b) The iron ore is reduced by carbon monoxide to form iron.

Write a balanced chemical equation, including state symbols, for the reaction between the iron ore and carbon monoxide.

..... [2]

(c) Describe, with the use of balanced chemical equations, how acidic impurities are removed in the blast furnace.

.....

.....

.....

.....

.....

..... [4]

(d) Suggest why molten slag floats on top of molten iron and explain how this could be useful during the extraction of iron.

.....

.....

.....

..... [2]

8 Liquid hydrogen peroxide, H_2O_2, decomposes into water and oxygen.

(a) Write a balanced chemical equation, including state symbols, for the decomposition of hydrogen peroxide into water and oxygen.

..... [2]

(b) How would you verify the identity of oxygen produced in this reaction?

.....

..... [1]

(c) In Experiment 1, a solution of hydrogen peroxide was decomposed and the volume of oxygen released was measured every minute.

The results of this experiment are shown in Table 8.1.

Table 8.1

time/min	0	1	2	3	4	5	6	7	8
volume of oxygen /cm^3	0	15	23	26	27	27	27	27	27

(i) Plot the results from Table 8.1, on the grid in Fig. 8.2, and draw a curve of best fit.
Label this curve **P**.

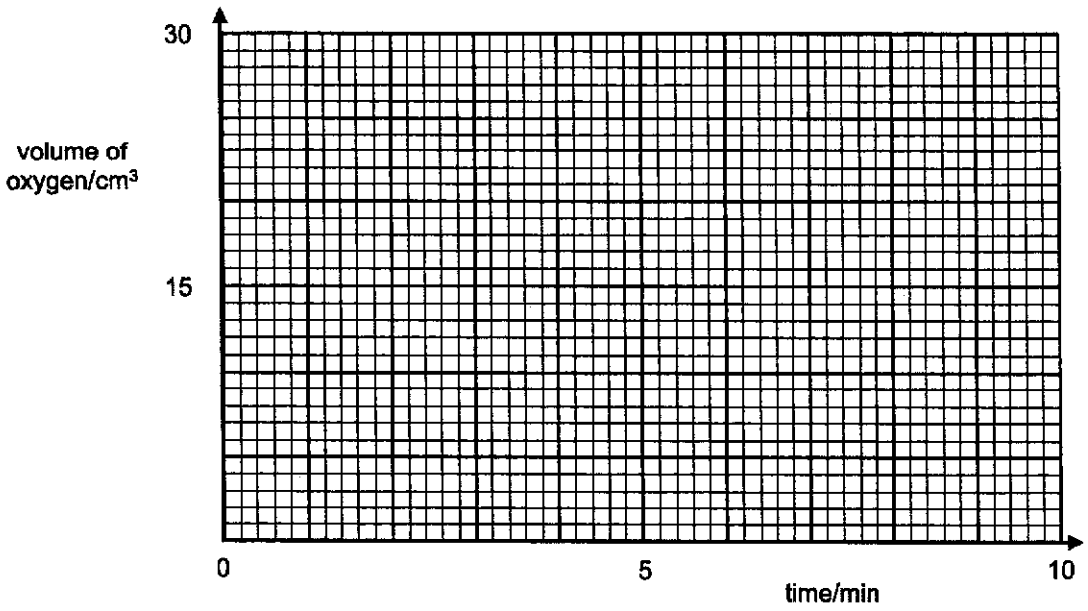


Fig. 8.2

[2]

[Turn over

(ii) Calculate the average speed of reaction in cm^3/min for the first 3 minutes.

average speed = ... cm^3/min [1]

(d) Experiment 2 is repeated with all conditions kept the same as per Experiment 1, except that the hydrogen peroxide is diluted with an equal volume of water.

(i) Sketch on Fig. 8.2, the curve you would expect for this second experiment. [1]
Label this curve **Q**.

(ii) Using Collision Theory, explain the difference in the reaction rate between Experiment 1 and 2.

.....

.....

.....

.....

.....

.....

.....

..... [3]

9 (a) Acid **J** has a relative molecular mass of 36.5. A 500 cm^3 aqueous solution contains 73 g of **J**.

Calculate the concentration of **J** in mol/dm^3.

concentration = ... mol/dm^3 [2]

(b) (i) Name a suitable solid that can be used to react with acid **J** to prepare a sample of magnesium chloride.

..... [1]

(ii) Describe the procedure used to obtain a pure and dry sample of magnesium chloride.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

[Turn over

(c) Describe how you would carry out a test to identify the anion present in acid **J**. Include the observation you would expect.

.....

.....

..... [2]

(d) Suggest why a sample of solution **J** can conduct electricity.

.....

..... [1]

END OF PAPER

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

The Periodic Table of Elements

Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group 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 –

lume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

Marking Scheme for Prelims 5078 P1 2020

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

Marking Scheme for Prelims 5076 P1 2020

21	B	22	A	23	D	24	B	25	B
26	C	27	A	28	C	29	B	30	C
31	B	32	B	33	D	34	C	35	A
36	B	37	D	38	C	39	A	40	C

[Turn over

Marking Scheme for 5076, 5078 Prelims P3 2020

Section A

1	(a)	Isotopes 1, 2 and 3 each have 16 protons. Isotopes 1, 2 and 3 have 13, 14 and 15 neutrons respectively. They are isotopes of the same element since they are atoms with the same number of protons but different number of neutrons.	[1] – quote data from question [1]
	(b)	The three isotopes each have 6 electrons in outer shell, hence they have the same chemical reactions.	[1]
	(ci)	X: sulfur Y: oxygen Z: zinc	[2] for all 3 correct answer [1] for 1 correct answer
	(ii)	Z/Zinc is a metal that reacts with acid to produce salt and hydrogen gas.	[1] [1]

2	(a)	<table><tr><th>element</th><th>oxidation state of the underlined element</th></tr><tr><td>T</td><td>+6</td></tr><tr><td>U</td><td>+4</td></tr><tr><td>V</td><td>+1</td></tr><tr><td>W</td><td>+3</td></tr></table>	[2] for any 3 correct O.S. [1] for any 1 correct O.S O.S – sign must be in front of the number.
	(bi)	W	[1]
	(ii)	V, W, U, T	[1]
	(ci)		[1] for each correct ion Do not penalise if students show all electrons in their 'dot-and-cross' diagram, provided both ions are drawn correctly.
	(d)	V_2O is a solid at room temperature as it has a high melting point. A lot of energy is required to overcome the strong electrostatic forces of attraction between oppositely charged ions.	[1] [1]

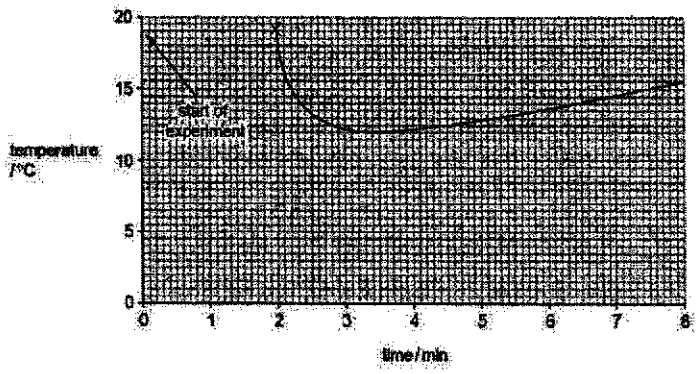
[Turn over

3	(a)	Melting and boiling points increase down the Group OR Colour intensity increases/colour darkens down the Group OR Density increases down the Group	**[1] for each correct trend – any 2 trends**
	(bi)	observation: colourless solution turns brown/filter paper turns brown explanation: chlorine is more reactive than iodine, hence it can displace iodine from potassium iodide/its salt. OR chlorine is reduced as the oxidation state decreases from 0 in chlorine to -1 in potassium chloride ; potassium iodide is oxidised as the oxidation state increases from -1 in potassium iodide to 0 in iodine.	**[1]** **[1]** **[1]** **OR** **[1]** **[1]**
	(ii)	Potassium iodide/KI	**[1]**
	(c)	1. Below its melting point, chlorine molecules vibrate about its fixed positions. Above its boiling point, chlorine molecules move rapidly in all directions/move freely over long distances. 2. Below its melting point, chlorine molecules are packed very closely together in an orderly manner/in a fixed and regular arrangement. Above its boiling point, chlorine molecules are far apart in a disorderly/random manner.	**[1] each – must have a comparison, clearly stating if it is below melting point or above boiling point.** ***1m is also awarded if either the arrangement or movement of each physical state being compared → presented correctly though not compared directly like in the marking scheme.**
	(d)	Any correct name and chemical formula of Group II halide	**[1] – name** **[1] – chemical formula**

4	(a)	Yes, as Euro coins consist of a mixture of (four different) metals/elements.	**[1]** **accept – physically mixed/combined instead of mixture**
	(bi)	Atoms of (added elements) have different sizes, which disrupt the orderly arrangement (of atoms). Layers of atoms cannot slide over one another easily when a force is applied.	**[1]** **[1]** **[1]**

[Turn over

	(ii)	Malleability decreases.	[1]

5	(a)		[1]
	(b)	-7°C	[1] with correct sign and unit
	(c)	Endothermic reaction as temperature decreases/final temperature is lower than initial temperature.	[1] [1] to allow max ecf [2] for exothermic reaction as with reference to their answer in (b)
	(di)	relative formula mass of $NaHCO_3$ = 23 + 1 + 12 + 3(16) = 84	[1]
	(ii)	no of mol. of $NaHCO_3$ = 420 ÷ 84 = 5 mol. comparing mol. ratio – $NaHCO_3$: Na_2CO_3 2 : 1 5 mol. : 2.5 mol. mass of Na_2CO_3 = 2.5 x [2(23)+12+3(16)] = 265 g	[1] [1] to allow ecf [1] if no of mol. of $NaHCO_3$ is computed wrongly due to careless mistake
	(iii)	comparing mol. ratio – $NaHCO_3$: CO_2 2 : 1 5 mol. : 2.5 mol. volume of CO_2 = 2.5 x 24 = 60 dm^3	[1] [1] to allow ecf [1] if no of mol. of $NaHCO_3$ is computed wrongly due

			to careless mistake from (ii)

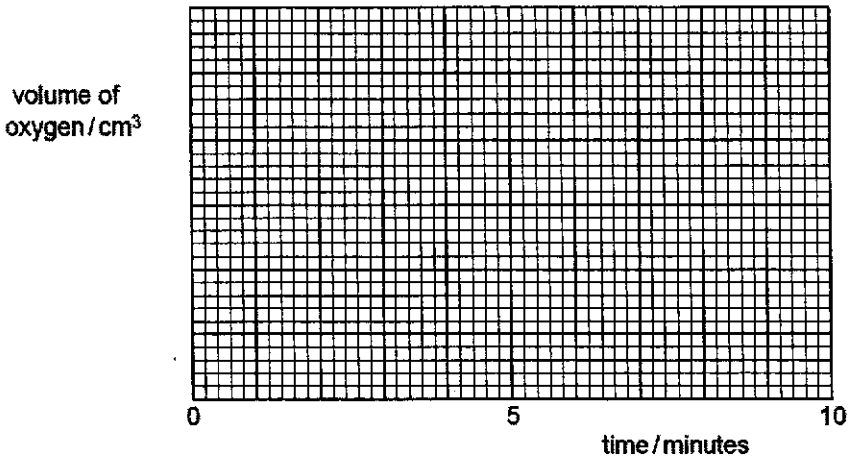
6	**(a)**	**C**: copper(II) hydroxide/$Cu(OH)_2$ **D**: barium sulfate/$BaSO_4$ **E**: ammonia/NH_3	**[1]** **[1]** **[1]**
	(b)	Cu^{2+}/copper(II) NH_4^+/ammonium	**[1]** **[1]**
	(c)	Ba^{2+} (aq) + SO_4^{2-} (aq) → $BaSO_4$ (s)	**[1]**

Section B

(only mark 1st 2 questions if students attempted all 3 questions)

7	**(ai)**	Iron(III) oxide	**[1]**
	(ii)	Coke/carbon & Limestone/calcium carbonate	**[1]**
	(b)	$Fe_2O_3(s) + 3CO(g) \rightarrow 2Fe(l) + 3CO_2(g)$	**[1] – correct balanced chemical equation** **[1] – correct state symbols**
	(c)	$CaCO_3 \rightarrow CaO + CO_2$ Limestone decomposes to form calcium oxide. $CaO + SiO_2 \rightarrow CaSiO_3$ (Basic) calcium oxide reacts with (acidic) silicon dioxide/sand to form molten slag/molten calcium silicate, (hence removing the impurities).	**[1] – answer** **[1] – correct balanced chemical equation** **[1] – answer** **[1] – correct balanced chemical equation**
	(d)	Molten slag has a lower density than molten iron, hence it floats above molten iron. By floating above molten iron, molten slag prevents molten iron from being oxidised by hot air.	**[1]** **[1]**

8	**(a)**	$2H_2O_2(l) \rightarrow 2H_2O(l) + O_2(g)$	**[1] – correct balanced chemical equation** **[1] – correct state symbols**
	(b)	Insert a glowing splint. If glowing splint relights, oxygen is present.	**[1]**

	(ci)		[1] – correctly plotted points with 'x' [1] – best fit curve with curve labelled P *1m is awarded if (0,0) is not plotted, but students drew the curve from (0,0) and with curve labelled as P.
	(ii)	26/3 = 8.67 cm^3/minute	[1]
	(di)	Curve Q is less steep than Curve P and total volume of oxygen is still the same for both curves.	[1] – with curve sketched and labelled Q on Fig. 8.2
	(ii)	Slower rate of reaction in experiment 2 as compared to experiment 1. A less concentrated/Diluted (hydrogen peroxide) solution has lesser particles occupying a given volume, resulting (in less frequent collisions between particles), thus less frequent effective collisions.	[1] [1] [1]

9	(a)	no of mol. of acid J = 73 ÷ 36.5 = 2 mol. concentration in mol/dm^3 = 2 ÷ (500/1000) = 4 mol/dm^3 OR concentration in g/dm^3 = 73 ÷ 0.5 = 146 g/dm^3 concentration in mol/dm^3 = 146 ÷ 36.5 = 4 mol/dm^3	[1] [1] OR [1] [1]
	(bi)	magnesium carbonate / magnesium oxide / magnesium	[1]
	(ii)	Procedure: *** Heat/Warm the acid in a beaker. (optional 1st step) 1) Add magnesium / magnesium carbonate / magnesium oxide in excess (and stir thoroughly, to ensure all acid has been completely reacted). 2) Filter to collect the filtrate (salt solution). 3) Heat the filtrate to obtain a hot saturated solution. 4) Cool to allow crystals to form. 5) Filter to collect salt crystals.	[4] for all 7 points [3] for 5 points [2] for 3 points [1] for 1 point Steps have to be in sequence.

		6) Wash with cold (deionised) water. 7) Dry the crystals between filter papers.	**Reject – skipping steps** **eg. step 3 as step 1, as without step 1, would not be able to execute the rest of the steps**
	(c)	Add (acidify aqueous) silver nitrate to J. White precipitate/ppt. observed (indicating the presence of chloride ions).	**[1]** **[1] – provided the test is correct**
	(d)	Solution J has free moving ions that enable it to conduct electricity.	**[1]**