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Pasir Ris Secondary School

Name	Class	Register Number
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SECONDARY 4 EXPRESS PRELIMINARY EXAMINATION 2020

CHEMISTRY

6092/01

Paper 1 Multiple Choice

26 Aug 2020

Wednesday 1300 – 1400

1 hour

Additional Material: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

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

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

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 Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

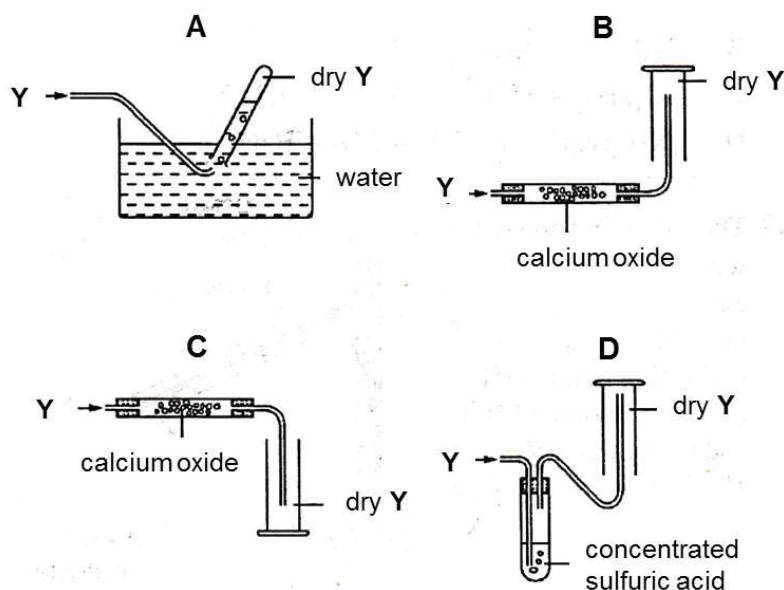
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

A copy of the Periodic Table is printed on page 14.

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

- 1 A gas, Y, is denser than air, soluble in water and is alkaline. Which method is used to collect a dry sample of the gas?

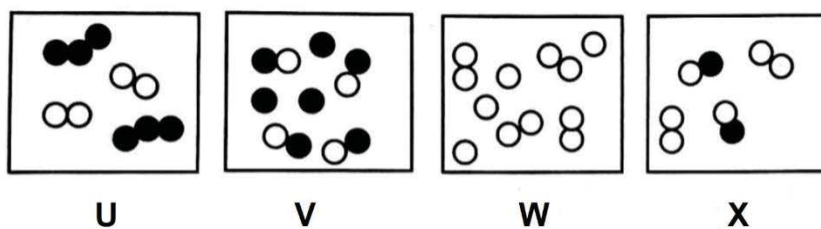


- 2 A technician was analysing some waste water from an industrial plant. He collected 500 cm³ of the water and separated it into two 250 cm³ samples. He filtered the first sample and evaporated the water from the other sample. He weighed the dried solid residue from each sample and found that the mass of solid from the filtered sample was 40 g and the mass from the evaporated sample was 55 g.

What was the mass of soluble and insoluble material in 1000 cm³ waste water?

	mass of soluble material in 1000 cm ³ waste water / g	mass of insoluble material in 1000 cm ³ waste water / g
A	15	40
B	30	80
C	60	160
D	60	220

- 3 Diagrams U, V, W and X represent containers of gas.



Key:
Atom of element Y ○
Atom of element Z ●

Which diagram(s) can be used to illustrate a mixture of allotropes?

- A U only
B W only
C U and W
D V and X

- 4 Five students each dissolved an indigestion tablet in 100 cm³ of water. They then titrated 25.0 cm³ of their solutions with dilute hydrochloric acid, using the same indicator.

The results are tabulated as shown.

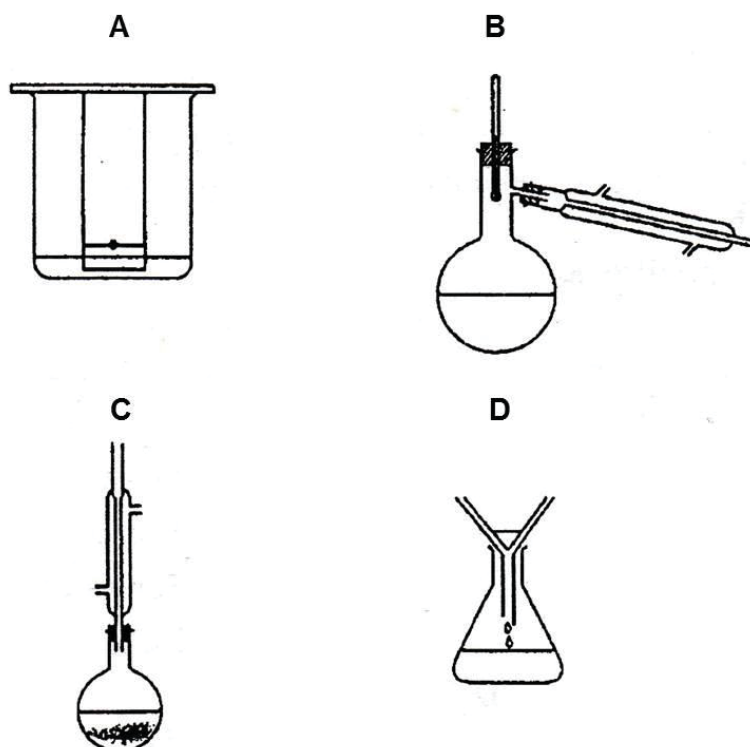
student	1	2	3	4	5
titration value / cm ³	21.15	21.10	21.20	21.10	23.00

Which statement could explain the result obtained by student 5?

- A** The burette was washed out with hydrochloric acid.
B The pipette was washed out with the tablet solution.
C The titration flask was washed out with the tablet solution.
D The student measured to the top of the meniscus in the pipette.
- 5 Compound **X** has the following properties:

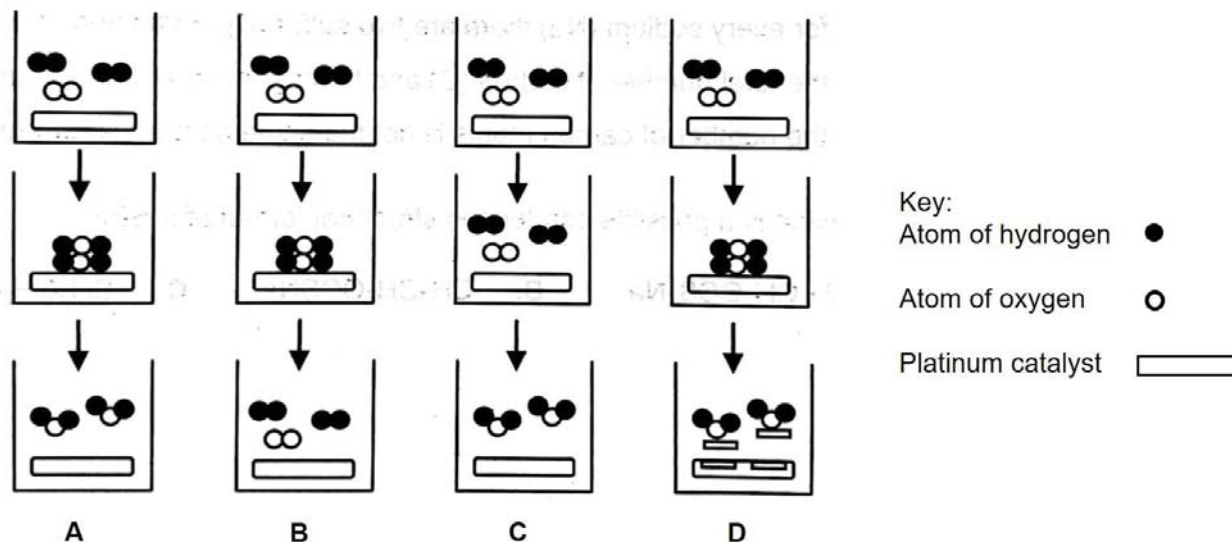
melting point / °C	86
boiling point / °C	149
solubility in 100 cm ³ water / g	0.00017

Which apparatus can be used to separate pure **X** from a mixture of **X** and water?

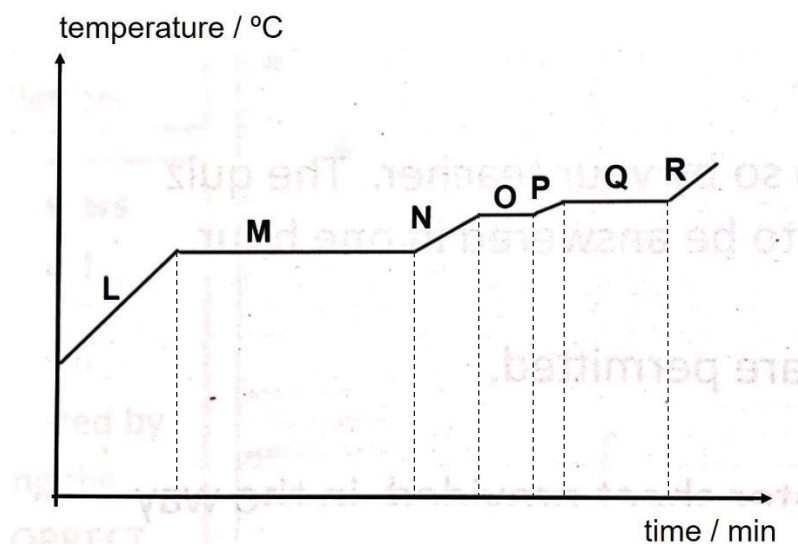


- 6 A catalyst is a substance that can be used to speed up a reaction. An example of a catalysed reaction is the formation of water from hydrogen, H_2 , and oxygen, O_2 , gases using powdered platinum catalyst.

Which sequence of diagrams best represents the catalysed reaction between hydrogen and oxygen?



- 7 Liquid air can be separated into its three main components by fractional distillation. These three components boil at either -196°C , -186°C or -183°C . The graph shows the temperature of a liquid air mixture as it is heated.



Which of the following correctly states the temperature in section **P** of the graph?

- A above -183°C B below -196°C
 C between -196°C and -186°C D between -186°C and -183°C

8 **M** and **N** have the following compositions:

	number of protons	number of neutrons	number of electrons
M	11	11	10
N	8	8	10

Which of the following is true?

- A** **M** and **N** are cations.
B **M** and **N** are elements from Group 0.
C The formula of the compound formed between **M** and **N** is **M₂N**.
D The compound formed from **M** and **N** is soluble in organic solvent.

9 Nihonium is a newly discovered element with an atomic number of 113. It has the chemical symbol, Nh. One possible isotope of nihonium is Nh-286, which has a mass number of 286. How many neutrons are there in Nh-286?

- A** 113 **B** 173
C 286 **D** 399

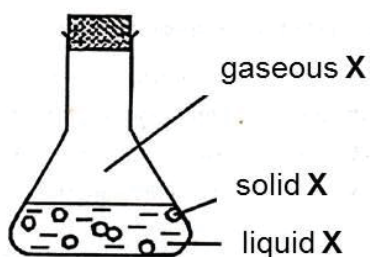
10 Silane (SiH_4) is a substance containing one silicon atom and four hydrogen atoms. It has a boiling point of $-112\text{ }^\circ\text{C}$. What can be deduced from this information?

- A** Silane has a giant molecular structure.
B Silane has a simple molecular structure.
C Silicon is a metal that forms an ionic bond with hydrogen.
D Silicon will always form an insoluble compound since silicon is insoluble.

11 Which statement explains why potassium chloride, KCl , has a lower melting point than calcium oxide, CaO ?

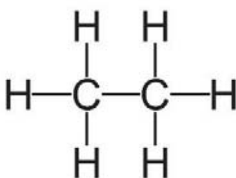
- A** Potassium is more reactive than calcium.
B The melting point of potassium is lower than calcium.
C Potassium chloride is covalent but calcium oxide is ionic.
D The forces of attraction between K^+ and Cl^- is weaker than that between Ca^{2+} and O^{2-} .

- 12 The conical flask contains compound **X** which is present in the solid, liquid and gaseous states.



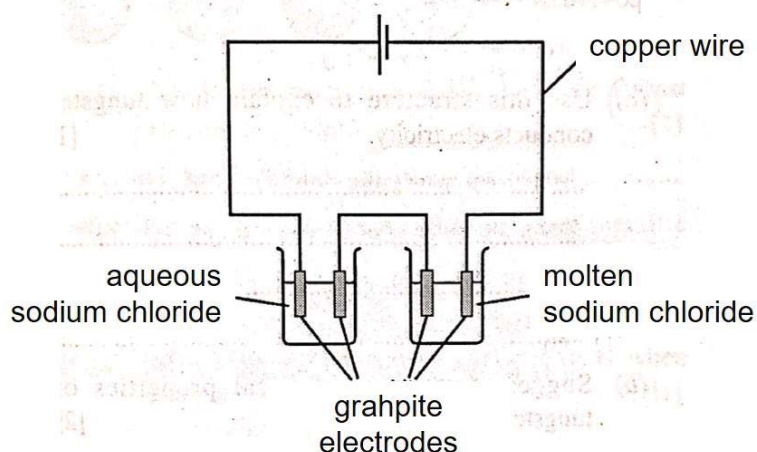
Which statement is correct?

- A Liquid **X** is at a higher temperature than solid **X**.
 - B Liquid **X** molecules vibrate about their fixed positions.
 - C A gaseous **X** molecule has a lower mass than a liquid **X** molecule.
 - D Some molecules of liquid **X** gain sufficient energy to move to the gaseous phase.
- 13 Ethane has the structure shown.



How many electrons in a molecule of ethane, C_2H_6 , are **not** involved in bonding?

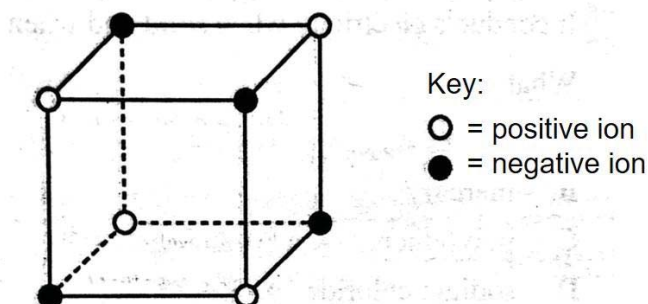
- A 0
 - B 2
 - C 4
 - D 8
- 14 The diagram shows the electrolysis of aqueous sodium chloride and of molten sodium chloride.



Which labelled component contains both positive ions and mobile electrons?

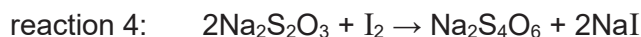
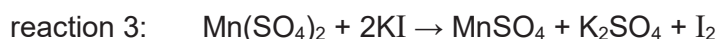
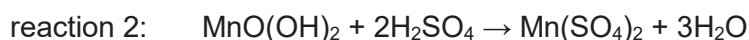
- A aqueous sodium chloride
- B copper wire
- C graphite electrodes
- D molten sodium chloride

- 15 The diagram shows the arrangement of the ions in an ionic crystal.



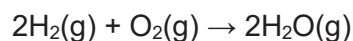
Which compound **cannot** have this arrangement of ions?

- A calcium chloride, CaCl_2
 B copper(I) nitrate, CuNO_3
 C sodium chloride, NaCl
 D zinc sulfate, ZnSO_4
- 16 A sudden decline in the amount of dissolved oxygen in water can cause mass fish deaths. A normal river usually contains about 0.008 g/dm^3 of dissolved oxygen. Most species of fish cannot survive if the oxygen level drops to about 0.003 g/dm^3 . To measure the amount of dissolved oxygen in a water sample, a series of chemical reactions is used. These reactions can be summarised in the following chemical equations.



In reaction 4, the amount of $\text{Na}_2\text{S}_2\text{O}_3$ required to react with all of the iodine, I_2 is carefully measured. What is the ratio of the amount of $\text{Na}_2\text{S}_2\text{O}_3$ used in reaction 4 to the amount of O_2 present in reaction 1?

- A 1:1
 B 2:1
 C 3:1
 D 4:1
- 17 The reaction between hydrogen gas and oxygen gas produces water as represented by the following chemical equation.



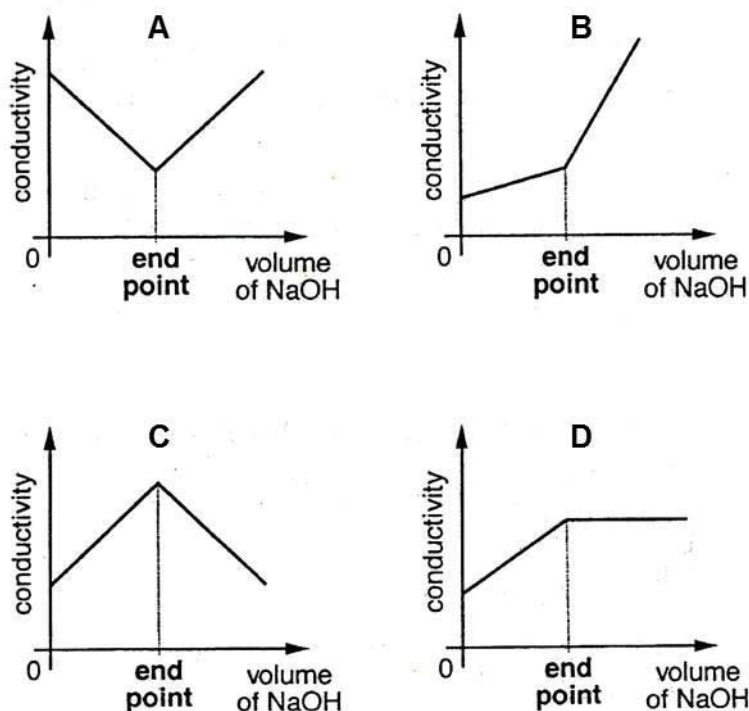
500 hydrogen molecules are mixed with 1000 oxygen molecules in a sealed container and ignited. What is the total number of molecules in the container after the reaction?

- A 500
 B 750
 C 1000
 D 1250

- 18** How much sulfuric acid is required to exactly neutralise 25.0 cm³ of 1.0 mol/dm³ sodium hydroxide solution?
- A** 5.0 cm³ of 2.0 mol/dm³ sulfuric acid
B 5.0 cm³ of 2.5 mol/dm³ sulfuric acid
C 10.0 cm³ of 1.5 mol/dm³ sulfuric acid
D 12.5 cm³ of 2.0 mol/dm³ sulfuric acid
- 19** Which salt is best prepared by a method using precipitation?
- A** copper(II) sulfate **B** lead(II) sulfate
C potassium carbonate **D** sodium nitrate
- 20** All ammonium salts on heating with aqueous sodium hydroxide produce ammonia gas. From which ammonium salt can the greatest mass of ammonia be obtained?
- A** 0.5 mol (NH₄)₃PO₄ **B** 0.5 mol (NH₄)₂SO₄
C 1.0 mol NH₄Cl **D** 1.0 mol NH₄NO₃
- 21** Some dry crystals of citric acid are placed on a piece of dry blue litmus paper. What observation can be made?
- A** Litmus paper turned red.
B Litmus paper was bleached.
C Litmus paper remained unchanged.
D Litmus paper turned red then bleached.
- 22** Aqueous ammonia is added to a solution of a salt. A white precipitate is formed which dissolves in an excess of aqueous ammonia. Which metal ion could the salt contain?
- A** Al³⁺ **B** Ca²⁺
C Cu²⁺ **D** Zn²⁺
- 23** Phosphine, PH₃, is a gas which behaves like ammonia. What ions would be produced when phosphine dissolves in water?
- A** PH₃⁺, H⁺ **B** PH₄⁺, H⁺
C PH₃⁺, OH⁻ **D** PH₄⁺, OH⁻

- 28** Aqueous sodium hydroxide is a strong alkali while ethanoic acid is a weak acid. The reaction between aqueous sodium hydroxide and ethanoic acid causes a change in electrical conductivity of the mixture.

Which graph shows the change in electrical conductivity when aqueous sodium hydroxide is added slowly to ethanoic acid until the alkali is present in excess?



- 29** What is the most abundant noble gas in the Earth's atmosphere?

A argon
C krypton

B helium

D xenon

- 30** Which atmospheric pollutants, emitted by internal combustion engines, are reacted together to convert them to less harmful products?

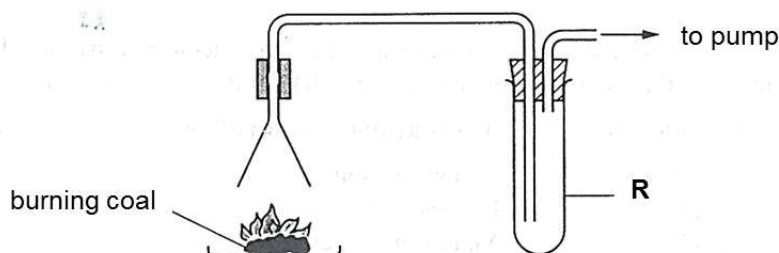
A carbon monoxide and nitrogen dioxide
B carbon monoxide and unburnt hydrocarbons
C nitrogen dioxide and sulfur dioxide
D sulfur dioxide and unburnt hydrocarbons

- 31** Which reaction does **not** involve oxidation and/or reduction?

A $2\text{SO}_2 + \text{O}_2 \rightarrow 2\text{SO}_3$
C $\text{CuO} + \text{H}_2 \rightarrow \text{Cu} + \text{H}_2\text{O}$

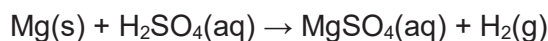
B $\text{Ba}^{2+} + \text{SO}_4^{2-} \rightarrow \text{BaSO}_4$
D $\text{Mg} \rightarrow \text{Mg}^{2+} + 2\text{e}^-$

- 32 The diagram shows the apparatus used to test the gases produced by burning coal.

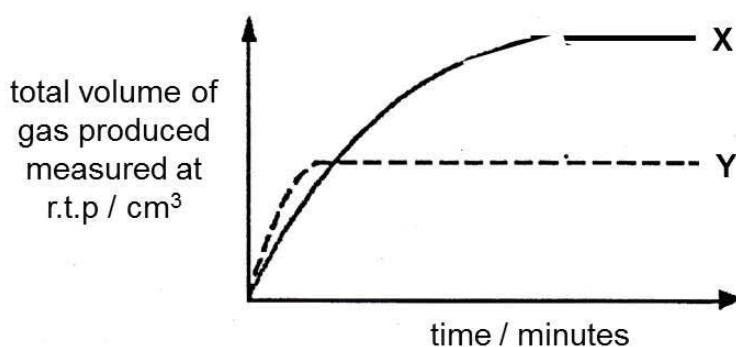


Which solution is placed in the tube **R** to show that sulfur dioxide is formed?

- | | |
|-------------------------------------|---|
| A acidified potassium iodide | B acidified potassium manganate(VII) |
| C calcium chloride | D limewater |
- 33 In which reaction is the pressure least likely to affect the rate of reaction?
- A** $\text{C(s)} + \text{CO}_2\text{(g)} \rightarrow 2\text{CO(g)}$
B $2\text{SO}_2\text{(g)} + \text{O}_2\text{(g)} \rightarrow 2\text{SO}_3\text{(g)}$
C $\text{NH}_3\text{(g)} + \text{HCl(g)} \rightleftharpoons \text{NH}_4\text{Cl(s)}$
D $\text{NaOH(aq)} + \text{HCl(aq)} \rightarrow \text{NaCl(aq)} + \text{H}_2\text{O(l)}$
- 34 The reaction between magnesium and sulfuric acid can be represented by the following chemical equation:

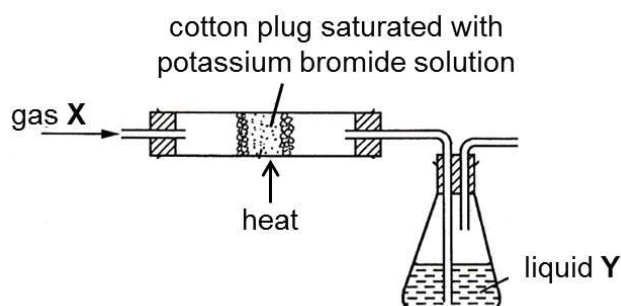


In the graph below, curve **X** represents the result of the reaction between 2.4 g of magnesium ribbon and 50 cm³ of 1 mol/dm³ sulfuric acid at 50°C. Which reaction mixture below could produce curve **Y** at 50°C?



- A** 1.2 g of magnesium powder and 50 cm³ of 1 mol/dm³ sulfuric acid
B 1.2 g of magnesium ribbon and 50 cm³ of 1 mol/dm³ sulfuric acid
C 2.4 g of magnesium powder and 12.5 cm³ of 2 mol/dm³ sulfuric acid
D 2.4 g of magnesium ribbon and 25 cm³ of 2 mol/dm³ sulfuric acid

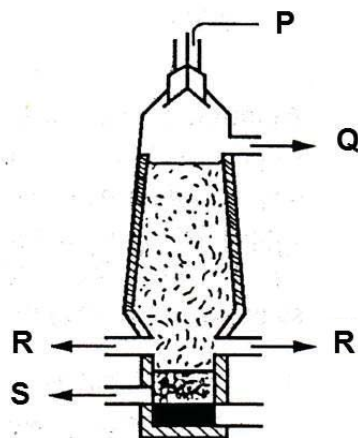
- 35 Using the apparatus shown below, gas **X** was passed through the tube containing a cotton plug saturated with potassium bromide solution. A gaseous product was produced when the tube was warmed gently. The gas leaving the tube was bubbled into liquid **Y**. Liquid **Y** turned brown eventually.



What could likely be gas **X** and liquid **Y**?

	gas X	liquid Y
A	chlorine	aqueous hydrochloric acid
B	chlorine	aqueous iodine
C	fluorine	aqueous iron(III) sulfate
D	fluorine	aqueous potassium iodide

- 36 The diagram of a blast furnace is as shown.

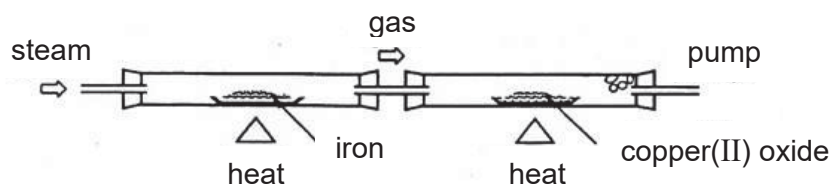


Which one of the following statements is **incorrect**?

- A** Slag is tapped off at **S**.
 - B** Hot air is blown out through **R**.
 - C** Iron ore, coke and limestone are fed in at **P**.
 - D** **Q** consists of a mixture of gases, mainly carbon dioxide.
- 37 In an electrolysis experiment, the same amount of charge deposited 16 g of copper and 70 g of cerium. Cerium has a relative atomic mass of 140. What was the charge on the cerium ion?

- A** Ce^+
- B** Ce^{2+}
- C** Ce^{3+}
- D** Ce^{4+}

- 38 Which is **not** a product of the following reaction sequence?

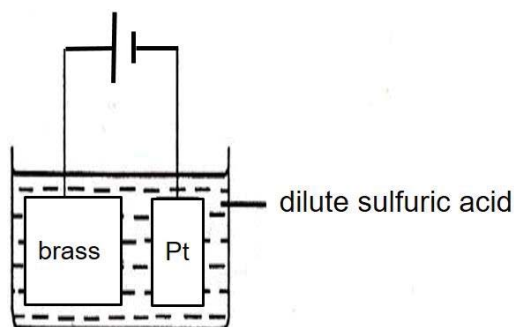


- A copper
B iron(III) oxide
C oxygen
D water vapour
- 39 The table shows the reactions of metals, **A**, **B**, **C** and **D** when placed in aqueous solutions of their nitrates.

metal	nitrate of A	nitrate of B	nitrate of C	nitrate of D
A	-	reacts	reacts	reacts
B	no reaction	-	reacts	no reaction
C	no reaction	no reaction	-	no reaction
D	no reaction	reacts	reacts	-

If a mixture of nitrates of **A**, **B**, **C** and **D** are electrolysed using carbon electrodes, which metal ion would be most readily discharged at the cathode?

- 40 Brass is an alloy of copper and zinc. The diagram shows an electrolysis set-up of dilute sulfuric acid using an anode of brass and a cathode of platinum.



Which pair of electrode reactions would be expected to occur initially?

	anode	cathode
A	copper dissolves before zinc	hydrogen gas is released
B	copper dissolves before zinc	copper is deposited
C	zinc dissolves before copper	hydrogen gas is released
D	zinc and copper dissolve at the same time	copper is deposited

The Periodic Table of Elements

Group																	
I	II	Key										III	IV	V	VI	VII	0
proton (atomic) number atomic symbol name relative atomic mass																	
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 -	113 Nh nihonium -	114 Fl flerovium -	115 Lv livermorium -	116 Lv livermorium -	117 Ts tennessine -	118 Og oganesson -
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.).



Pasir Ris Secondary School

Name	Class	Register No.
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SECONDARY 4 EXPRESS PRELIMINARY EXAMINATION 2020

CHEMISTRY

Paper 2

6092/02

26 Aug 2020

1 h 45 min

Wednesday 1040 – 1225

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

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

Write in dark blue or black pen.

You may use a soft pencil for any diagrams or graphs.

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

Section A

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

Section B

Answer all **three** questions, the last question is in the form either/or.

Answer **all** questions 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 Periodic Table is printed on page 18.

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

For Examiner's Use	
Section A	
B8	
B9	
B10	
Total	

This document consists of **18** printed pages, including the cover page.

[Turn over

Section AAnswer **all** the questions in the spaces provided.

The total mark for this section is 50.

- A1 (a)** Complete Table 1.1 to show the number of protons, electrons and neutrons in the sulfur atom and in the magnesium ion.

Table 1.1

	number of protons	number of electrons	number of neutrons
$^{33}_{16}\text{S}$			
$^{25}_{12}\text{Mg}^{2+}$			

[3]

- (b)** State the electronic configuration of the magnesium ion.

..... [1]

[Total: 4]

- A2** Consider the following list of substances.

lead	magnesium oxide	zinc sulfate
silver chloride	ammonium sulfate	barium carbonate
sodium hydroxide	iron(II) nitrate	dilute sulfuric acid

Each substance can be used once, more than once or not at all.

Name the substance(s) from the list above which

- (a)** is a salt that is prepared by precipitation.

..... [1]

- (b)** can be used together to prepare a green insoluble solid.

..... [1]

- (c)** can react together to produce a gas that turns moist red litmus paper blue.

..... [1]

- (d)** can react together to form magnesium sulfate.

..... [1]

- (e)** can react together to form a white precipitate that dissolves when one of the substances is added in excess.

..... [1]

[Total: 5]

A3 A student carried out three experiments using zinc and dilute hydrochloric acid.

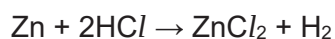


Fig. 3.1 shows the apparatus used in all three experiments. To start off the reaction, the student tipped the flask so that the acid and zinc were mixed together.

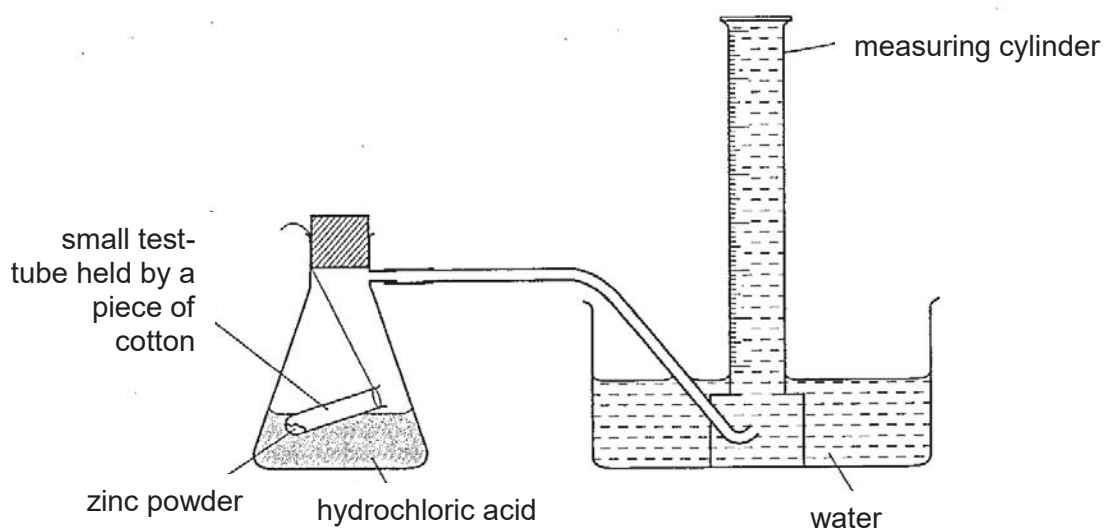


Fig. 3.1

In **experiment 1**, 0.650 g of zinc was added to 50 cm³ of 2.0 mol/dm³ dilute hydrochloric acid.

At every minute, the volume of hydrogen gas collected was measured and the results were plotted on the graph shown in Fig. 3.2.

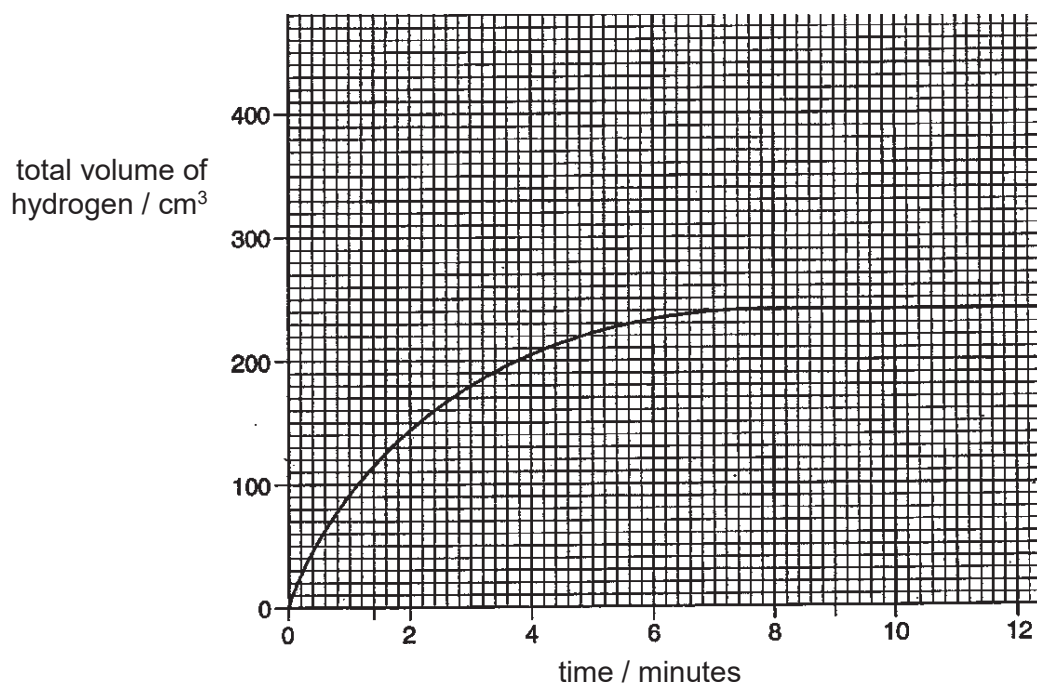


Fig. 3.2

- (a) Which reagent, zinc or hydrochloric acid, was in excess at the end of the reaction?

Explain your answer with suitable calculations.

.....

.....

.....

.....

[3]

- (b) Describe and explain, using ideas about collision theory, how the rate of reaction changes during the experiment.

.....

.....

.....

.....

.....

.....

[3]

- (c) The student carried out two further experiments.

Experiment 2 was similar to **experiment 1**, except that **0.325 g** zinc was used.

Experiment 3 was similar to **experiment 1**, except that **4.0 mol/dm³** of hydrochloric acid was used.

Predict how the rates of reaction and the volume of gas(es) produced for **experiments 2 and 3** would vary in comparison to **experiment 1**.

.....

.....

.....

[2]

[Total: 8]

A4 Hydrogen is an alternative fuel to gasoline (petrol). The combustion of hydrogen in vehicles provides energy for vehicles.

(a) Write a balanced chemical equation for the combustion of hydrogen.

..... [1]

(b) Use the bond energies in Table 4.1 below to calculate the energy change for this reaction.

Table 4.1

bond	bond energy in kJ/mol
H – H	436
O = O	498
O – H	464

[2]

(c) Suggest why the bond energy of O = O is higher than the bond energies of H – H or O – H.

.....

..... [1]

(d) Explain, in terms of the energies involved in bond breaking and bond forming, why hydrogen can be used as a fuel.

.....

.....

.....

..... [2]

(e) Complete the energy profile diagram in Fig. 4.2 for the combustion of hydrogen.

Your diagram should include

- the formula of the reactant(s) and product(s) of the reaction,
- a label for the enthalpy change and activation energy of the reaction.

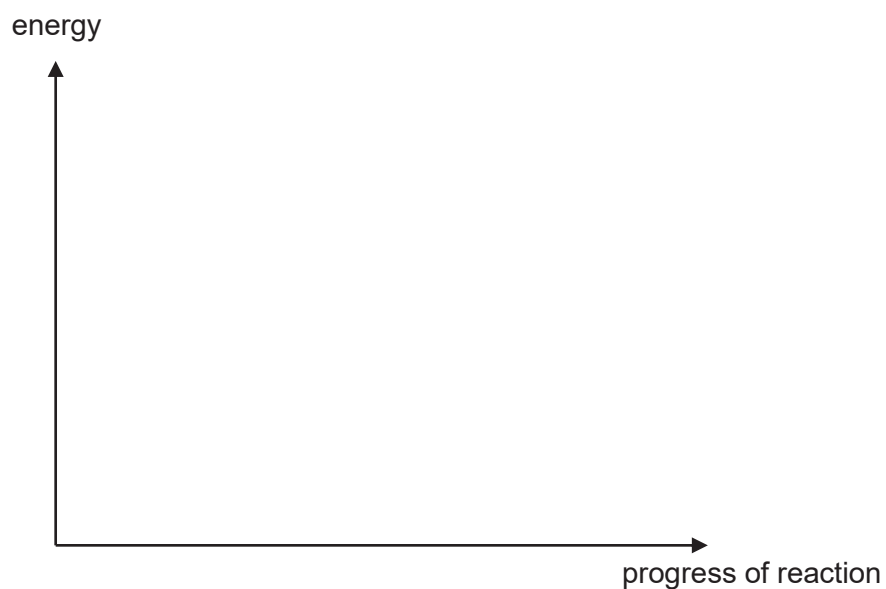
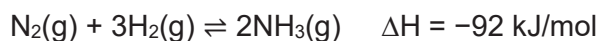


Fig. 4.2

[3]

[Total: 9]

- A5** Fritz Haber was a German chemist who received the Nobel Prize in Chemistry in 1918 for his invention of the Haber process. In this process, nitrogen and hydrogen gases are reacted together at 450 °C and 200 atm, as shown in the following equation.



- (a) Nitrogen and hydrogen gases are the reactants for this process. Give the source of each reactant.

.....

..... [2]

The graphs in Fig. 5.1 show the percentage yields of the Haber process under different conditions of pressure and temperature used in the industries.

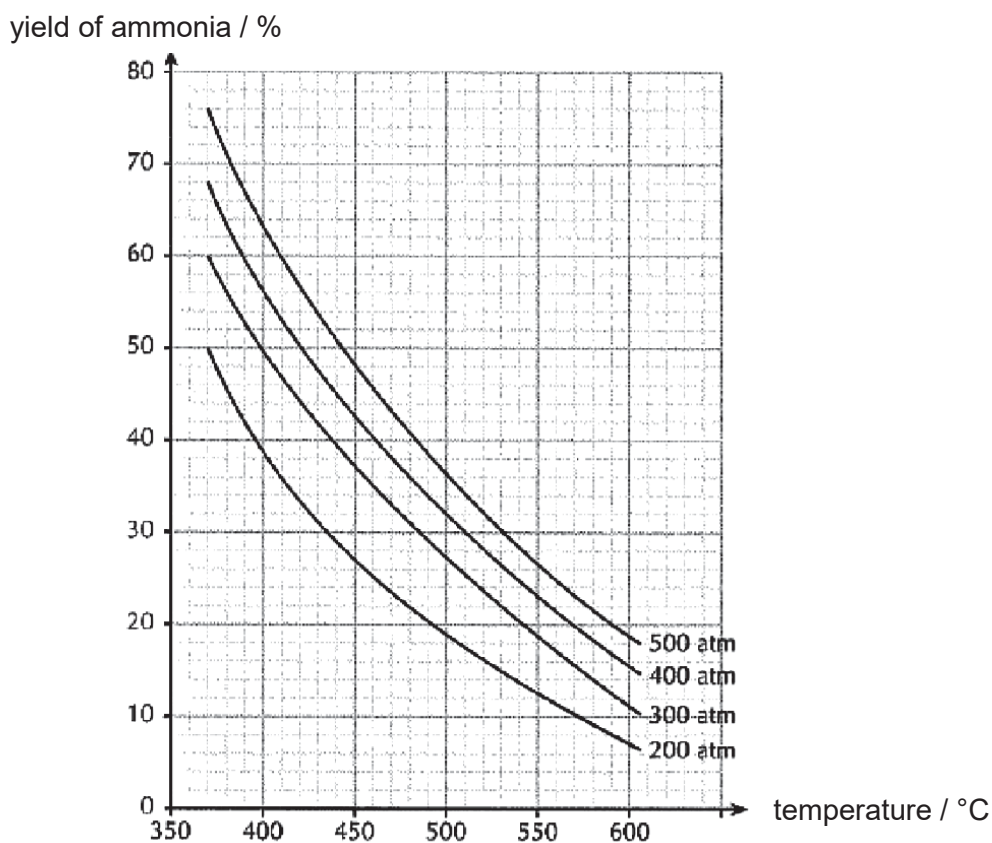


Fig. 5.1

- (b) (i) 140 g of nitrogen is mixed with 30 g of hydrogen at 450 °C and 200 atm. With reference to Fig. 5.1, calculate the mass of ammonia formed.

[3]

- (ii) Sketch a graph in Fig. 5.2 to show how the percentage yield of ammonia formed varies with time.



Fig. 5.2

[1]

- (iii) In Fig. 5.1, a higher yield of ammonia can be achieved with a pressure of 500 atm. Suggest why this pressure is **not** used in the industry.

.....

..... [1]

- (iv) The graphs seem to indicate that the minimum temperature used in the industry is 370 °C. Suggest why a lower temperature is **not** used.

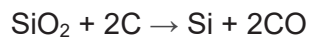
.....

..... [1]

[Total: 8]

A6 Silicon is a metalloid found in Group IV of the Periodic Table.

- (a) Silicon is extracted from silicon dioxide by reacting it with carbon.



Explain why this reaction is a redox reaction.

..... [2]

.....

.....

- (b) Silicon dioxide has a giant molecular structure. Suggest **two** physical properties of silicon dioxide.

..... [2]

.....

- (c) Silane is a molecular compound made up of hydrogen and silicon atoms only.

- (i) Draw the 'dot-and-cross' diagram for silane. You only need to show the outer shell electrons.

- [2]
- (ii) Using ideas about structure and bonding, suggest why silane has a low boiling point.

..... [2]

.....

.....

[Total: 8]

A7 Three important processes in the carbon cycle are combustion, respiration and photosynthesis.

(a) Write a balanced chemical equation for the complete combustion of methane, CH₄.

..... [1]

(b) (i) Describe how the processes in the carbon cycle regulate the amount of carbon dioxide in the atmosphere.

.....

..... [2]

(ii) Carbon dioxide is a greenhouse gas. What do you understand by the term *greenhouse gas*?

.....
 [1]

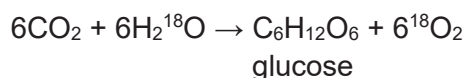
(iii) Methane is also a greenhouse gas. Give one source of methane in the atmosphere.

.....
 [1]

(iv) The percentage of methane by volume in the air is 0.00014 %. Calculate the mass of methane in 1000 dm³ of air.

[2]

(c) Plants use water in photosynthesis. Water containing the radioactive isotope ¹⁸O is fed to a plant. The resulting radioactivity in the products of photosynthesis is shown in the following equation.



What does this tell you about the origin of the oxygen in each of the products?

..... [1]

[Total: 8]

Section B

Answer all **three** questions from this section.

The last question is in the form of an either/or and only one of the alternatives should be attempted.

The total mark for this section is 30.

- B8** Bromine is an important industrial chemical used for making flame retardants and water disinfectant. Bromine is usually extracted from sea water, which is naturally rich in bromide ions in the form of sodium bromide. Chlorine can be bubbled into the sea water to convert bromide ions into bromine.

A student carried out an experiment in a laboratory to investigate the reaction between bromide ions and chlorine gas. She bubbled chlorine gas through dilute potassium bromide solution for 6 minutes. She took samples of the reaction mixture every 30 seconds and measured the colour intensity of each sample using a colorimeter.

A colorimeter measures light absorbed when the light passes through a coloured solution. Fig. 8.1 shows how a colorimeter works.

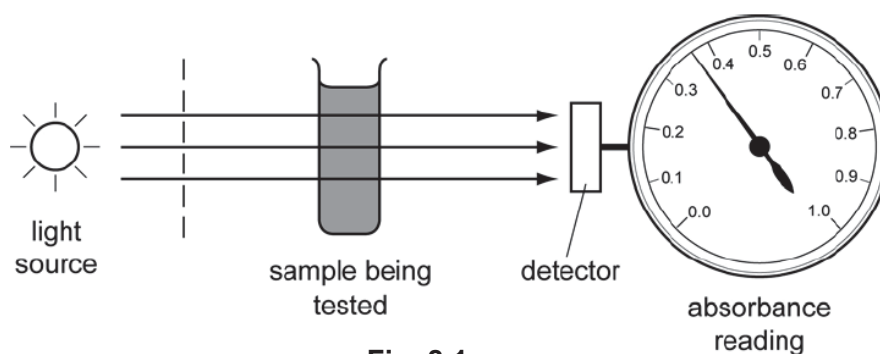


Fig. 8.1

The darker the colour of the solution, the more light is absorbed and the higher the absorbance reading on the colorimeter. The student plotted her results in the graph as shown in Fig. 8.2.

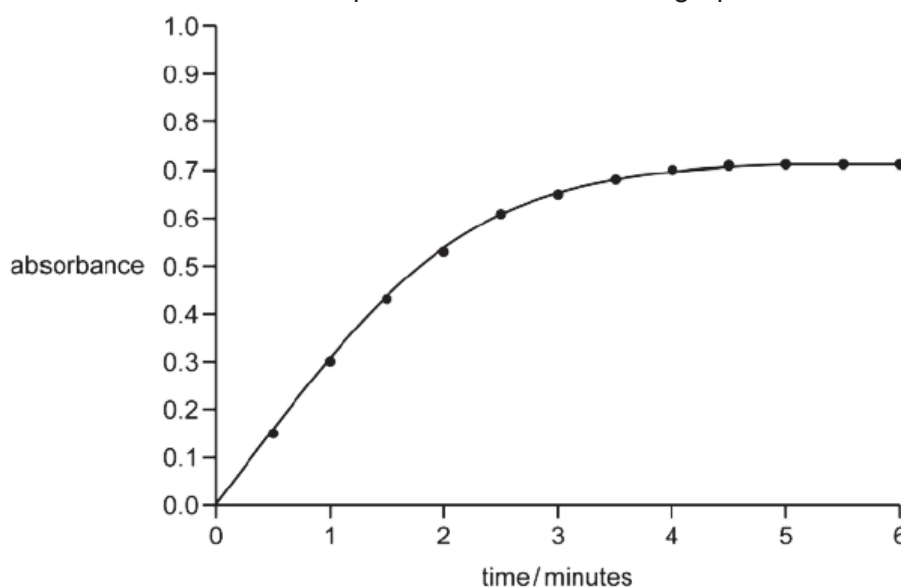


Fig. 8.2

- (a) Explain why chlorine bubbled into sea water can convert bromide ions into bromine.

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

- (b) Write an ionic equation for the reaction between chlorine gas and aqueous sodium bromide.

..... [2]

- (c) (i) Describe the colour change that the student will observe when chlorine gas is bubbled into aqueous sodium bromide.

..... [1]

- (ii) Hence, explain why aqueous bromine has a high absorbance value but aqueous chlorine has a low absorbance value.

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

- (d) With reference to Fig. 8.2, describe how the value of absorbance changes with time during the 6 minutes.

.....
.....
.....
.....
..... [3]

[Total: 10]

B9 Nitrogenous fertilisers are soluble salts used to increase crop yield. Two commonly used nitrogenous fertilisers are ammonium chloride and ammonium phosphate.

- (a) Which fertiliser, ammonium chloride or ammonium phosphate, contains a greater percentage mass of nitrogen? Explain your answer with suitable calculations.

[2]

- (b) Ammonium chloride can be prepared by reacting aqueous ammonia with dilute hydrochloric acid. Write an ionic equation for this reaction.

[1]

- (c) Ammonium phosphate can be prepared by reacting dilute phosphoric acid and aqueous ammonia. Phosphoric acid is a weak acid.

- (i) Describe the difference between strong and weak acids.

[2]

- (ii) Describe a chemical test to distinguish the strong acid and the weak acid.

[2]

- (iii) Suggest the chemical formula of a possible 'acid salt' formed in the reaction between dilute phosphoric acid and aqueous ammonia.

[1]

- (d) Suggest why slaked lime should **not** be added to soil together with ammonium fertilisers such as ammonium chloride. Use an equation to support your answer.

.....

.....

.....

..... [2]

[Total: 10]

EITHER

B10 Iron is extracted in a blast furnace using haematite, coke and limestone. During the extraction, waste products are formed.

- (a) (i) Name **two** main waste products of this process and write equations to show their formations.

.....

.....

..... [3]

- (ii) Calcium **cannot** be extracted from its metal ore using the same method as iron. Suggest a suitable method of extraction and explain your answer.

.....

.....

.....

..... [2]

- (b) When underwater, iron pipes will rust relatively rapidly.

- (i) State the essential conditions needed for the rusting of iron.

..... [1]

- (ii) Pieces of magnesium are often attached to underwater iron pipes. Explain how the magnesium protects the iron pipes against rusting.

.....

.....

[2]

- (iii) Iron pipes in warmer sea water rust much faster than those in colder sea water. Explain why this is so.

.....

.....

[2]

[Total: 10]

OR

- B10** (a) The NASA space shuttle uses fuel cells to generate electricity. Fig. 10.1 shows a hydrogen-oxygen fuel cell.

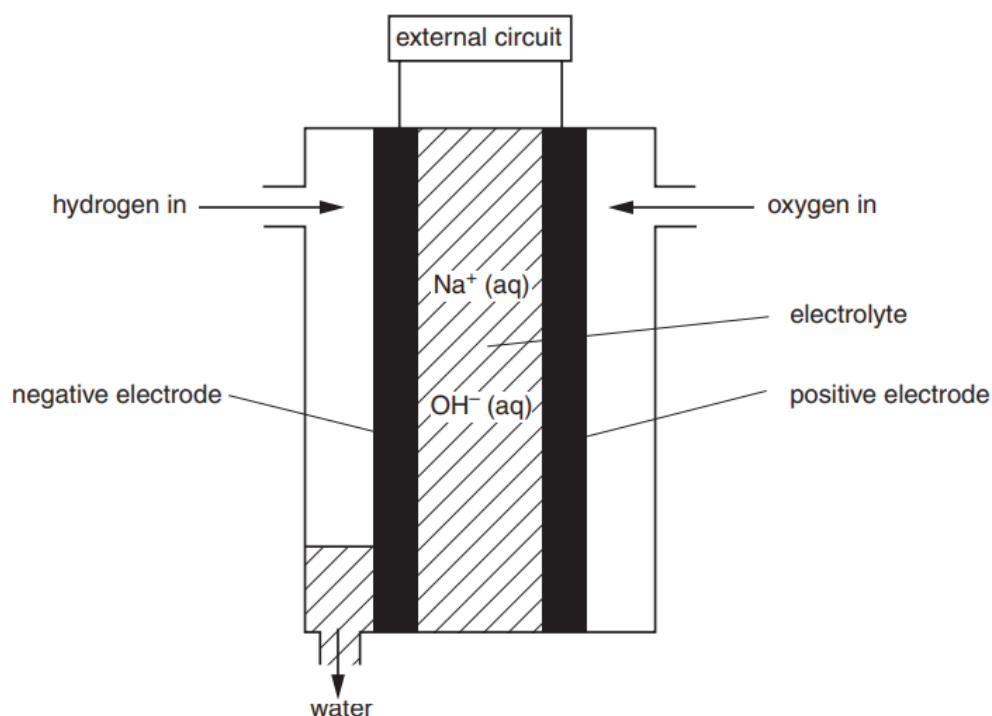
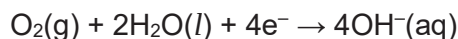
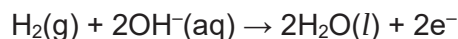


Fig. 10.1

At the positive electrode, oxygen reacts with water as shown.



At the negative electrode, hydrogen reacts with hydroxide ions as shown.



The overall reaction in the fuel cell is the reaction between hydrogen and oxygen to make water.

(i) Give **one** source for oxygen for use in a fuel cell.

..... [1]

(ii) What is the name of the electrolyte used in the fuel cell?

..... [1]

(iii) What type of reaction takes place, reduction or oxidation, at the positive electrode?

Explain your answer in terms of oxidation state.

..... [1]

(iv) Describe **one** advantage and **one** disadvantage of using a fuel cell to generate electricity.

..... [2]

(b) Fig. 10.2 shows a cell that can be used to make electrical energy.

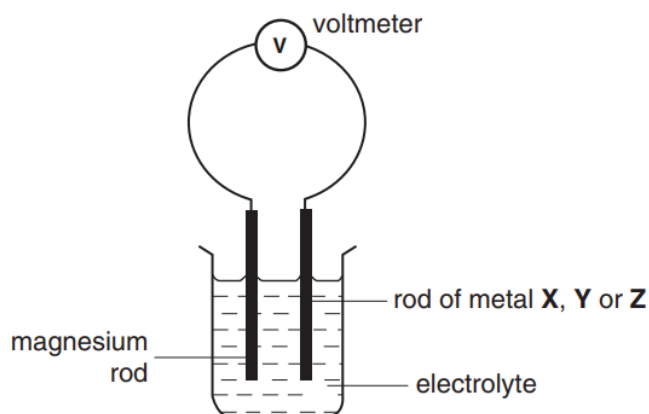


Fig. 10.2

- (i) Explain why distilled water is **not** used as the electrolyte.

.....
 [1]

- (ii) Table 10.3 shows the results when rods of three metals, **X**, **Y** and **Z**, are used in separate experiments. All the metals are less reactive than magnesium.

Table 10.3

rod 1	rod 2	voltmeter reading / V
magnesium	X	2.72
magnesium	Y	0.78
magnesium	Z	1.10

Place the metals in order of reactivity.

most reactive magnesium

.....

least reactive [1]

- (iii) In a separate experiment, a student places a rod of magnesium in aqueous silver nitrate. What would you expect to see after the reaction had been taking place for some time?

Include an **ionic equation** to explain the reaction which happened.

.....

 [3]

[Total: 10]

The Periodic Table of Elements

Group																		
I	II	1 H hydrogen 1										III	IV	V	VI	VII	0	
		Key																
		proton (atomic) number atomic symbol name relative atomic mass																
3 Li lithium 7	4 Be beryllium 9																	
11 Na sodium 23	12 Mg magnesium 24																	
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84	
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131	
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids		72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium -	85 At astatine -	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 -	118 Ts tennessine -	119 Og oganeson -	120 Nh nihonium -	121 Lr lawrencium -

lanthanoids

actinoids

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

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

