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AHMAD IBRAHIM SECONDARY SCHOOL
GCE-O LEVEL PRELIMINARY EXAMINATION 2020

SECONDARY 4 EXPRESS

Name:	Class:	Register No.:
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CHEMISTRY

6092/01

31 August 2020

1 hour

Additional Materials
Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST:

Do not use staples, paper clips, highlighters, glue or correction fluid.
Write your name, class number and registration number on the Answer Sheet.

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 Answer Sheet provided.

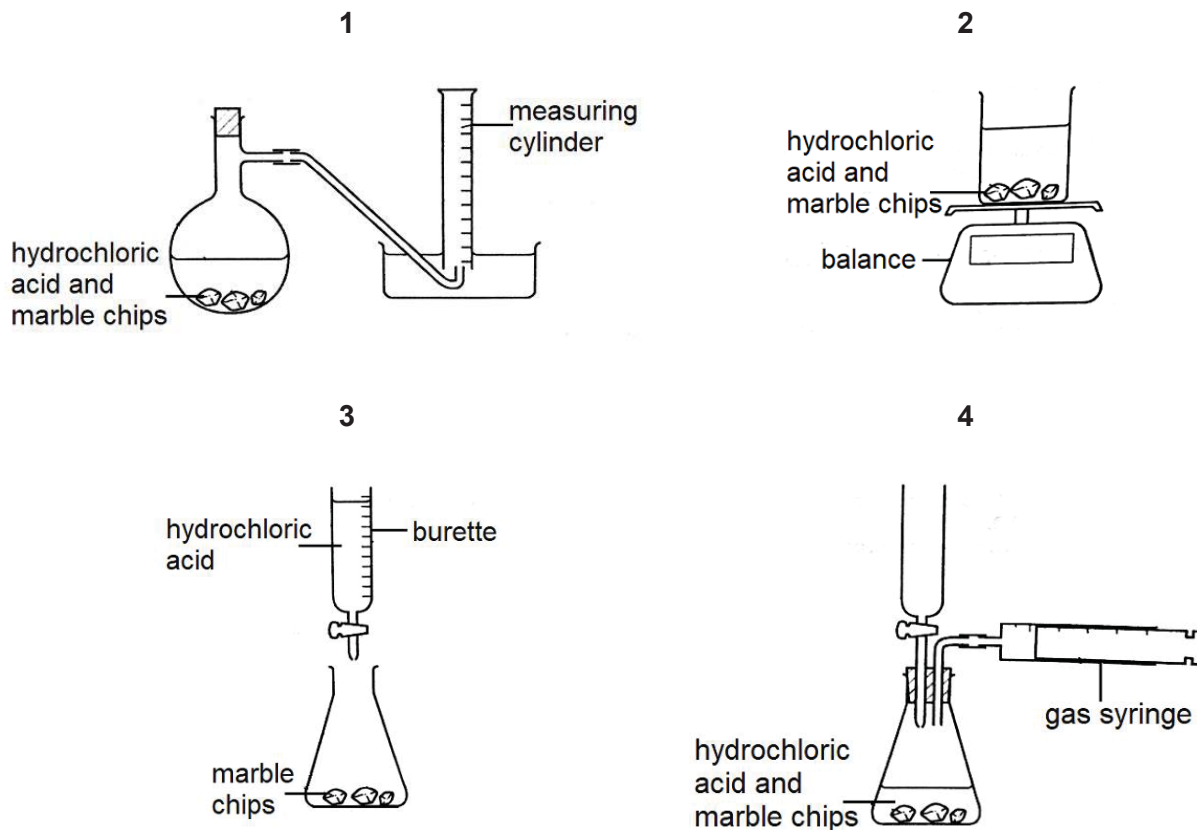
Read the instructions on the answer sheet very carefully.

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

- 1 A student wants to carry out an experiment to study the rate of the reaction between marble chips and hydrochloric acid. A stopwatch is used to measure the time taken.



Which diagrams show apparatus that is suitable for this experiment?

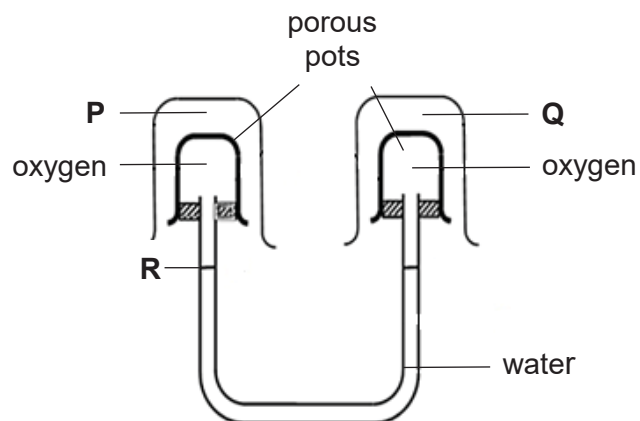


- A** 1 and 2 only
B 1 and 3 only
C 1 and 4 only
D 1, 2 and 4
- 2 Solutions of lead(II) nitrate and potassium iodide are mixed together to form lead(II) iodide.

Which method can be used to separate the lead(II) iodide from the mixture?

- A** crystallisation
B distillation
C evaporation
D filtration

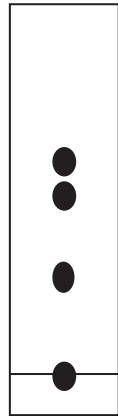
- 3 Which gas is neither an element nor a compound?
- A ammonia
 B chlorine
 C air
 D carbon monoxide
- 4 In which of the following substances are the particles closest together?
- A dry ice
 B hydrogen gas
 C lithium fluoride solution
 D molten iron
- 5 The diagram shown is set up using different gases in different beakers.



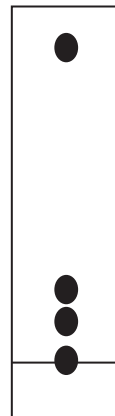
Which gases, when placed in beakers **P** and **Q** respectively, will cause the water level at **R** to fall initially?

	P	Q
A	carbon dioxide	nitrogen
B	argon	nitrogen
C	nitrogen	carbon dioxide
D	nitrogen	hydrogen

- 6 A class was investigating the colour in a flower. The chromatograms from two groups of students are shown below.



chromatogram 1



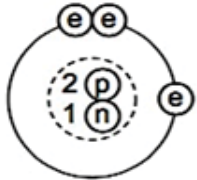
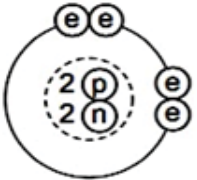
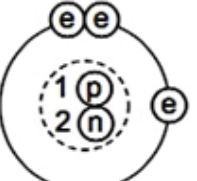
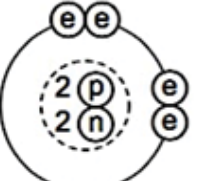
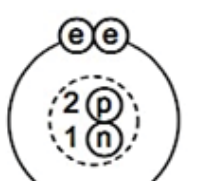
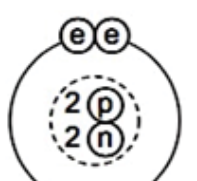
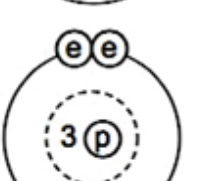
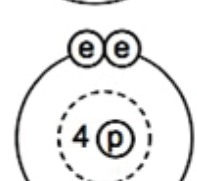
chromatogram 2

If both groups analysed the same flower, why were the chromatograms different?

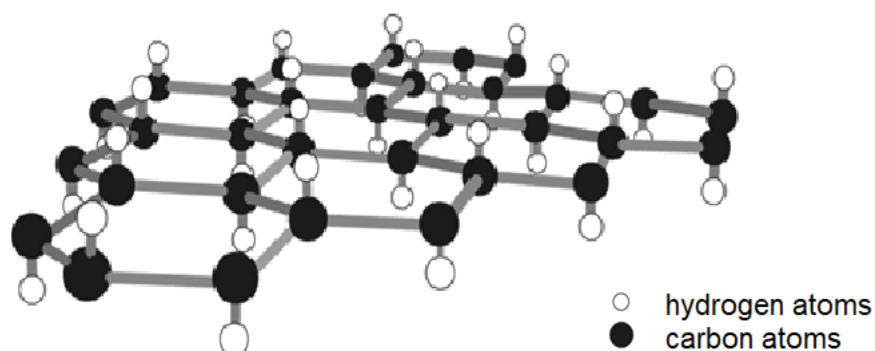
- A One group did not use enough solvent.
- B One group did not use enough of the flower sample.
- C The solvent in chromatogram 1 did not reach the top of the paper.
- D The two groups used different solvents.
- 7 Which statement about the particles ${}^{19}_{9}\text{F}^{-}$, ${}^{20}_{10}\text{Ne}$ and ${}^{23}_{11}\text{Na}^{+}$ is correct?
- A They all contain more electrons than protons.
- B They all contain more neutrons than protons.
- C They all contain the same number of electrons.
- D They all contain the same number of protons.

8 Two isotopes of helium are ${}^3_2\text{He}$ and ${}^4_2\text{He}$.

Which two diagrams show the correct arrangement of particles in these two isotopes?

	${}^3_2\text{He}$	${}^4_2\text{He}$	
A			key e = electron p = proton n = neutron ○ = nucleus
B			
C			
D			

- 9 Graphane has a structure similar to graphite. Graphane, however, has one hydrogen atom attached to each carbon as shown in the diagram.

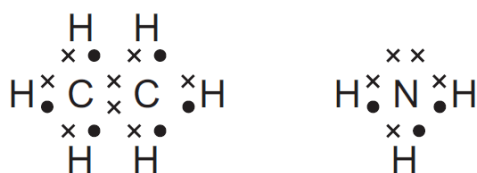


Which set of properties will graphane have?

- 1 It is soluble in water.
- 2 It has a high melting point.
- 3 It has a giant molecular structure.
- 4 It conducts electricity in the solid state.

- A** 1 and 2
B 2 and 3
C 1, 2 and 3
D 1, 2, 3 and 4

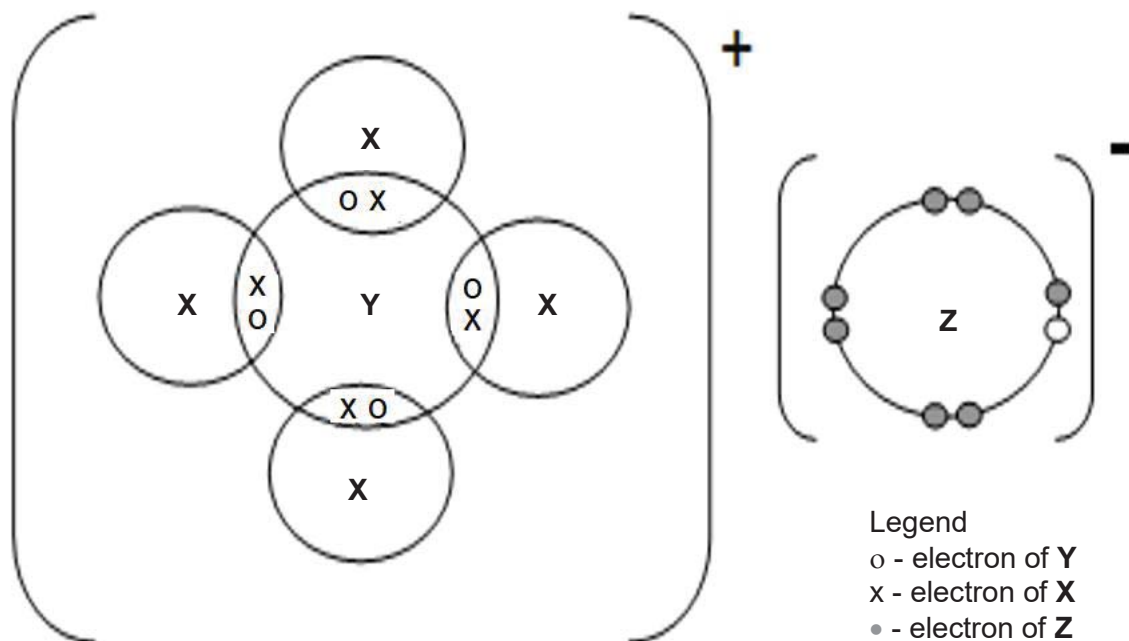
- 10 Ethane, C_2H_6 , and ammonia, NH_3 , are covalent compounds. The 'dot-and-cross' diagrams of these compounds are shown below.



Which statement is incorrect?

- A** A molecule of ethane contains twice as many hydrogen atoms as a molecule of ammonia.
B Nitrogen atom in NH_3 has 3 of its valence electrons with 3 hydrogen atoms.
C There are 6 bonding electrons in a molecule of NH_3 .
D NH_3 can conduct electricity due to a pair of free moving electrons.

- 11 **X**, **Y** and **Z** are three different elements. The 'dot-and-cross' diagram (showing the outermost shells only) of the compound formed by **X**, **Y** and **Z** is shown below.

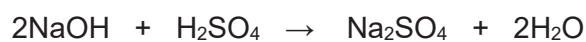


Which of the following statements are correct?

- 1 There is one electron in the outermost shell of an atom of **X**.
- 2 There are five electrons in the outermost shell of an atom of **Y**.
- 3 There are seven electrons in the outermost shell of an atom of **Z**.

- A** 1 and 2 only
B 1 and 3 only
C 2 and 3 only
D all of the above

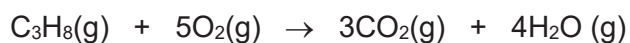
- 12 In a volumetric experiment, 25.0 cm³ of 0.100 mol/dm³ sodium hydroxide reacts exactly with 20.0 cm³ of sulfuric acid.



What is the concentration of the sulfuric acid?

- A** 0.0313 mol/dm³
B 0.0625 mol/dm³
C 0.125 mol/dm³
D 0.250 mol/dm³

- 13 The chemical equation for the complete combustion of propane, C_3H_8 , is shown below.



40 cm³ of propane gas is mixed with 100 cm³ of oxygen gas in a sealed vessel and burnt.

What are the volumes of the gases remaining at room temperature and pressure?

	volume of propane/cm ³	volume of oxygen/cm ³	volume of carbon dioxide/cm ³	volume of steam/cm ³
A	0	0	60	80
B	0	60	120	160
C	20	0	60	80
D	20	60	120	160

- 14 The formulae of some oxides are shown below.



Which row in the table below gives the correct number of each type of oxide?

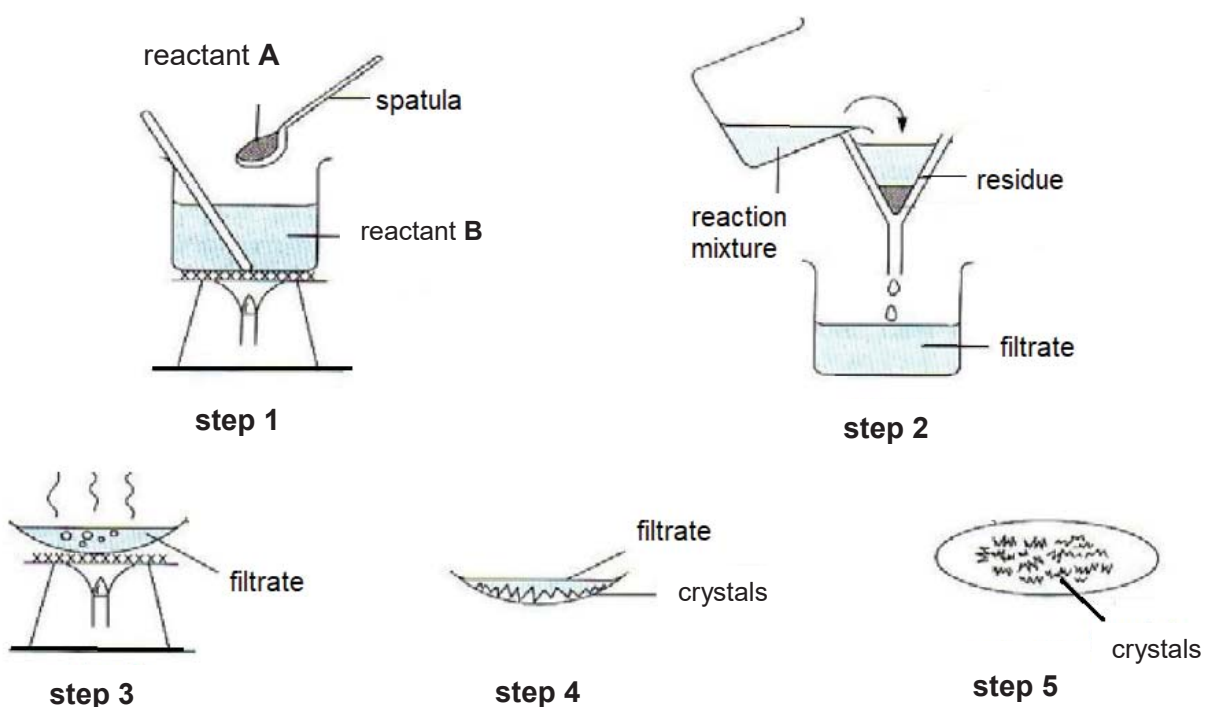
	number of each type of oxide		
	acidic	amphoteric	basic
A	1	2	2
B	2	0	3
C	1	1	3
D	2	1	2

- 17 The labels fell off two bottles each containing a colourless solution, one of which was sodium carbonate solution and the other was sodium chloride solution.

Which of the following tests would allow the identification of the solutions?

- A addition of dilute nitric acid
- B addition of sodium hydroxide solution
- C addition of aqueous ammonia
- D addition of lead(II) nitrate solution

- 18 The diagrams below show the set-up involved in the preparation of a salt.



Which of the following pair of reactants will produce the highest yield of salt shown by the method above?

	reactant A	reactant B
A	sodium oxide	dilute sodium hydroxide
B	magnesium nitrate	sodium carbonate
C	calcium carbonate	dilute nitric acid
D	lead(II) hydroxide	dilute hydrochloric acid

- 19 An analysis of salt **S** gave the following results.

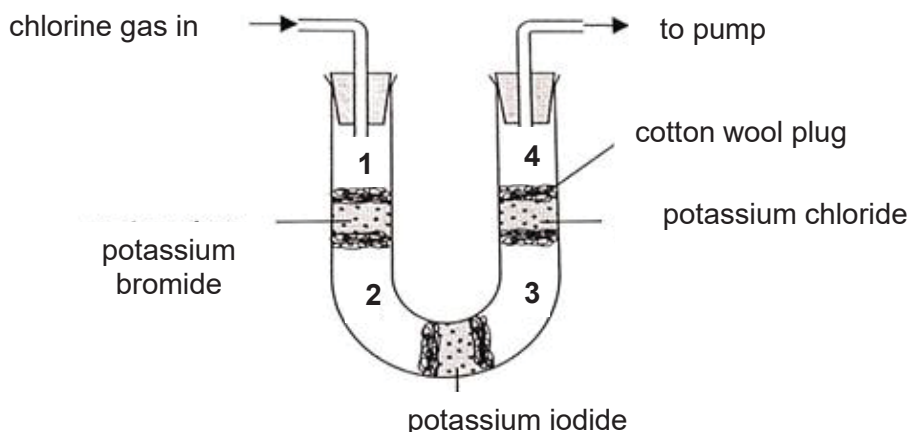
Test 1: When solid **S** was warmed with aqueous sodium hydroxide and aluminium foil, a colourless and pungent gas was produced. The gas turns moist red litmus paper blue.

Test 2: When excess aqueous sodium hydroxide was added to a solution of **S**, a white precipitate was formed.

What could salt **S** be?

- A calcium carbonate
 - B calcium nitrate
 - C zinc carbonate
 - D zinc nitrate
- 20 Which of the following statements correctly describes a trend in the properties of the elements, going from left to right of Period 3 of the Periodic Table?
- A The ability of the elements to conduct electricity increases.
 - B The number of neutrons in the atom increases.
 - C The number of valence electrons decreases in the atoms.
 - D The tendency to gain electrons increases.
- 21 Which of the following statements concerning the element caesium (proton number 55) is **not** consistent with its position in Group I?
- A It is a stronger reducing agent than potassium.
 - B It reacts with chlorine to form an ionic compound.
 - C It has a higher density than sodium.
 - D It has a higher melting point than lithium.

- 22 Chlorine gas was passed through the following apparatus. The apparatus was continuously heated and the observations were recorded.



Which of the following observations would be made at regions 1, 2, 3 and 4?

	region 1	region 2	region 3	region 4
A	red-brown gas	black solid	violet gas	yellow-green gas
B	red-brown gas	violet gas	black solid	black gas
C	yellow-green gas	red-brown gas	violet gas	violet gas
D	yellow-green gas	violet gas	brown gas	yellow-green gas

- 23 Chromium is a transition metal used in flash bulbs. When the filament inside the bulb gets hot, chromium burns with a white light to form a mixture of chromium(II) oxide and chromium(III) oxide. These oxides can react with both acids and bases. Chromium has no reaction with water or steam.

Which statement shows that chromium is a transition metal?

- A** Chromium is unreactive.
- B** Chromium can form two different oxides.
- C** The oxides of chromium are amphoteric.
- D** The oxides of chromium can react with acid to form a salt and water only.

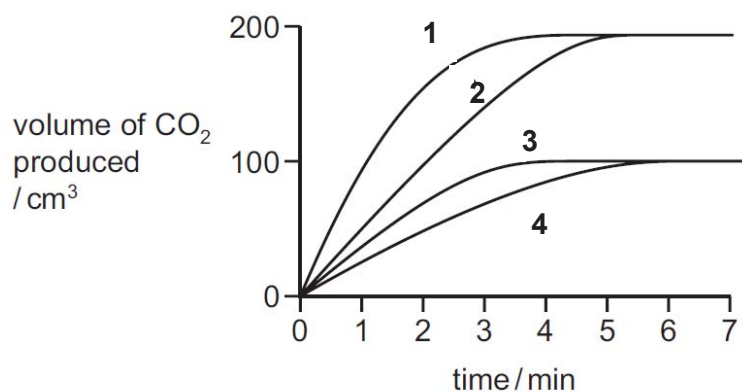
- 24 The formation of liquid water from hydrogen and oxygen may occur in four stages. Which stage would be exothermic?

- A $2\text{H}_2(\text{g}) \rightarrow 4\text{H}(\text{g})$
 B $4\text{H}(\text{g}) + 2\text{O}(\text{g}) \rightarrow 2\text{H}_2\text{O}(\text{g})$
 C $2\text{H}_2\text{O}(\text{l}) \rightarrow 2\text{H}_2\text{O}(\text{g})$
 D $\text{O}_2(\text{g}) \rightarrow 2\text{O}(\text{g})$

- 25 In four separate experiments, **1**, **2**, **3** and **4**, nitric acid was added to excess marble chips and the volume of carbon dioxide formed was measured.

In all four experiments, the same volume of nitric acid was used. Its concentration and temperature of acid were changed.

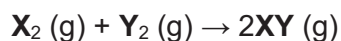
The results of the experiments are shown on the graph.



Which statement is correct?

- A A lower concentration of acid was used in experiment **3** than in experiment **1**.
 B Experiment **4** was faster than experiment **3**.
 C The acid used in experiment **2** was of a lower concentration than in experiment **1**.
 D The temperature of the acid was the same in experiments **1** and **2**.

- 26 **X** and **Y** are two elements which react to form the compound **XY**, as shown below.



Which of the following statements are true?

- 1 Increasing the pressure has no effect on the amount of **XY** obtained.
- 2 Each collision between **X₂** and **Y₂** molecules will result in a reaction to form **XY**.
- 3 A small rise in temperature will lead to more effective collisions between **X₂** and **Y₂** molecules.
- 4 Increasing the concentration of **X₂** alone has no effect on the reaction rate, unless the concentration of **Y₂** is increased as well.

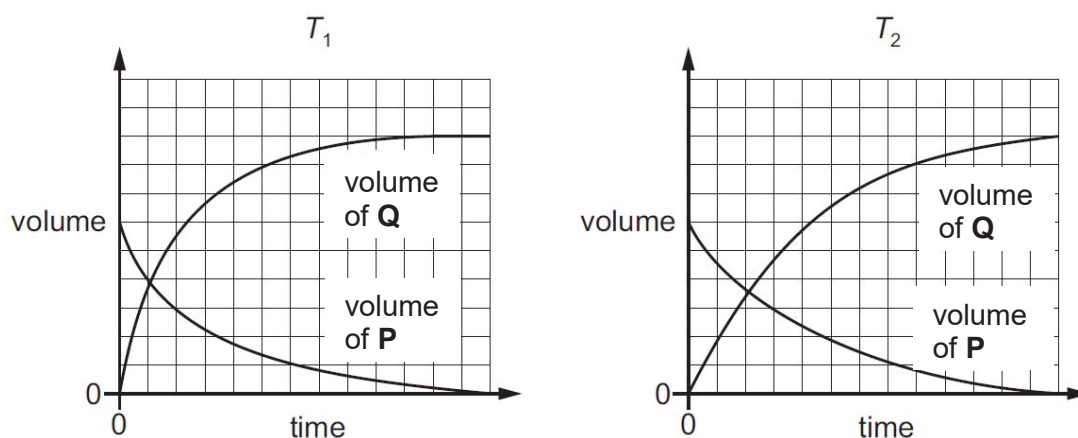
- A** 1 and 2 only
B 1 and 3 only
C 2 and 4 only
D 1, 3 and 4

- 27 Gas **P** decomposes to form gas **Q**.



Two experiments are carried out to investigate the rate of reaction. The conditions are the same except that two different temperatures, T_1 and T_2 , are used.

The results are plotted on graphs, drawn to the same scale.



Which row is correct?

	x	y	temperature
A	2	3	T_1 is higher than T_2
B	2	3	T_2 is higher than T_1
C	3	2	T_1 is higher than T_2
D	3	2	T_2 is higher than T_1

- 28 Methods used to stop iron from rusting include: coating with tin; coating with zinc; connection to magnesium rods.

Which metal is most often used to protect iron in food containers, in oil pipelines and in roofing sheets?

	food containers	oil pipelines	roofing sheets
A	magnesium	tin	zinc
B	tin	zinc	magnesium
C	tin	magnesium	zinc
D	zinc	magnesium	tin

- 29 The table below shows the results of heating the carbonates and nitrates of three metals to the same temperature.

metal	products of decomposition	
	metal carbonate	metal nitrate
W	no change	metal nitrite and oxygen
X	metal oxide and carbon dioxide	metal oxide, nitrogen dioxide and oxygen
Y	no change	metal oxide, nitrogen dioxide and oxygen

What is the order of these metals in the reactivity series likely to be?

	most reactive	→	least reactive
A	W		Y
B	W		X
C	X		W
D	Y		X

30 The position of metal **M** in the reactivity series is shown.

K, Na, **M**, Al, Zn, Fe, Pb, Cu, Ag

Which method will be used to extract **M** from its ore?

- A Electrolysis of its molten oxide.
- B Electrolysis of its aqueous sulfate.
- C Reduction of its oxide by heating with hydrogen.
- D Reduction of its oxide by heating with coke.

31 Three types of steel have different properties.

steel 1 easily shaped

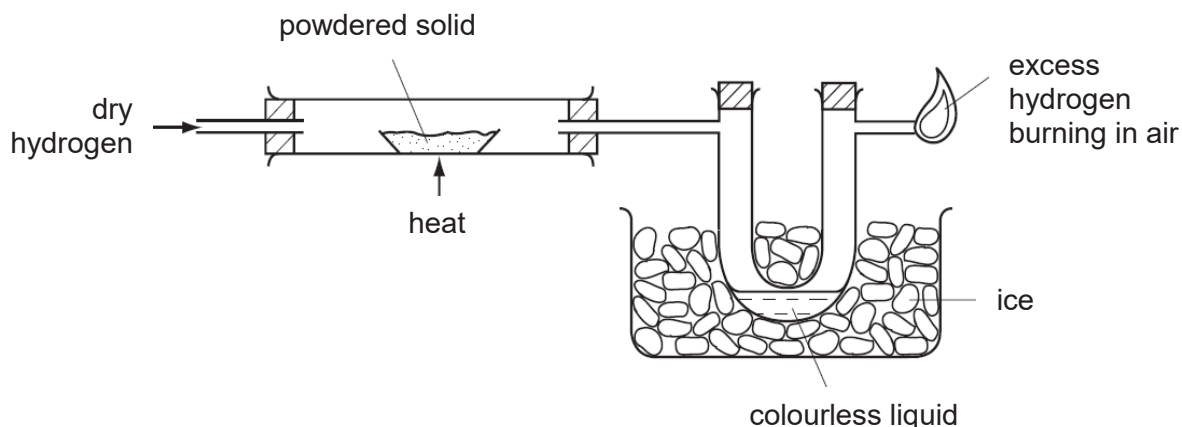
steel 2 brittle

steel 3 resistance to corrosion

What are the names of these three types of steel?

	steel 1	steel 2	steel 3
A	high carbon	mild	stainless
B	high carbon	stainless	mild
C	mild	high carbon	stainless
D	mild	stainless	high carbon

- 32 Dry hydrogen gas is passed over a powdered solid and then through a cooled U-tube before the excess of hydrogen is burned in air.



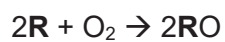
A colourless liquid collects in the U-tube.
What could the powdered solid be?

- | | | | |
|----------|------------------|----------|-----------------|
| A | calcium oxide | B | magnesium oxide |
| C | copper(II) oxide | D | zinc oxide |
- 33 Two statements about metals are given.
- statement 1 Metals contain a lattice of negative ions in a 'sea of electrons'.
- statement 2 The electrical conductivity of metals is related to the mobility of the electrons in the structure.

Which option is correct?

- A** Both statements are correct and statement 1 explains statement 2.
- B** Both statements are correct but statement 1 does not explain statement 2.
- C** Statement 1 is correct and statement 2 is incorrect.
- D** Statement 2 is correct and statement 1 is incorrect.

34 An element **R** reacts in the following ways:

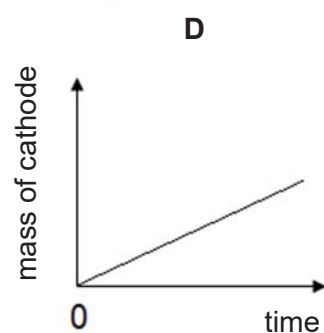
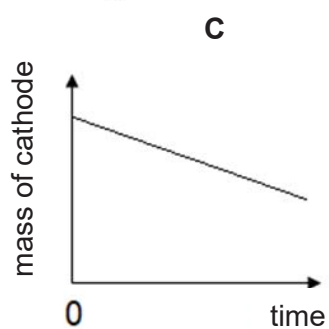
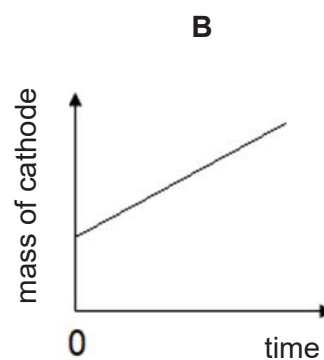
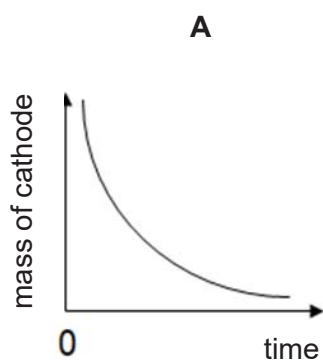


Which of the following could be **R**?

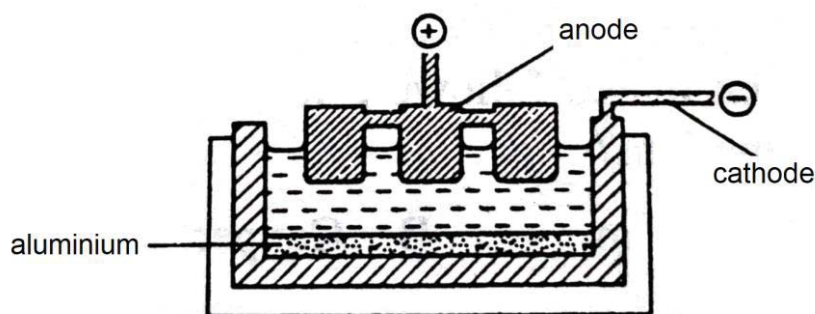
- A zinc
- B copper
- C calcium
- D aluminium

35 Aqueous copper(II) sulfate is electrolysed using copper electrodes. The current is constant and the cathode is weighed at regular intervals.

Which graph is obtained when the mass of the cathode is plotted against time?



- 36 The diagram shows the cell used in the electrolysis extraction of aluminium.



Which reaction takes place at the electrode where the aluminium is formed?

- A Atoms gain electrons and form ions.
 - B Atoms lose electrons and form ions.
 - C Ions gain electrons and form atoms.
 - D Ions lose electrons and form atoms.
- 37 Dilute sulfuric acid is electrolysed using inert electrodes.

Which statement(s) is/are correct?

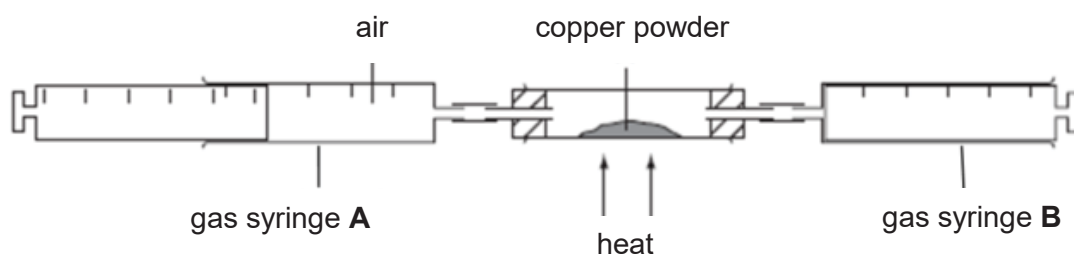
- 1 Hydrogen is released at the negative electrode
- 2 Oxygen is released at the positive electrode
- 3 Sulfur dioxide is released at the positive electrode

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

- 38 Which is the best explanation of why farmers should not add lime and ammonium sulfate to the soil at the same time?

- A Lime makes ammonium sulfate insoluble in water.
- B Lime and ammonium sulfate react together to form insoluble calcium sulfate.
- C Lime makes the soil alkaline which prevents plants from absorbing ammonium ions.
- D Nitrogen in ammonia gas is lost from a reaction between lime and ammonium sulfate.

- 39 200 cm³ of air in gas-syringe **A** was made to pass over hot copper powder until all the oxygen in the air reacts with the copper and the remaining gas was collected in syringe **B**.



The gas in syringe **B** was then allowed to cool to its original temperature. What is the volume of gas collected in syringe **B**?

- A 42 cm³
 B 84 cm³
 C 158 cm³
 D 180 cm³
- 40 Catalytic converters are used to remove harmful pollutants from exhaust gases.

Which equations show reactions that are useful in removing harmful pollutants?

- 1 $\text{N}_2(\text{g}) + 2\text{O}_2(\text{g}) \rightarrow 2\text{NO}_2(\text{g})$
- 2 $\text{NO}(\text{g}) + \text{CO}_2(\text{g}) \rightarrow \text{NO}_2(\text{g}) + \text{CO}(\text{g})$
- 3 $2\text{NO}(\text{g}) + 2\text{CO}(\text{g}) \rightarrow \text{N}_2(\text{g}) + 2\text{CO}_2(\text{g})$
- 4 $2\text{NO}_2(\text{g}) + 4\text{CO}(\text{g}) \rightarrow \text{N}_2(\text{g}) + 4\text{CO}_2(\text{g})$

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

END OF PAPER

Setter : Mdm Azlin Abdul Majid

The Periodic Table of Elements

		Group															
I	II	III	IV	V	VI	VII	0										
3 Li lithium 7	4 Be beryllium 9	1 H hydrogen 1	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 -	117 Ts tennessine -	118 Og oganeson -	119 Uue unbinilium -	120 Uuo unbinilium -

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 dm³ at room temperature and pressure (r.t.p.).



AHMAD IBRAHIM SECONDARY SCHOOL
GCE-O LEVEL PRELIMINARY EXAMINATION 2020

SECONDARY 4 EXPRESS

Name:	Class:	Register No.:
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CHEMISTRY

6092

Paper 2

25 August 2020

1 hour 45 minutes

Candidates answer on the Question Paper.
No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Do not open this booklet until you are told to do so.

Write down your name, class and register number in the spaces at the top of this page.

Write in dark blue or black pen.

You may use an HB 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.

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 22.

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

FOR EXAMINER'S USE	
P1	40
Section A	50
B 7	12
B 8	8
B 9	10
TOTAL	120

Section A

Answer **all** questions in this section in the spaces provided.
The total mark for this section is 50.

- 1 (a) Choose from the following compounds to answer the questions below.

calcium oxide
carbon dioxide
zinc oxide
copper(II) sulfate
sodium iodide
sodium hydroxide
nitrogen dioxide
aqueous ammonia
hydrochloric acid

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

Write the name of the compound which

- (i) reacts with both acid and base to form salt and water,
..... [1]
- (ii) is formed in the atmosphere by lightning activity,
..... [1]
- (iii) gives yellow precipitate when reacts with dilute nitric acid and aqueous silver nitrate,
..... [1]
- (iv) produces a pink deposit at the cathode during electrolysis of this aqueous compound,
..... [1]
- (v) reacts with magnesium to form hydrogen gas,
..... [1]
- (vi) turns moist red litmus paper blue with ammonium chloride.
..... [1]

(b) Calcium reacts with oxygen to form the ionic solid calcium oxide, CaO.

Explain, in terms of movement of electrons, how CaO is formed by the reaction of calcium with oxygen.

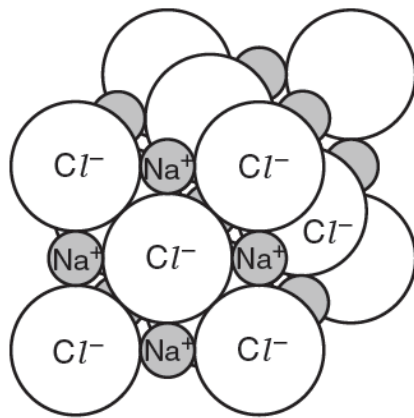
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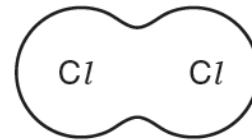
..... [2]

[Total: 8]

2 The structures of sodium chloride and chlorine are shown below.



sodium chloride



chlorine

(a) The melting point of sodium chloride is 801°C.
The melting point of chlorine is -101°C.

Explain, in terms of structure and bonding, the difference between the melting points of these two substances.

.....

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.....

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.....

..... [4]

- (b) Explain why molten sodium chloride conducts electricity but solid sodium chloride does not.

.....

 [2]

- (c) The electrode reactions occurring when molten sodium chloride is electrolysed are shown below.



Refer to these equations to explain why this electrolysis involves both oxidation and reduction.

.....

 [2]

[Total: 8]

- 3 Iron is a transition metal that shows variable oxidation states. Iron can be extracted from haematite in a blast furnace. Haematite is an iron ore which is mainly made up of iron(III) oxide.

- (a) There are a number of reactions occurring in the blast furnace. Write down the equation for

- (i) a redox reaction,

.....

- (ii) a thermal decomposition reaction.

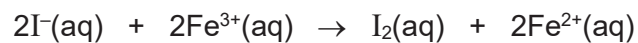
..... [2]

- (b) 2000 kg of haematite was used to produce 1300 kg of iron. Using your equation from (a)(i), find the percentage purity of iron(III) oxide in haematite.

[3]

- (c) Iron(III) ions are an example of transition metal compounds used as catalysts because of their ability to change oxidation state.

The reaction between iron(III) ions and iodide ions are shown in the following equation shows the change in oxidation state.



- (i) Explain how iron(III) ions are acting as an oxidising agent in this reaction.

.....

[1]

- (ii) Describe a test for iron(III) ions.

test

observation

[2]

[Total: 8]

4 Tin and silver are metals.

(a) State **two** physical properties which are characteristic of most metals.

.....
.....

[2]

(b) Draw a labelled diagram to show how a tin rod can be electroplated with silver.

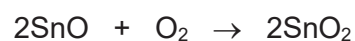
[3]

(c) A 9.50 g sample of a chloride of tin contains 5.95 g of tin.

Deduce the empirical formula of this chloride of tin.

[2]

(d) Tin(II) oxide, SnO, reacts with oxygen to form tin(IV) oxide, SnO₂.



When a sample of 13.5 g of tin(II) oxide is reacted with oxygen, 12.7 g of tin(IV) oxide is formed.

Calculate the percentage yield of tin(IV) oxide.

[3]

[Total: 10]

5 Fig. 5.1 below shows how the average temperature at the Earth's surface has changed over the last 150 thousand years.

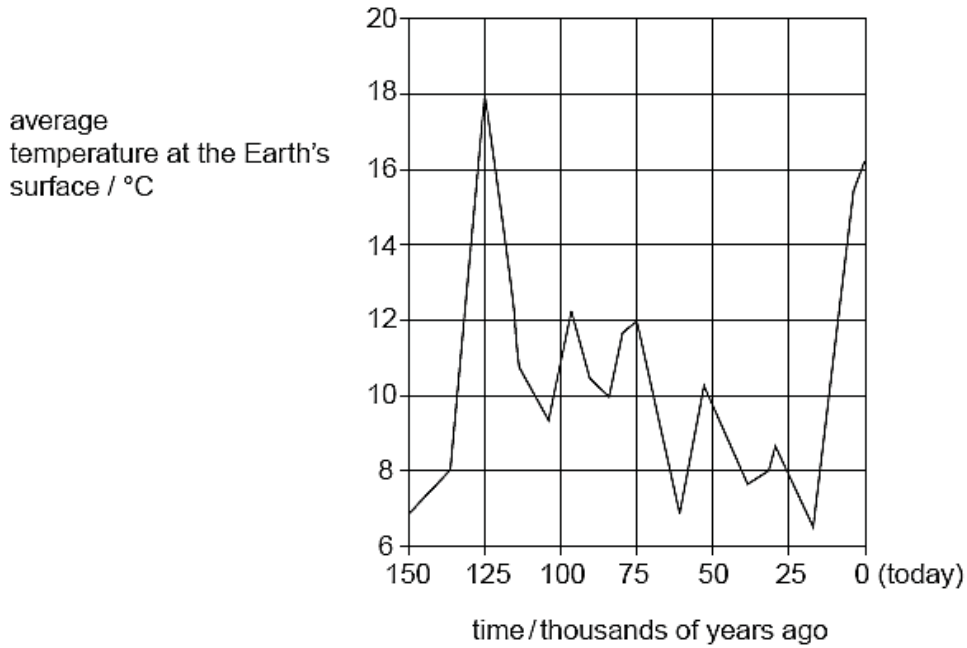


Fig. 5.1

Fig. 5.2 below shows how the percentage of carbon dioxide in the atmosphere has changed over the last 150 thousand years.

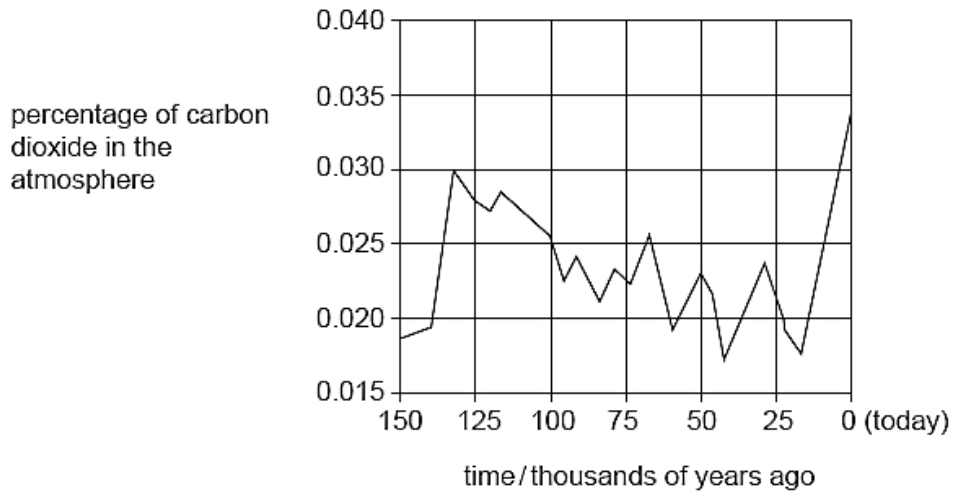


Fig. 5.2

(a) (i) Using Fig. 5.1 and Fig. 5.2, describe the relationship between the percentage of carbon dioxide in the atmosphere and the average temperature at the Earth's surface.

.....

.....

[1]

- (ii) A student thinks that the increase in carbon dioxide in the atmosphere is the only factor that causes global warming. Do you agree with the statement? Explain your answer.

.....

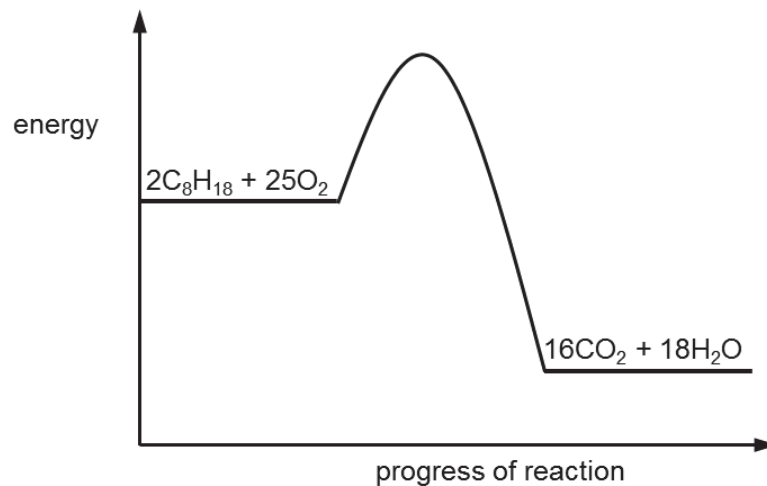
[1]

- (iii) Describe **two** consequences of global warming.

.....

[2]

- (b) One source of carbon dioxide is the combustion of fossil fuels like octane. The energy profile diagram for the reaction is shown below.



- (i) Label clearly the activation energy of the reaction. [1]

- (ii) Explain how the diagram above shows that the combustion of fossil fuels is considered an *exothermic* reaction.

.....

[1]

(iii) The table below shows some bond energies, measured in kilojoules per mole.

bond	bond energy, in kJ/mol	bond	bond energy, in kJ/mol
O – O	150	C – O	360
O = O	496	C – H	412
C = C	612	C – C	348
C = O	743	O – H	463

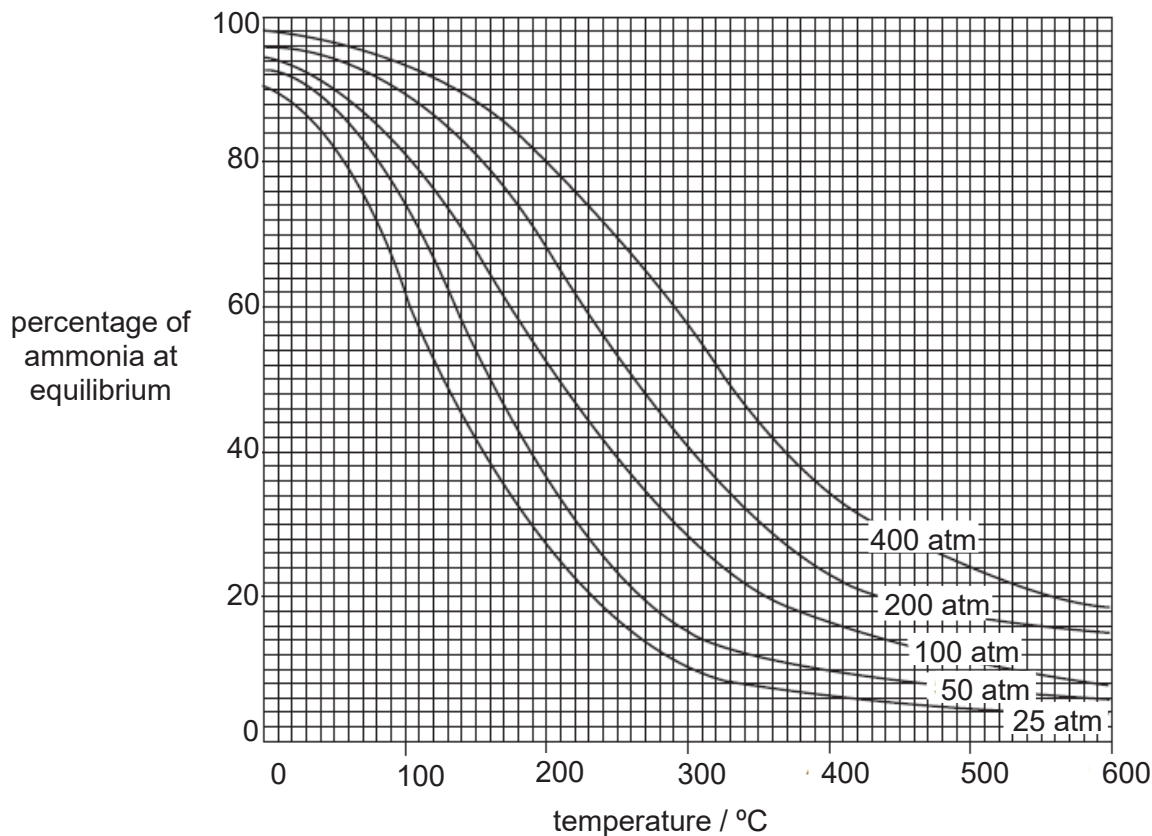
Given that the amount of heat energy absorbed to break the bonds present in octane and oxygen is 32104 kJ, calculate the enthalpy change for the combustion of octane.

[3]

[Total: 9]

- 6 Ammonia is manufactured by the Haber process. The reaction is a reversible reaction, and when the percentages of reactants and product remains constant, it is said to have reached an 'equilibrium'.

The graph below shows the percentages of ammonia present at equilibrium at different temperatures and pressures.



- (a) Write a balanced chemical equation for the formation of ammonia. Include state symbols.

..... [2]

- (b) From the graph, state the reaction conditions that would give the highest percentage yield of ammonia.

.....
 [1]

- (c) From the graph, describe the relationship between temperature and the percentage of ammonia at equilibrium.

.....
 [1]

- (d) Give a reason why temperatures above 400°C are typically used in the Haber process.

.....
.....

[1]

- (e) The ammonia produced is used to make fertilisers for plants, providing a source of nitrogen from the ammonium compounds the fertiliser contains.

A farmer uses this fertiliser, and then adds calcium hydroxide to the soil to reduce its acidity. Comment on the resulting effectiveness of the fertiliser in providing nitrogen for the plants.

.....
.....
.....

[2]

[Total: 7]

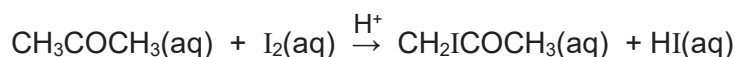
Section B

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

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

- 7 This question is on the reaction between aqueous iodine and propanone.

Aqueous iodine and propanone, CH_3COCH_3 , react together with a small volume of acid according to the equation:



Propanone, CH_3COCH_3 , is a colourless solution and the hydroiodic acid, HI, produced is a strong acid.

The concentration of propanone was measured when 0.00200 mol/dm^3 of iodine was used and the results are shown in Fig. 8.1.

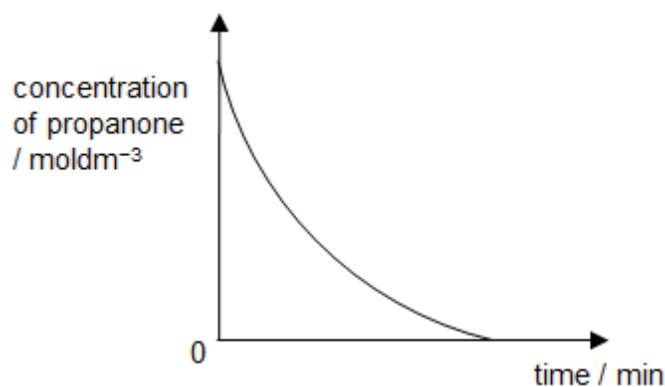


Fig. 8.1

Initial Rate of Reaction

To further investigate the rate of reaction between aqueous iodine and propanone, the initial rate of reaction was calculated. The initial rate of reaction is the rate of the reaction when the reagents are **first** brought together, as shown in Fig. 8.2.

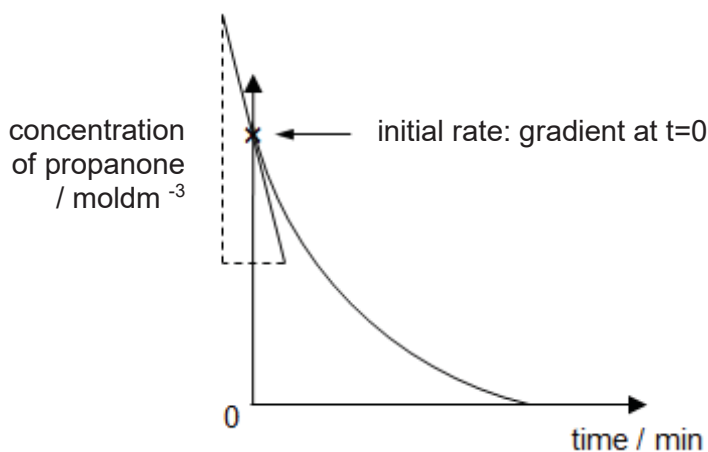
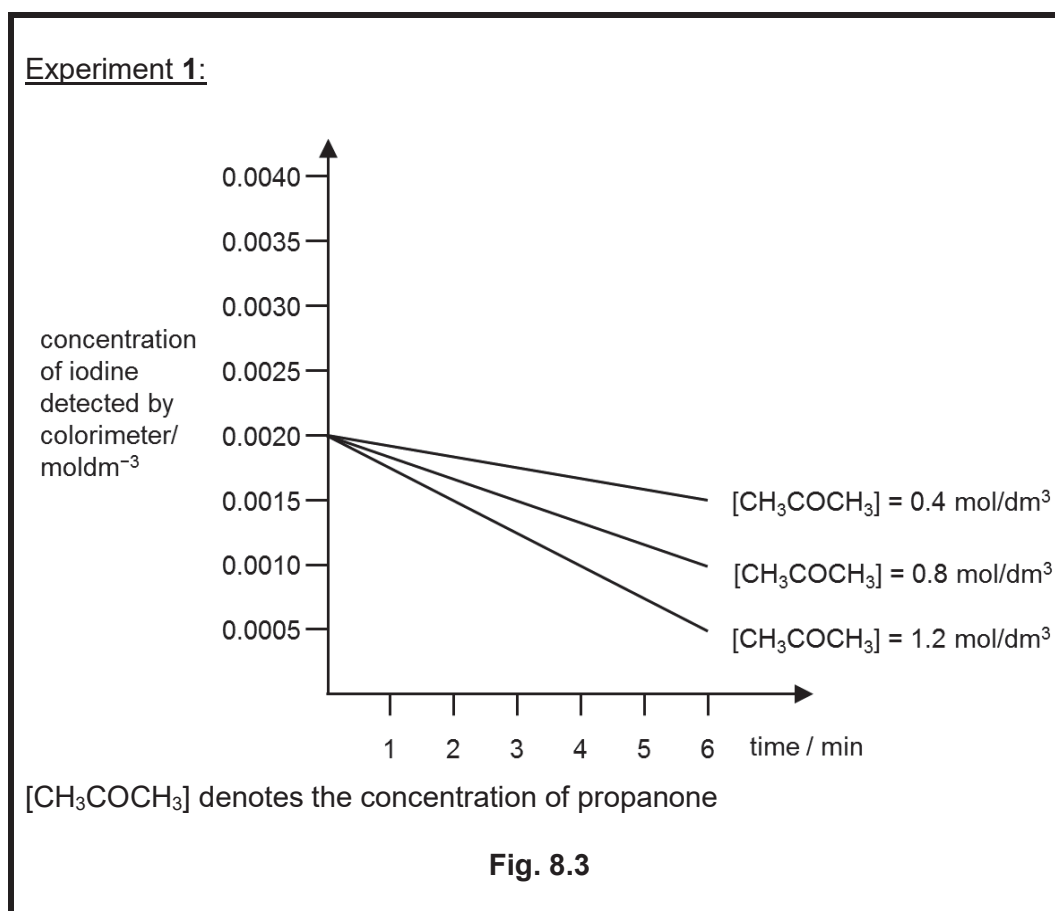


Fig. 8.2

Two sets of experiments were conducted in order to determine how the concentration of reactants affects the initial rate of reaction.

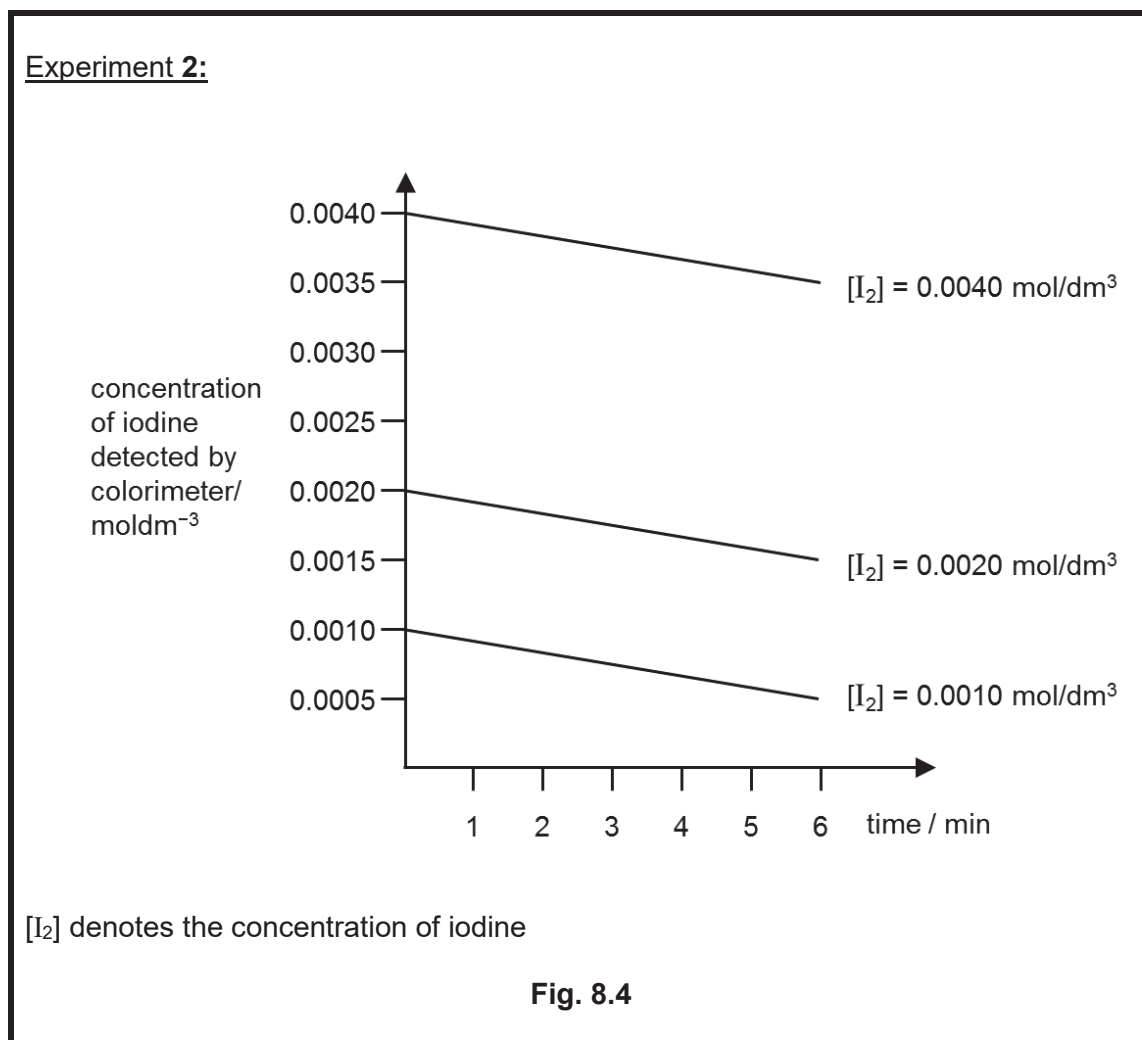
In Experiment 1, different concentrations of propanone were reacted with a fixed concentration of iodine. During the reaction, the concentration of iodine decreased and this caused the colour intensity of the reaction mixture to decrease. The changes in colour intensity were then measured by the use of a colorimeter. Thus, the concentration of iodine can be measured throughout the reaction and the initial rate of the reaction can be determined.

The graph in Fig. 8.3 shows how the concentration of iodine changes with time.



In Experiment 2, different concentrations of iodine were reacted with a fixed concentration of propanone. The changes in the concentration of iodine were also measured in a similar manner.

The graph in Fig. 8.4 shows how the concentration of iodine changes with time.



- (a) (i) Which reagent, propanone or iodine, is in excess in this reaction? Explain your answer.

.....
 [1]

- (ii) Sketch, on Fig. 8.1, the graph you would expect when 0.0040 mol/dm³ of iodine was used. [1]

- (b) What is the concentration of iodine detected by the colorimeter at **4 minutes** when 1.2 mol/dm³ of propanone is used in Experiment 1?

..... [1]

(c) The gradient of the graphs in Fig. 8.3 and Fig. 8.4 show the initial rate of reaction. Explain how the initial rate of reaction is affected by the

(i) concentration of propanone,

.....
.....
.....
.....

(ii) concentration of iodine.

.....
.....
.....
.....

[4]

(d) (i) The acid added to the reaction between iodine and propanone serves as a catalyst. Explain, using ideas about collisions between particles, how a catalyst affects the rate of reaction.

.....
.....
.....

[2]

(ii) Suggest why only a small volume of acid is required for the reaction between iodine and propanone.

.....
.....
.....

[2]

(e) Predict the colour change of the solution at the end of the reaction when iodine is in excess.

.....

[1]

[Total: 12]

- 8 (a) Michael conducted two experiments to investigate the relative reactivity of **iron** and three other solid metals **X**, **Y** and **Z**.

In experiment **1**, he heated each of the metal oxides in a test-tube and observed if there was any change.

In experiment **2**, he tested metals **X**, **Y** and **Z** with aqueous iron(II) sulfate

(Note: sulfate solution of **X**, **Y** and **Z** are all colourless).

He then tabulated the results of both experiments as follows.

experiment 1	oxide of iron	oxide of X	oxide of Y	oxide of Z
action of heat	no change	no change	no change	metal Z is formed

experiment 2	metal X	metal Y	metal Z
addition of metal into aqueous iron(II) sulfate	a reaction occurs	iron deposited, gas evolved from vigorous bubbling	no change

- (i) Deduce the order of reactivity of iron, **X**, **Y** and **Z**, in terms of increasing reactivity.

..... [1]

- (ii) When metal **X** is added into aqueous iron(II) sulfate, a reaction occurs. Describe and explain **all** observations when **X** is placed in aqueous iron(II) sulfate in experiment II.

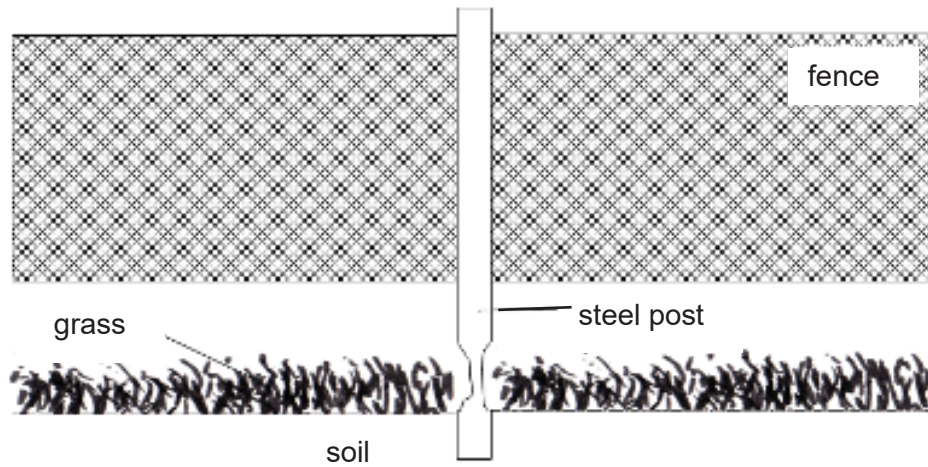
.....

 [3]

- (iii) Describe the test for gas that is formed when **Y** is placed in aqueous iron(II) sulfate.

.....
 [1]

- (b) The diagram shows a wire fence which is held up by steel posts. The fence was recently blown down by strong winds. It was found that the steel posts had rusted badly at ground level.



- (i) Suggest one reason why the steel posts had rusted much more at the ground level as shown in the diagram.

.....
.....

[1]

- (ii) One way to protect the steel post is by galvanising.

Explain how galvanising protects against rusting and why galvanising is preferred to painting.

.....
.....
.....

[2]

[Total: 8]

Either

- 9 Two experiments were conducted concurrently. In experiment 1, a constant current was passed through a concentrated solution of potassium bromide using inert electrodes for 60 minutes. In experiment 2, the same current was passed through molten lead(II) bromide using inert electrodes for 60 minutes. The observations were recorded in the table below.

Time	Experiment 1: concentrated potassium bromide solution	Experiment 2: molten lead(II) bromide
After 5 minutes	Colourless gas produced at one electrode. Solution around the other electrode turned yellowish brown and slowly spread through the solution.	Shiny grey liquid formed on one electrode sank to the bottom of the container. Reddish brown fumes produced at the other end.
After 30 minutes	Colourless gas produced at one electrode. Solution around the other electrode further darkened in colour. The solution has turned alkaline.	Shiny grey liquid formed on one electrode sank to the bottom of the container. Reddish brown fumes produced at the other end. Volume of the molten lead(II) bromide decreased.
After 60 minutes	Colourless gas produced at one electrode. Colourless gas also formed at the other electrode.	Shiny grey liquid in the container. No more reddish brown fumes.

- (a) Identify the shiny grey liquid formed in experiment 2. Explain why it sank to the bottom of the container.

.....

[2]

- (b) Write relevant equations for the different observations in experiment 1 after 5 minutes and after 60 minutes. Explain the difference in the observations.

.....

[4]

(c) After 30 minutes, explain why

(i) the solution turned alkaline in experiment 1,

.....
.....
.....

[2]

(ii) the volume of the original liquid was reduced in experiment 2.

.....
.....

[1]

(d) Predict the final colour of the solution in experiment 1 after 60 minutes.

.....
.....

[1]

[Total: 10]

Or

- 9 Group VII elements react with hydrogen to form hydrogen halides such as hydrogen fluoride, hydrogen chloride and hydrogen iodide. The hydrogen halides are gases at room conditions and can dissolve in water to form hydrofluoric acid, hydrochloric acid and hydroiodic acid respectively.

The quantitative measure of the strength of an acid in solution is referred to as acid dissociation constant K_a . The larger the K_a value, the more dissociation of the acid molecules in solution and thus, stronger the acid.

Table 9.1 below shows the acid dissociation constants of some acids, in an aqueous dilute solution.

Table 9.1

Substance	Formula of acid	Acid dissociation constant, K_a
hydrofluoric acid	HF	6.8×10^{-4}
hydrochloric acid	HCl	1.0×10^7
hydroiodic acid	HI	3.0×10^9
hydrocyanic acid	HCN	6.2×10^{-10}
hydrochlorous acid	HClO	3.0×10^8

- (a) With reference to Table 9.1, deduce which substance is the strongest acid. Explain your answer.

.....

[2]

- (b) Construct an ionic equation to show the dissociation of dilute hydrochlorous acid, HClO.

.....

[1]

- (c) (i) Draw a 'dot-and-cross' diagram to illustrate the bonding of hydrogen iodide, showing only the valence electrons.

[2]

- (c) (ii) Describe and explain the condition that allows hydrogen iodide to conduct electricity.

.....

.....

.....

[2]

- (d) Table 9.2 below shows the atomic size of some Group VII elements in picometre (pm).

Table 9.2

Group VII elements	Atomic size (pm)
fluorine	68
chlorine	99
bromine	114
iodine	

- (i) With reference to Table 9.1 and Table 9.2, describe how the atomic size of Group VII element affects the strengths of the acids formed of the hydrogen halides.

.....

.....

[1]

- (ii) Predict whether dilute hydrobromic acid, HBr, will be more or less acidic than dilute hydroiodic acid, HI. Explain your reasoning.

.....

.....

.....

[2]

[Total: 10]

END OF PAPER

Setter: Mdm Azlin Abdul Majid

The Periodic Table of Elements

		Group																
I	II	III	IV	V	VI	VII	0											
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 -	118 Og oganeson -	119 Uue unbinilium -	120 Uuo unbinilium -	121 Uuh ununilium -	122 Uuq ununilium -

1
H
hydrogen
1

Key
proton (atomic) number
atomic symbol
name
relative atomic mass

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 -

lanthanoids

actinoids

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

