

Name	Index Number	Class
------	--------------	-------



# WOODGROVE SECONDARY SCHOOL

A SCHOOL OF CHOICE, A COMMUNITY OF DYNAMIC LEARNERS

## O LEVEL PRELIMINARY EXAMINATION 2020

**LEVEL & STREAM** : **SECONDARY 4 EXPRESS**

**SUBJECT (CODE)** : **CHEMISTRY (6092)**

**PAPER NO** : **1**

**DATE (DAY)** : **17 SEPTEMBER 2020 (THURSDAY)**

**DURATION** : **1 HOUR**

### READ THESE INSTRUCTIONS FIRST

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

Answer all multiple choice questions in the OMR answer sheet. For each question, there are four possible answers: **A, B, C** and **D**. Choose the most suitable answer and shade its letter in pencil on the OMR answer sheet.

A copy of the Periodic Table is printed in this paper.  
The use of an approved scientific calculator is expected, where appropriate.

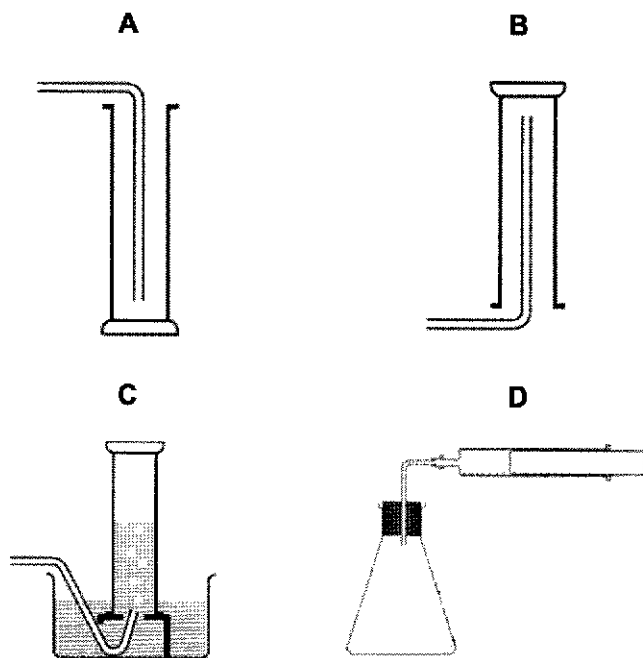
**DO NOT TURN OVER THE QUESTION PAPER UNTIL YOU ARE TOLD TO DO SO.**

<b>Student's Signature</b>		<b>Parent's Signature</b>		<b>For Examiner's Use</b>	
<b>Date</b>		<b>Date</b>		<b>Total</b>	<b>/ 40</b>

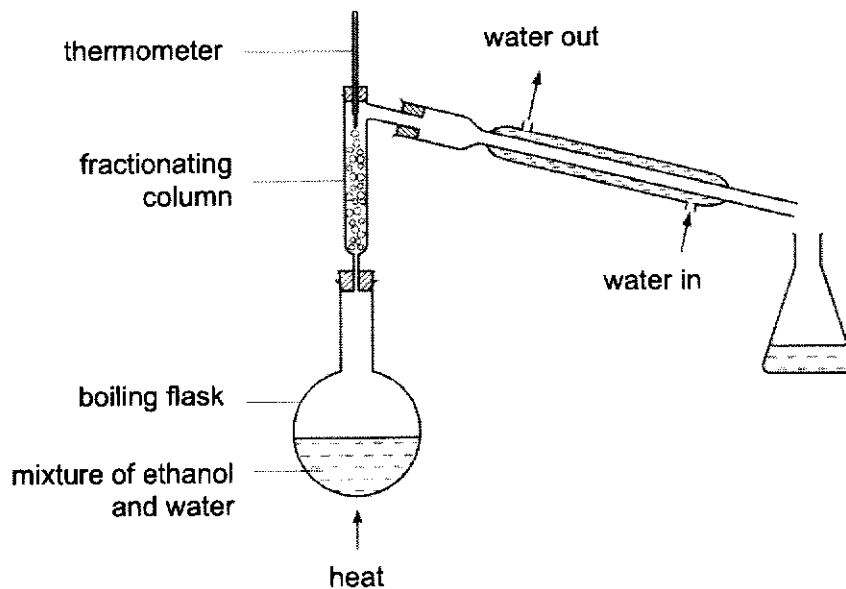
This document consists of **18** printed pages including this cover page  
Setter : Mdm Shuryati



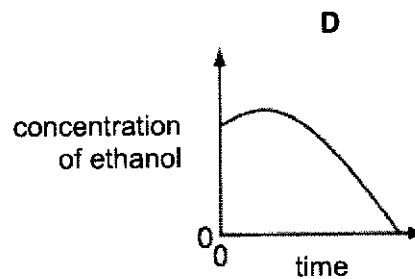
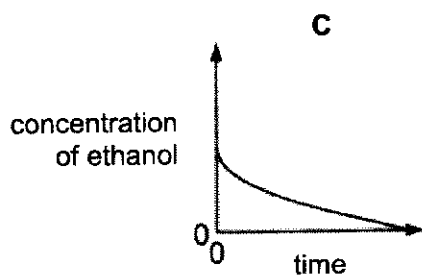
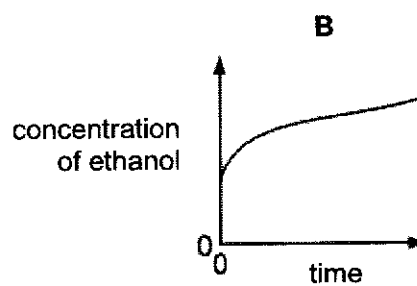
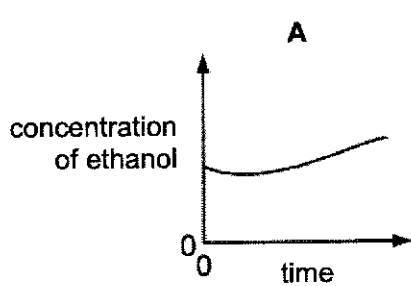
- 1 In an experiment, a student reacts nitric acid with zinc powder. She wants to collect and measure the amount of gas produced at 30-second intervals. Which apparatus is most suitable for collecting and measuring the amount the gas produced?



- 2 The apparatus shown is used to distill a dilute solution of ethanol in water.  
[boiling point of ethanol =  $78\text{ }^{\circ}\text{C}$  ; boiling point of water =  $100\text{ }^{\circ}\text{C}$ ]



Which graph shows the change in concentration of the ethanol in the boiling flask as the distillation proceeds?



3 In which of the following solid mixtures can the underlined substance be obtained by adding water, stirring and filtering?

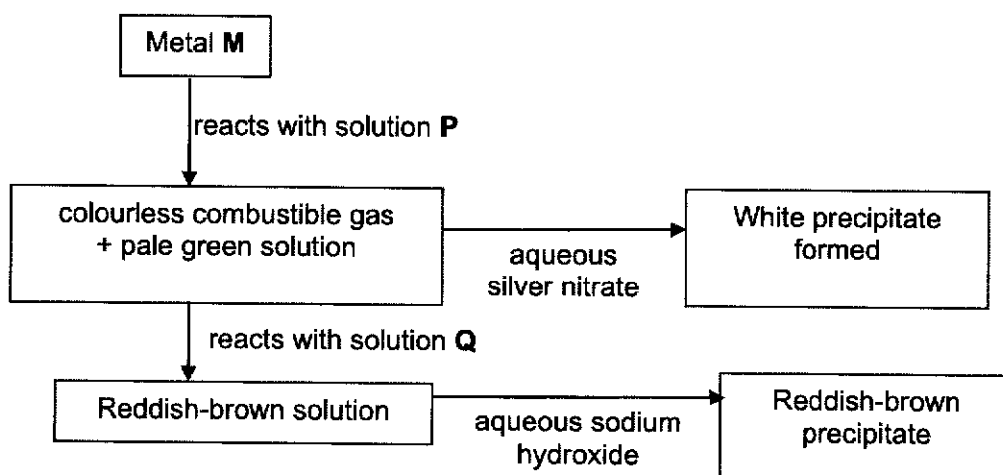
- A Mixture of copper and copper(II) chloride
- B Mixture of potassium chloride and potassium hydroxide
- C Mixture of sodium and iron(II) sulfate
- D Mixture of zinc and iron

4 A series of chemical tests performed on an unknown solution produced the following results.

test	observation
add aqueous sodium hydroxide	white precipitate formed, precipitate dissolved in excess aqueous sodium hydroxide
add acidified barium nitrate	white precipitate formed

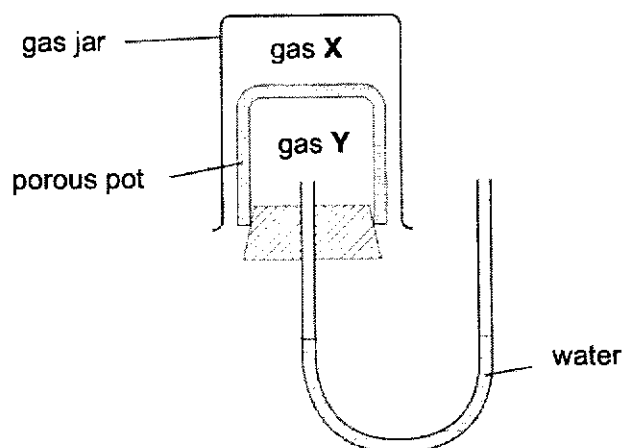
Which of the following substance could be present in the solution?

- A aluminium chloride
  - B calcium carbonate
  - C sodium hydrogencarbonate
  - D zinc sulfate
- 5 In the reaction scheme below, solutions **P** and **Q** are involved in some reactions. Identify **P** and **Q**.



	<b>P</b>	<b>Q</b>
<b>A</b>	dilute hydrochloric acid	chlorine
<b>B</b>	dilute hydrochloric acid	potassium iodide
<b>C</b>	dilute nitric acid	chlorine
<b>D</b>	dilute nitric acid	potassium iodide

- 6 The following apparatus was set up as shown below.



Which of the following pair of gases **X** and **Y** will result in **no** movement of the water in the U-shaped tube?

	gas X	gas Y
<b>A</b>	H <sub>2</sub>	He
<b>B</b>	N <sub>2</sub>	CO
<b>C</b>	O <sub>2</sub>	CH <sub>4</sub>
<b>D</b>	SO <sub>2</sub>	NO <sub>2</sub>

7 The information on two substances **P** and **Q** are given below.

substance	<b>P</b>	<b>Q</b>
arrangement of particles	close and disorderly	far apart and disorderly
movement of particles	sliding around randomly	moving rapidly and randomly

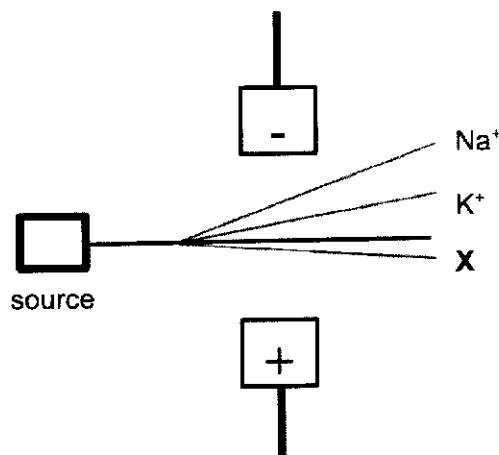
Four substances are given below.

substance	description
1	copper at 100 °C
2	water at 25 °C
3	graphite at 30 °C
4	oxygen at 50 °C

Which of the substances are **P** and **Q**?

	<b>P</b>	<b>Q</b>
<b>A</b>	1	2
<b>B</b>	2	4
<b>C</b>	3	1
<b>D</b>	4	3

- 8 In an experiment, a sample was vapourised, ionised and passed through an electric field. Analysis of the deflection occurring at the electric region revealed the following data for the sample.



[Ar: Li, 7 ; F, 19 ; Na, 23 ; K, 39 ; Br, 80 ; Rb, 85]

What is a possible identity of the unknown particle, X?

- A Br<sup>-</sup>  
 B F<sup>-</sup>  
 C Li<sup>+</sup>  
 D Rb<sup>+</sup>
- 9 Which of the following statements about an atom is correct?
- A The number of protons determine its chemical properties  
 B The numbers of protons and neutrons determine its mass  
 C Its nucleon number is the total number of neutrons in its nucleus  
 D It is electrically neutral as there are equal numbers of protons and neutrons
- 10 Which of the following groups of substances contain an element, a compound and a mixture?
- A brass, rust, haematite  
 B diamond, graphite, air  
 C limestone, diamond, water  
 D ozone, bronze, slag
- 11 Which of the following has substances with high melting points?
- A copper, sodium chloride, silicon dioxide  
 B diamond, carbon dioxide, methane  
 C glucose, ammonia, aluminium oxide  
 D graphite, rubidium, magnesium oxide

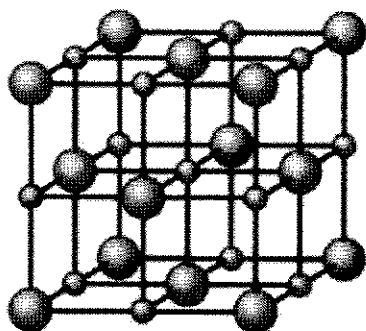


- 12 The nucleon number of element X is 51. The ion  $X^{3+}$  has 20 electrons. What does the nucleus of the ion  $X^{3+}$  contain?

Legend: n = neutrons; p = protons ; e = electrons

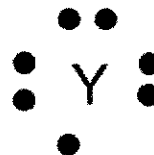
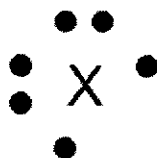
A	20e	20p
B	20p	31n
C	23e	28n
D	23p	28n

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



Which compound cannot have this arrangement of its ions?

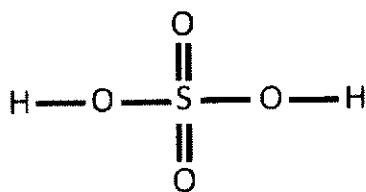
- A lithium nitrate
  - B zinc sulfate
  - C sodium oxide
  - D lead(II) sulfate
- 14 The diagram below shows the valence electrons of elements X and Y.



Which of the following correctly shows the type of bond and chemical formula of the compound formed between X and Y?

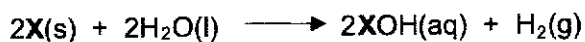
	type of bonds	chemical formula
A	covalent	$XY_2$
B	ionic	$XY$
C	ionic	$X_2Y_3$
D	covalent	$X_3Y_2$

- 15 The structural formula of sulfuric acid is shown.



How many pairs of valence electrons are **not** involved in bonding in one sulfuric acid molecule?

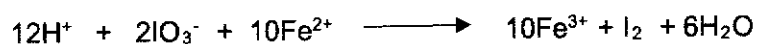
- A 5  
B 8  
C 10  
D 16
- 16 The equation shows the reaction between a metallic element **X** and water.



Which particles are responsible for the electrical conductivity in **X** and **XOH**?

	<b>X</b>	<b>XOH</b>
<b>A</b>	electrons	cations
<b>B</b>	electrons	cations and anions
<b>C</b>	cations	electrons
<b>D</b>	cations	cations and anions

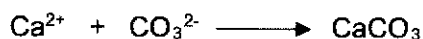
- 17 In the reaction below :



Which of the following is the oxidising agent?

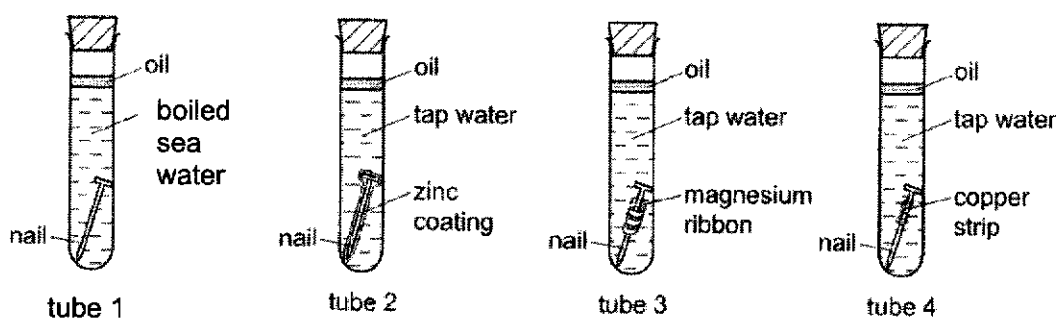
- A  $\text{H}^+$   
B  $\text{Fe}^{2+}$   
C  $\text{IO}_3^-$   
D  $\text{I}_2$

- 18 The ionic equation for a reaction is shown below:



Which of the following conditions will make this reaction take place readily?

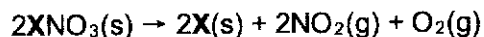
- A Aqueous sodium carbonate is added to limewater.  
 B Calcium sulfate is added to aqueous sodium carbonate.  
 C Carbon dioxide is passed through aqueous calcium chloride.  
 D Calcium carbonate is crystallised from its saturated solution.
- 19 A student set up four test-tubes to investigate the factors that cause the rusting of iron nails.



After leaving the tubes for one week, which tubes would show evidence of rusting?

- A 1 and 2  
 B 2 and 3  
 C 3 only  
 D 4 only
- 20 Which of the following pairs of compounds contain the same percentage by mass of nitrogen?
- A  $\text{NO}_2$  and  $\text{NH}_4\text{NO}_3$   
 B  $\text{NH}_4\text{CNO}$  and  $(\text{NH}_2)_2\text{CO}$   
 C  $\text{N}_2\text{H}_4$  and  $\text{NH}_3$   
 D  $(\text{NH}_2)_2\text{CO}$  and  $\text{NH}_4\text{Cl}$

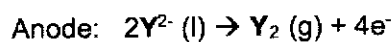
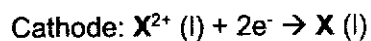
- 21 Upon strong heating, a metal nitrate compound undergoes decomposition according to the following equation:



Complete decomposition of 3.40 g of the nitrate gives 240 cm<sup>3</sup> of oxygen, measured at room temperature and pressure.

What is the relative atomic mass of **X**?

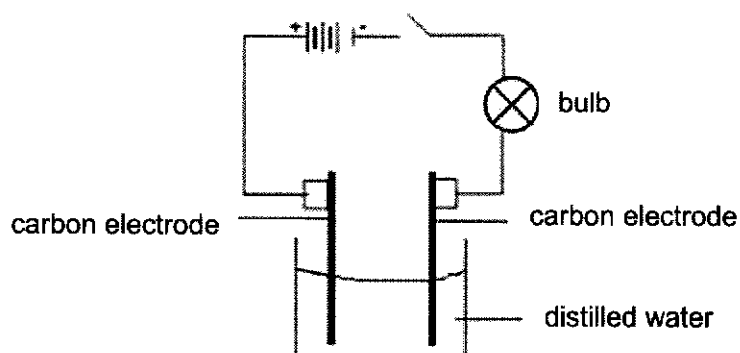
- A 85
  - B 108
  - C 133
  - D 170
- 22 Element **X** is extracted by the electrolysis of a molten compound of elements **X** and **Y**. The electrode reactions are as shown:



Which of the following could be the compound?

- A aluminium oxide
- B calcium chloride
- C magnesium oxide
- D potassium chloride

- 23 The diagram below shows an electrolytic cell. Initially, the bulb does **not** light up when the switch is closed.

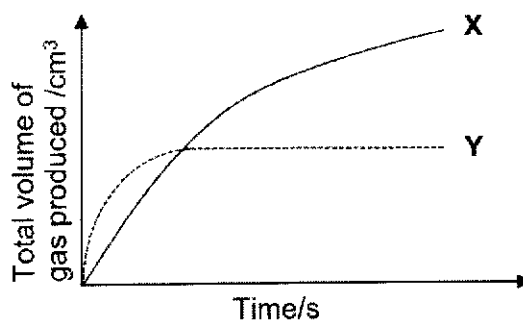


Which of the following substances, when added, will cause the bulb to be the brightest?

- A ethanoic acid
  - B magnesium carbonate
  - C sodium hydroxide
  - D sugar
- 24 How will the addition of a catalyst affect the energy of particles and the activation energy of the reaction?

	energy of particles	activation energy
<b>A</b>	increases	decreases
<b>B</b>	increases	remains the same
<b>C</b>	remains the same	decreases
<b>D</b>	remains the same	remains the same

- 25 In the graph, curve X represents the results of the reaction between 1.0 g of granulated iron and excess acid at 30 °C.

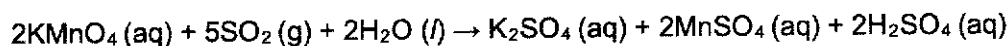


Which changes will produce curve Y?

- A Using 0.5 g of granulated iron at 20 °C.  
 B Using 0.5 g of granulated iron at 40 °C.  
 C Using 1.0 g of granulated iron at 20 °C.  
 D Using 1.0 g of powdered iron at 20 °C.
- 26 In which reaction is pressure **least** likely to affect the rate of reaction?

- A  $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightarrow 2\text{NH}_3(\text{g})$   
 B  $\text{HCl}(\text{g}) + \text{NH}_3(\text{g}) \rightarrow \text{NH}_4\text{Cl}(\text{s})$   
 C  $\text{CO}_2(\text{g}) + \text{Ca}(\text{OH})_2(\text{aq}) \rightarrow \text{CaCO}_3(\text{s}) + \text{H}_2\text{O}(\text{l})$   
 D  $\text{NaOH}(\text{aq}) + \text{HCl}(\text{aq}) \rightarrow \text{NaCl}(\text{aq}) + \text{H}_2\text{O}(\text{l})$

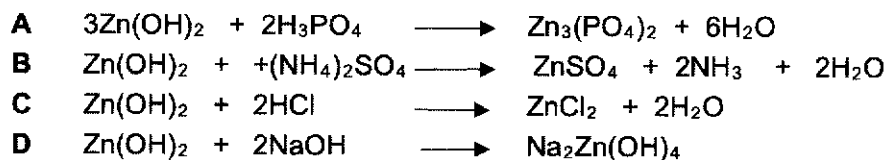
- 27 Study the reaction below:



Which is the correct pair of oxidising and reducing agents and the corresponding observation in this reaction?

	oxidising agent	reducing agent	observations
A	$\text{SO}_2$	$\text{KMnO}_4$	colourless solution turns purple
B	$\text{KMnO}_4$	$\text{SO}_2$	purple solution decolourises
C	$\text{KMnO}_4$	$\text{H}_2\text{O}$	purple solution decolourises
D	$\text{H}_2\text{SO}_4$	$\text{MnSO}_4$	colourless solution turns purple

- 28 Which compound will eliminate acid in the soil but does **not** react with ammonium fertilisers?
- A calcium carbonate  
 B calcium hydroxide  
 C calcium nitrate  
 D calcium oxide
- 29 In which of the following reaction is zinc hydroxide **not** behaving as a base?



30 Which pair of substances would **not** be suitable for producing a large quantity of carbon dioxide?

- A iron(II) carbonate and hydrochloric acid
- B lead(II) carbonate and hydrochloric acid
- C sodium carbonate and sulfuric acid
- D calcium carbonate and nitric acid

31 Which reaction produces most of the carbon monoxide used to extract iron in the blast furnace?

- A burning coke in air
- B reacting coke with carbon dioxide
- C reacting iron oxide with coke
- D decomposition of limestone

32 An element **X** reacts with iron to form two different compounds with the formulae  $\text{FeX}$  and  $\text{Fe}_2\text{X}_3$ .

What would the proton number of **X** likely to be?

- A 5
- B 7
- C 8
- D 9

33 Approximately 40% of all iron and steel are produced by recycling.

The following statements are possible reasons for recycling iron.

- 1 Recycling reduces the amount of waste taken to landfill sites.
- 2 Recycling reduces the amount of pollution at the site of the ore extraction.
- 3 Iron ore contains a higher percentage of iron than scrap steel.

Which of the statements are correct?

- A 1 and 2 only  
 B 2 and 3 only  
 C 1 and 3 only  
 D 1, 2 and 3
- 34 Which of the following metals is extracted from its ore via reduction by carbon and would require the most energy to do so?
- A Copper  
 B Iron  
 C Lead  
 D Zinc
- 35 Which of the following properties increases down the group in Group I?
- A ease of losing an electron  
 B ionic charge  
 C melting point  
 D non-metallic character

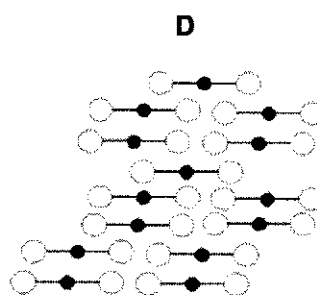
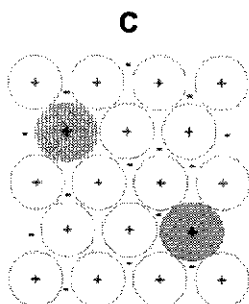
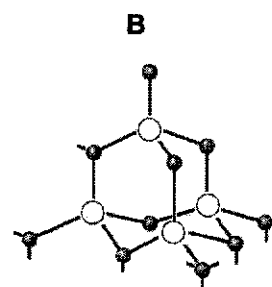
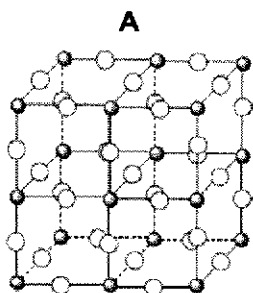
36 The table gives the catalysts used in some industrial processes.

process/reaction	catalyst
Cracking	aluminum oxide or silicon(IV) oxide
Esterification	concentrated sulfuric acid
Haber	iron
Manufacture of margarine	nickel

How many different transition metals are included in the list of catalyst?

- A 1  
 B 2  
 C 3  
 D 4
- 37 Which diagram best represents the structure of an alloy?





38 The table shows the results of adding weighed pieces of iron to solutions **M** and **S**.

solution used	initial mass of iron/g	final mass of iron after 15 minutes/g
<b>M</b>	5	4
<b>S</b>	5	4

What could be the aqueous solutions **M** and **S** be?

	<b>M</b>	<b>S</b>
<b>A</b>	copper(II) sulfate	silver nitrate
<b>B</b>	dilute hydrochloric acid	sodium chloride
<b>C</b>	iron(II)chloride	calcium chloride
<b>D</b>	magnesium chloride	dilute sulfuric acid

39 Which molecule has the greatest ozone-depleting potential?

- A** CFC/Br
- B** CFC/3
- C** CF<sub>4</sub>
- D** CH<sub>2</sub>F<sub>2</sub>

40 An atmospheric pollutant can be removed by the process of oxidation.

Which pollutant is removed by this process?

- A** carbon monoxide in a catalytic converter
- B** nitrogen dioxide in a catalytic converter
- C** nitrogen dioxide in acid rain by reaction with calcium carbonate
- D** sulfur dioxide from the flue gases by reaction with calcium carbonate

# The Periodic Table of Elements

		Group																																																																															
I	II	III	IV	V	VI	VII	0																																																																										
3 Li lithium 7	4 Be beryllium 9	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 Uu unbinilium -	117 Ts tennessium -	118 Og oganeson -

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 dm<sup>3</sup> at room temperature and pressure (r.t.p.).



## O LEVEL PRELIMINARY EXAMINATION 2020

**LEVEL & STREAM** : **SECONDARY 4 EXPRESS**  
**SUBJECT (CODE)** : **CHEMISTRY (6092)**  
**PAPER NO** : **2**  
**DATE (DAY)** : **2 SEPTEMBER 2020 (WEDNESDAY)**  
**DURATION** : **1 HOUR 45 MINUTES**

### READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on all the work you hand in.  
Write in dark blue or black pen.  
You may use a soft pencil for any diagrams, graphs, tables 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 **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 in this paper.  
The use of an approved scientific calculator is expected, where appropriate.

				For Examiner's Use	
				<b>A</b>	<b>/50</b>
				<b>B</b>	<b>/30</b>
<b>Student's Signature</b>		<b>Parent's Signature</b>		<b>Total</b>	<b>/80</b>
<b>Date</b>		<b>Date</b>			

This document consists of **24** printed pages including this cover page  
Setter : Mdm Shuryati

## Section A

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

- A1** Hydrogen, deuterium and tritium are isotopes of one another.  
Using this information, complete Table 1.1.

(a)

name	formula	number of protons	number of neutrons	number of electrons
hydrogen atom	${}^1_1\text{H}$	1		1
deuterium ion	${}^2_1\text{H}^+$			0
tritium ion			2	2

[3]

Table 1.1

- (b) Table 1.2 gives the relative abundance of each isotope in a mass spectrum of sample of germanium, Ge.

mass	70	72	74
relative abundance (%)	24.4	32.4	43.2

Table 1.2

Use the data in Table 1.2 to calculate the relative atomic mass ( $A_r$ ) of this sample of germanium.

$A_r$  of germanium = \_\_\_\_\_ [2]

- (c) A student commented, "Isotopes of an element should all have the same chemical properties."

Do you agree with the student? Give a reason for your answer.

---



---



---

[1]

**A2** Table 2.1 shows the formulae of some reagents. Use the formulae to answer the questions that follow.

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

$\text{Na}_2\text{CO}_3(\text{aq})$	$\text{KOH}(\text{aq})$	$\text{CuCl}_2(\text{aq})$
$\text{Zn}(\text{s})$	$\text{Ba}(\text{NO}_3)_2(\text{aq})$	$\text{H}_2\text{SO}_4(\text{aq})$
$(\text{NH}_4)_2\text{SO}_4(\text{aq})$	$\text{PbCO}_3(\text{s})$	$\text{Ag}(\text{s})$

**Table 2.1**

(a) Write the formulae of any two reagents which, when mixed together,

(i) would produce a green insoluble salt,

\_\_\_\_\_ [1]

(ii) would produce a white precipitate,

\_\_\_\_\_ [1]

(iii) would produce a gas which turns moist red litmus blue,

\_\_\_\_\_ [1]

(iv) would produce a pink solid,

\_\_\_\_\_ [1]

(v) would produce a salt prepared by titration.

\_\_\_\_\_ [1]

(b) Write the chemical equation, of the formation of salt in **A2(a)(i)**.

\_\_\_\_\_ [1]

- A3 (a)** Using the knowledge of the particulate model of matter, describe the changes in the particles in terms of arrangement and motion when dry ice is heated.

arrangement : \_\_\_\_\_

\_\_\_\_\_

[1]

motion : \_\_\_\_\_

\_\_\_\_\_

[1]

- (b)** A student separates four amino acids by paper chromatography using two different solvents.

The solvent front of solvent 1 takes five minutes to reach the end of the chromatogram while the solvent front of solvent 2 takes ten minutes.

Table 3.1 shows the  $R_f$  values she obtained for these amino acids.

amino acid	$R_f$ in solvent 1	$R_f$ in solvent 2
<b>A</b>	0.2	0.5
<b>B</b>	0.1	0.4
<b>C</b>	0.8	0.9
<b>D</b>	0.3	0.4

**Table 3.1**

- (i)** Which amino acid travels fastest in both solvents?

\_\_\_\_\_

[1]

- (ii) The student wrote the following paragraph about the chromatography experiment that she has conducted.

'It is better to use solvent 2 as it allows me to find out the identity of the 4 amino acids. One source of error in this experiment is that the duration of chromatography for solvent 2 is longer than for solvent 1, thus it is an unfair experiment.'

Do you agree with the student? Explain your reasoning.

---



---



---



---



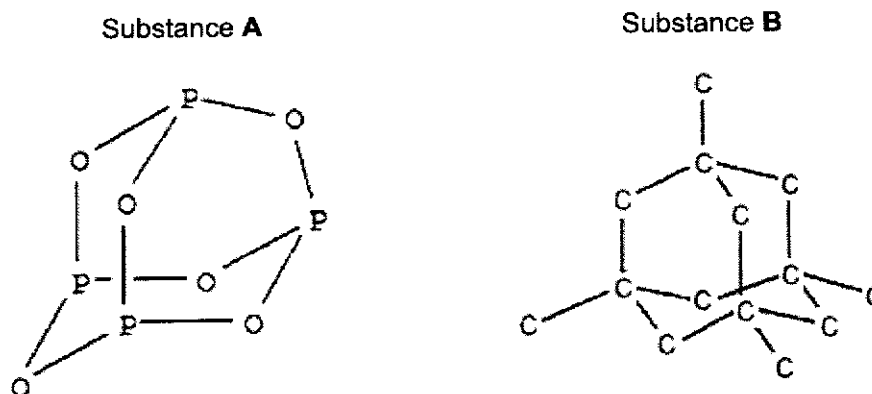
---



---

[2]

- A4** Fig. 4.1 shows the structures of substances **A** and **B**.



**Fig. 4.1**

- (a) Write down the molecular formula of substance **A**.

---

[1]

- (b) Explain why substance **B** is a poor conductor of electricity.

---



---

[1]



- (c) Substance **A** is a simple covalent molecule while substance **B** is a macromolecule.

With reference to the structures shown in Fig. 4.1, explain the difference in terms of structure and bonding between simple and giant molecular structures.

---

---

---

---

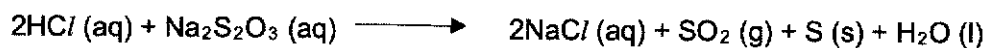
[2]

- (d) What type of oxide is substance **A**? Explain your answer.

---

[1]

- A5** (a) Dilute hydrochloric acid is added to a solution of sodium thiosulfate. The reaction is as shown below.



- (i) Using your knowledge of particle collisions, explain clearly how the rate of reaction is affected with increasing pH.

---

---

---

---

---

---

---

[2]

- (ii) In an experiment,  $50.0 \text{ cm}^3$  of  $1.0 \text{ mol/dm}^3$  dilute hydrochloric acid is added to  $50.0 \text{ cm}^3$  of  $1.0 \text{ mol/dm}^3$  sodium thiosulfate solution. The mass of the precipitate is measured and recorded in Fig. 5.1

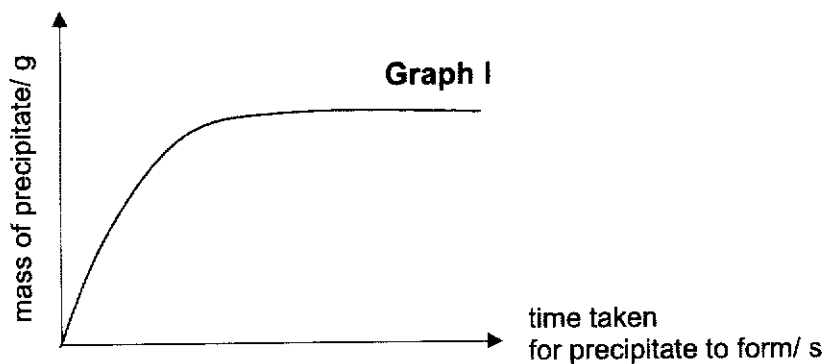


Fig. 5.1

Explain why the mass remains constant after some time.  
Show all working.

[2]

- (iii) On the graph in (a)(ii), sketch the graph of the results you would expect if the thiosulfate solution is heated from room temperature to  $50^\circ\text{C}$ . Label this "Graph II".

[1]

(b) Fig. 5.2 shows an electric cell.

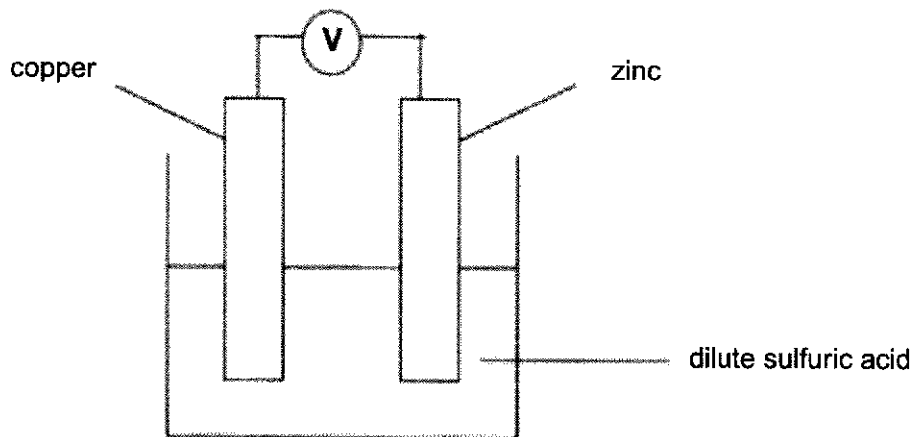


Fig. 5.2

- (i) Indicate with arrows on the diagram to show the direction of the flow of electrons in the wire. [1]
- (ii) The experiment is repeated with the zinc electrode replaced by iron. State and explain the change in voltmeter reading obtained.

---



---



---

[2]

6 (a) Strontium, Sr is in the same group as calcium and barium in the Periodic Table.

- (i) Explain in terms of atomic structure, why strontium is positioned below calcium but above barium in the Periodic Table.

---

[1]

- (ii) Strontium reacts with cold water. Write a balanced equation for the reaction.

---

[1]

- (iii) Would you expect strontium to be more reactive or less reactive than calcium?  
Explain your answer.

---

---

[1]

- (b) A student compared the speed of decomposition of three metal carbonates. She measured the volume of gas released over time using the apparatus shown in Fig. 6.1.

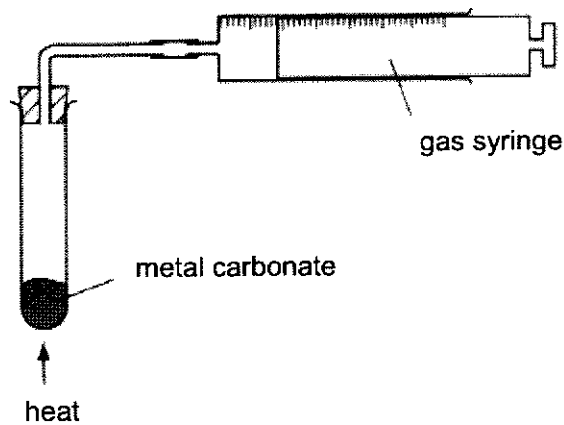


Fig. 6.1

State **one** thing that must be kept constant if the speed of decomposition of the three metal carbonates is to be compared.

---

[1]

- (c) Fig. 6.2 shows the graph of the volume of carbon dioxide released when the three metal carbonates decomposed when heated.

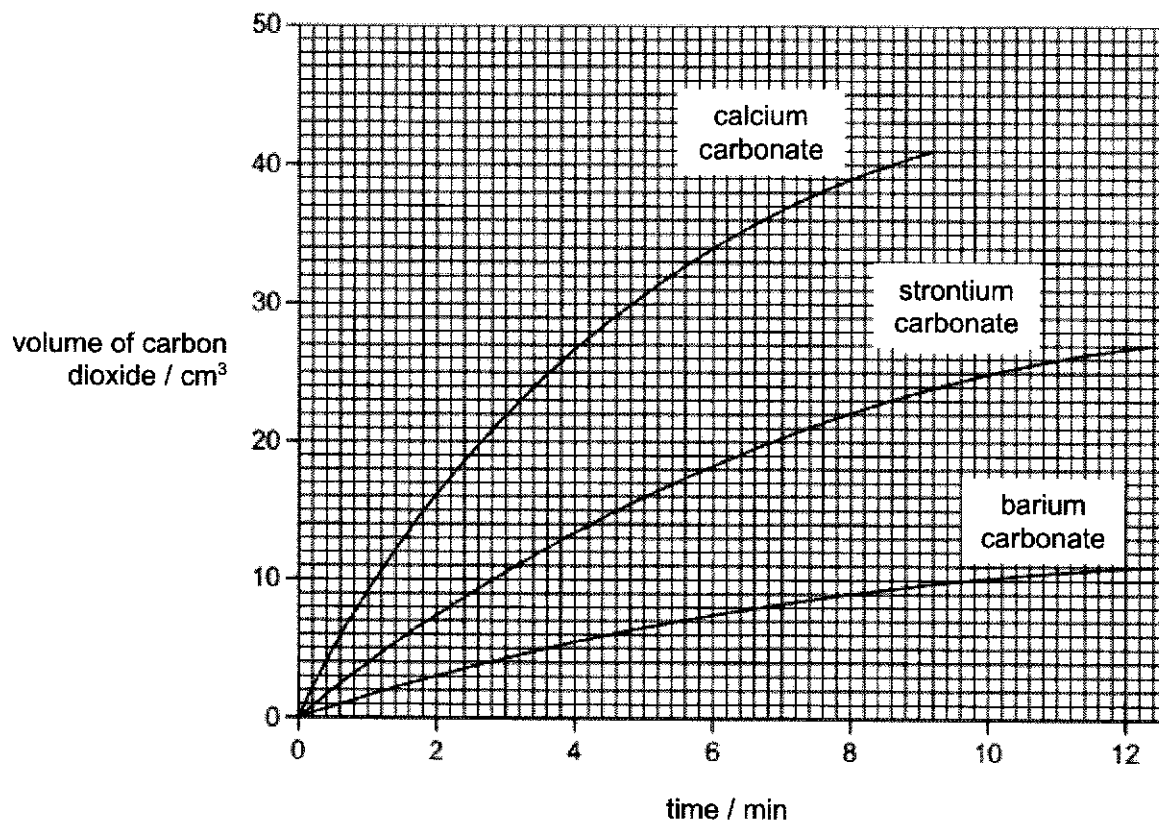


Fig. 6.2

- (i) Explain how does the speed of the decomposition of these three metal carbonates relate to the position of calcium, strontium and barium in the Periodic Table?

---



---



---

[2]

- (ii) On Fig. 6.2, draw a graph when potassium carbonate was heated, assuming all other conditions remain the same. Label the graph as (c)(ii).

[1]

- (iii) When 0.1 mole of barium carbonate was heated, 15.00 g of barium oxide was formed.

Calculate the percentage yield of barium oxide.

[2]

- (d) (i) Draw the 'cross and dot' diagram to show the arrangement of electrons in calcium oxide.

Show valence electrons only.

[2]

- (ii) Explain the difference in the electrical conductivity between barium and barium oxide.

---

---

---

---

---

---

---

[2]

(e) Iron is extracted in the blast furnace before it is made into alloys.

(i) Write the balanced chemical equation for the extraction of iron in the blast furnace.

\_\_\_\_\_ [1]

(ii) Describe the bonding in iron metal.

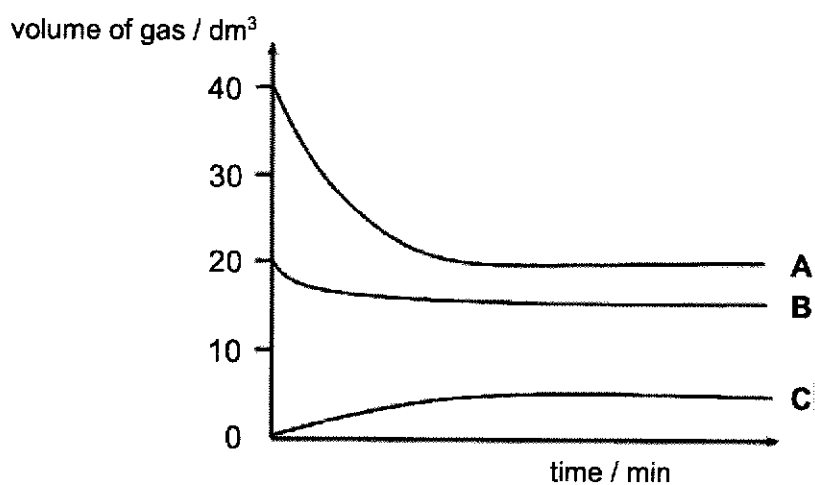
\_\_\_\_\_  
 \_\_\_\_\_ [1]

(iii) Explain why underwater pipes have a piece of magnesium attached to them.

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_ [2]

**A7** Ammonia is produced via the Haber process.

The volume of gases in the reaction chamber is monitored throughout the reaction, and the results were plotted in the graph in Fig. 7.1.



**Fig. 7.1**

(a) Write the equation for the formation of ammonia gas.

\_\_\_\_\_ [1]

- (b) Deduce which gas each graph represents, and explain how you derived your answer.

---

---

---

---

[2]



## 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.

**B8** Read the information about some titration experiments.

A pH probe attached to a computer measures pH changes during some titration experiments.

In the **experiment 1**,  $0.2 \text{ mol/dm}^3$  hydrochloric acid was added from a burette to  $25 \text{ cm}^3$  of dilute sodium hydroxide.

The pH probe measured the pH during the experiment.

Fig. 8.1 shows the results of the experiment 1.

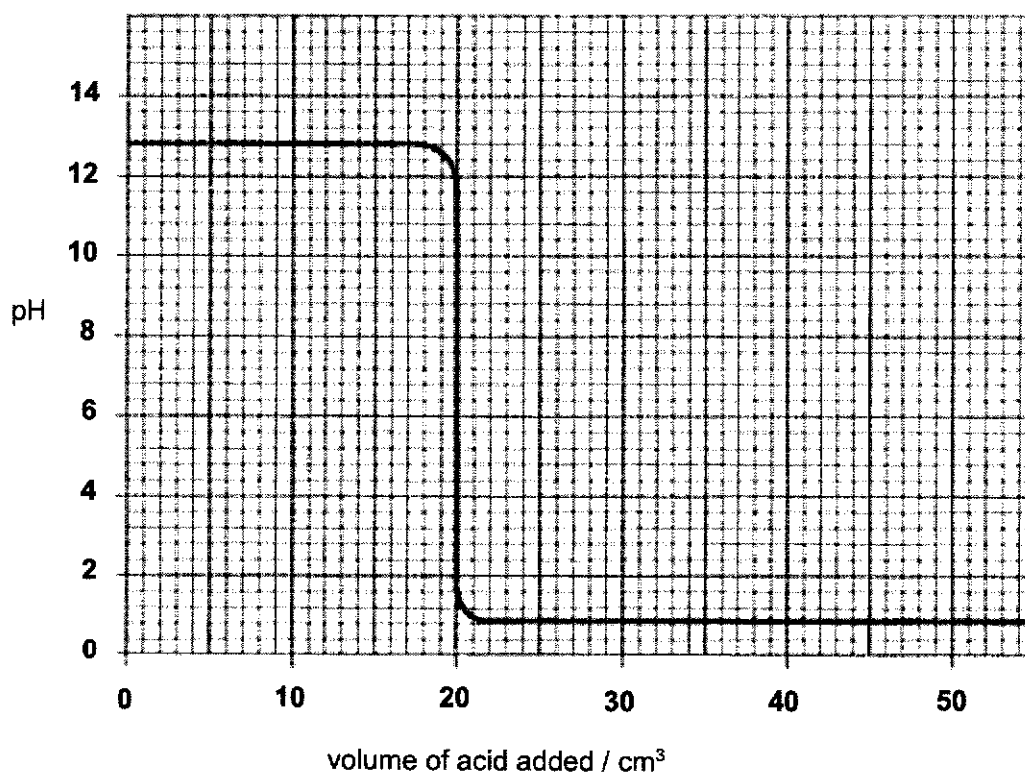
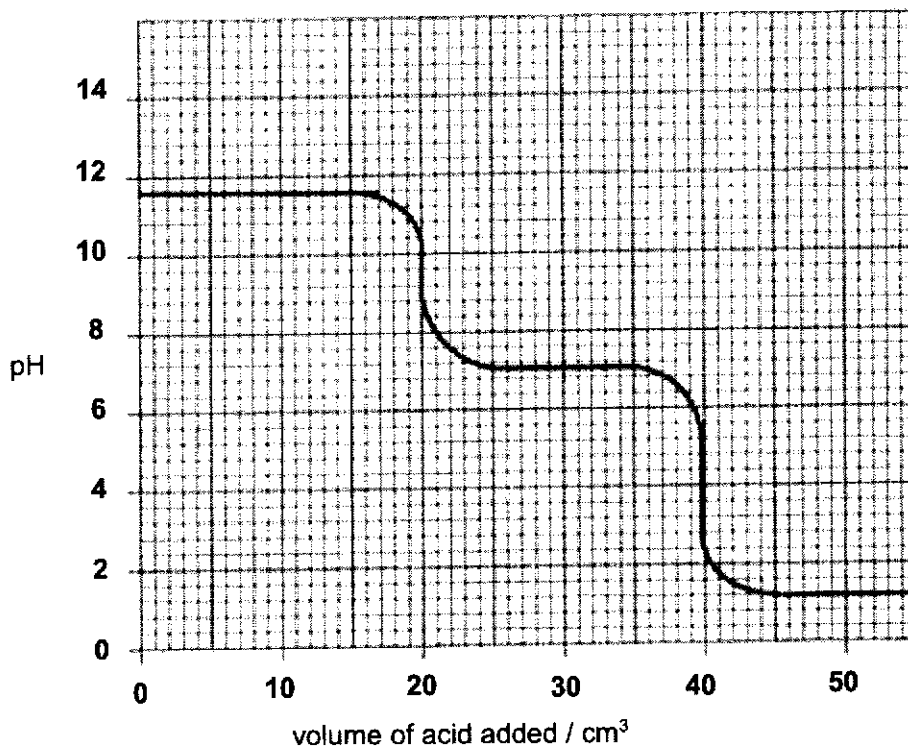


Fig. 8.1

In **experiment 2**,  $0.2 \text{ mol/dm}^3$  hydrochloric acid was added from a burette to  $25 \text{ cm}^3$  of dilute sodium carbonate.

Fig. 8.2 shows the results.



**Fig. 8.2**

The reaction between sodium carbonate and hydrochloric acid happens in two stages.

Stage 1: Sodium carbonate reacts with dilute hydrochloric acid to form sodium hydrogencarbonate ( $\text{NaHCO}_3$ ) and a neutral salt.

Stage 2: Sodium hydrogencarbonate undergoes a further reaction with hydrochloric acid.

## Endpoints and indicators

The endpoint of each titration happens when the indicator changes colour.

Fig. 8.3 shows the colours of some indicators at different pH values. In between the colours, most indicators change colour gradually over a range of pH values.

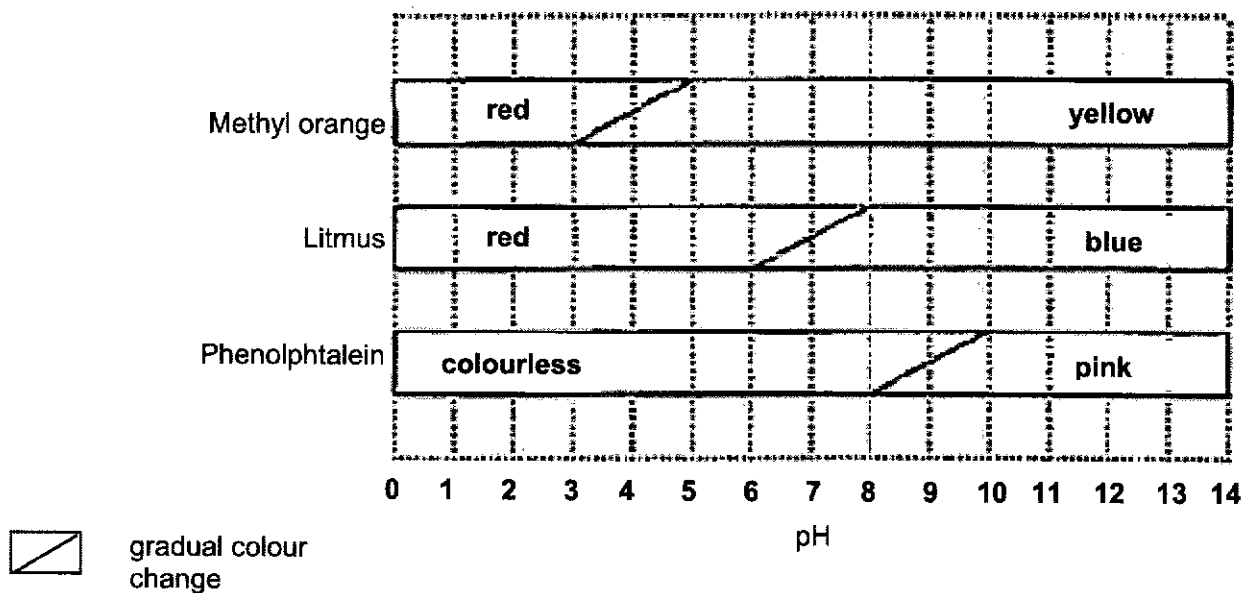


Fig. 8.3

- (a) Use the information to calculate the concentration of sodium hydroxide used in experiment 1.

[3]

- (b) A third experiment was carried out. A solution of sodium hydroxide of the same concentration as that used in experiment 1 was used. This time dilute hydrochloric acid of a concentration of  $0.1 \text{ mol/dm}^3$  was added from the burette.

On Fig. 8.1, sketch the graph you would expect from this experiment. [1]

- (c) What is the pH of sodium hydrogencarbonate?

\_\_\_\_\_ [1]

- (d) What is the name and formula of the neutral salt formed in **experiment 2** by the first stage of the reaction between sodium carbonate and hydrochloric acid?

\_\_\_\_\_ [1]

- (e) Sodium carbonate is described as a weak alkali but sodium hydroxide is described as a strong alkali.

Use information from the graphs to explain why.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ [2]

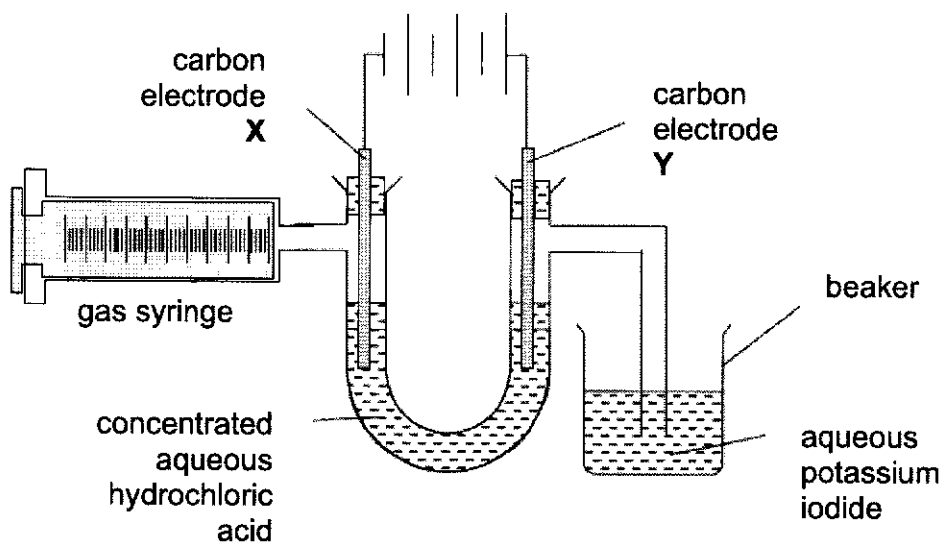
- (f) Explain why any of the indicators in Fig. 8.3 can be used to give an accurate titration volume when hydrochloric acid is titrated with dilute sodium hydroxide.

\_\_\_\_\_  
\_\_\_\_\_ [1]

- (g) Explain why methyl orange would **not** be suitable to use when titrating sodium carbonate with dilute hydrochloric acid.

\_\_\_\_\_  
\_\_\_\_\_ [1]

- B9** The electrolysis of concentrated aqueous hydrochloric acid was carried out using the apparatus as shown in Fig. 9.1.



**Fig. 9.1**

- (a)** Construct the half equations for the reactions at the electrodes.

carbon electrode X \_\_\_\_\_

carbon electrode Y \_\_\_\_\_

[2]

- (b)** Predict the observations in the beaker containing aqueous potassium iodide as the electrolysis proceeds.

With the aid of a chemical equation, explain your answer.

---



---



---



---



---



---

[3]

- (c) After the electrolysis was allowed to proceed for some time, it was observed that a new product was formed at carbon electrode **Y**.  
State the identity of this new product. Explain your answer.

---

---

---

---

[2]

- (d) Another experiment was carried out to electrolyse copper(II) sulfate solution using copper electrodes.

Student **A** commented that the colour intensity of the blue copper(II) sulfate solution will start to fade away throughout the experiment.

Student **B** commented that there will be no changes in the colour intensity of the blue copper(II) sulfate solution throughout the experiment.

Which student is correct? Explain your answer with the help of half equations.

---

---

---

---

---

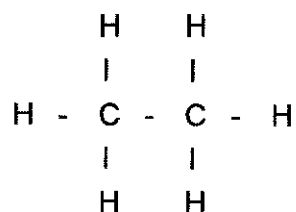
---

---

[3]

Either

**B10** The structural formula of ethane is



The combustion of ethane gas can be represented by the following equation.



Some bond energy values are given in Table 10.1.

bond	bond energy / $\text{kJ mol}^{-1}$
C-H	410
O=O	496
C=O	805
O-H	460

**Table 10.1**

(a) Draw an energy profile diagram for the combustion of ethane. Your diagram should indicate

- the activation energy,
- the enthalpy change of reaction,  $\Delta H$ .
- the formulae of the reactants and products.



[3]

(b) Calculate the bond energy for the C–C bond.

[3]

(c) Calculate the energy released by the complete combustion of 48.0 cm<sup>3</sup> of ethane.

[2]

(d) The amount of carbon dioxide in the atmosphere is increasing due to our use of fossil fuels.

(i) State the harmful effect of high concentration of carbon dioxide.

---

---

[1]

(ii) One approach to the problem is to plant more trees.  
Suggest why planting more trees is **not** a long term solution to the increase in the amount of carbon dioxide.

---

---

[1]



Or

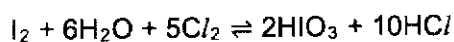
- B10 (a)** An oxyacid is a compound that contains hydrogen, oxygen and at least one other element. Iodine forms several types of oxyacids and their names and chemical formulae are given in Table 10.2.

name of oxyacid acid	chemical formula	oxidation state of iodine
periodic acid	$\text{HIO}_4$	
iodic acid	$\text{HIO}_3$	
hypoiodous acid	$\text{HIO}$	

Table 10.2

- (i) Complete Table 10.2 to show the oxidation states of iodine in the respective oxyacids. [2]
- (ii) What is the formula of the anion present in periodic acid?  
\_\_\_\_\_ [1]
- (iii) Draw a 'dot-and-cross' diagram to show the bonding in a molecule of hypoiodous acid,  $\text{HIO}$ .  
Show outer shell electrons only. [2]

- (b) Iodic acid is produced when iodine is mixed with water and chlorine, as shown in the equation below.



Explain, in terms of oxidation states, why this is a redox reaction

---

---

---

---

[2]

- (c) Oxalic acid is made up of carbon, oxygen and hydrogen and it contains 26.7 % carbon and 2.20 % hydrogen by mass.

- (i) Determine the empirical formula of oxalic acid.

[2]

- (ii) The relative molecular mass of oxalic acid is 90.  
Determine the molecular formula of oxalic acid.

[1]

**End of Paper**

# The Periodic Table of Elements

		Group																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
I	II	III	IV	V	VI	VII						0																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
3 Li lithium 7	4 Be beryllium 9	<div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <b>Key</b>                      proton (atomic) number                      atomic symbol                      name                      relative atomic mass                 </div>										2 He helium 4																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
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 Mc moscovium -	116 Lv livermorium -	117 Ts tennessine -	118 Og oganeson -	119 Uue unbinilium -	120 Uuo unbinilium -	121 Uut ununilium -	122 Uuq ununnilium -	123 Uub ununseptium -	124 Uuq ununquadium -	125 Uup ununpentium -	126 Uuh ununhexium -	127 Uuq ununquadium -	128 Uuo ununoctium -	129 Uuq ununquadium -	130 Uup ununpentium -	131 Uuh ununhexium -	132 Uuq ununquadium -	133 Uuo ununoctium -	134 Uuq ununquadium -	135 Uup ununpentium -	136 Uuh ununhexium -	137 Uuq ununquadium -	138 Uuo ununoctium -	139 Uuq ununquadium -	140 Uup ununpentium -	141 Uuh ununhexium -	142 Uuq ununquadium -	143 Uuo ununoctium -	144 Uuq ununquadium -	145 Uup ununpentium -	146 Uuh ununhexium -	147 Uuq ununquadium -	148 Uuo ununoctium -	149 Uuq ununquadium -	150 Uup ununpentium -	151 Uuh ununhexium -	152 Uuq ununquadium -	153 Uuo ununoctium -	154 Uuq ununquadium -	155 Uup ununpentium -	156 Uuh ununhexium -	157 Uuq ununquadium -	158 Uuo ununoctium -	159 Uuq ununquadium -	160 Uup ununpentium -	161 Uuh ununhexium -	162 Uuq ununquadium -	163 Uuo ununoctium -	164 Uuq ununquadium -	165 Uup ununpentium -	166 Uuh ununhexium -	167 Uuq ununquadium -	168 Uuo ununoctium -	169 Uuq ununquadium -	170 Uup ununpentium -	171 Uuh ununhexium -	172 Uuq ununquadium -	173 Uuo ununoctium -	174 Uuq ununquadium -	175 Uup ununpentium -	176 Uuh ununhexium -	177 Uuq ununquadium -	178 Uuo ununoctium -	179 Uuq ununquadium -	180 Uup ununpentium -	181 Uuh ununhexium -	182 Uuq ununquadium -	183 Uuo ununoctium -	184 Uuq ununquadium -	185 Uup ununpentium -	186 Uuh ununhexium -	187 Uuq ununquadium -	188 Uuo ununoctium -	189 Uuq ununquadium -	190 Uup ununpentium -	191 Uuh ununhexium -	192 Uuq ununquadium -	193 Uuo ununoctium -	194 Uuq ununquadium -	195 Uup ununpentium -	196 Uuh ununhexium -	197 Uuq ununquadium -	198 Uuo ununoctium -	199 Uuq ununquadium -	200 Uup ununpentium -	201 Uuh ununhexium -	202 Uuq ununquadium -	203 Uuo ununoctium -	204 Uuq ununquadium -	205 Uup ununpentium -	206 Uuh ununhexium -	207 Uuq ununquadium -	208 Uuo ununoctium -	209 Uuq ununquadium -	210 Uup ununpentium -	211 Uuh ununhexium -	212 Uuq ununquadium -	213 Uuo ununoctium -	214 Uuq ununquadium -	215 Uup ununpentium -	216 Uuh ununhexium -	217 Uuq ununquadium -	218 Uuo ununoctium -	219 Uuq ununquadium -	220 Uup ununpentium -	221 Uuh ununhexium -	222 Uuq ununquadium -	223 Uuo ununoctium -	224 Uuq ununquadium -	225 Uup ununpentium -	226 Uuh ununhexium -	227 Uuq ununquadium -	228 Uuo ununoctium -	229 Uuq ununquadium -	230 Uup ununpentium -	231 Uuh ununhexium -	232 Uuq ununquadium -	233 Uuo ununoctium -	234 Uuq ununquadium -	235 Uup ununpentium -	236 Uuh ununhexium -	237 Uuq ununquadium -	238 Uuo ununoctium -	239 Uuq ununquadium -	240 Uup ununpentium -	241 Uuh ununhexium -	242 Uuq ununquadium -	243 Uuo ununoctium -	244 Uuq ununquadium -	245 Uup ununpentium -	246 Uuh ununhexium -	247 Uuq ununquadium -	248 Uuo ununoctium -	249 Uuq ununquadium -	250 Uup ununpentium -	251 Uuh ununhexium -	252 Uuq ununquadium -	253 Uuo ununoctium -	254 Uuq ununquadium -	255 Uup ununpentium -	256 Uuh ununhexium -	257 Uuq ununquadium -	258 Uuo ununoctium -	259 Uuq ununquadium -	260 Uup ununpentium -	261 Uuh ununhexium -	262 Uuq ununquadium -	263 Uuo ununoctium -	264 Uuq ununquadium -	265 Uup ununpentium -	266 Uuh ununhexium -	267 Uuq ununquadium -	268 Uuo ununoctium -	269 Uuq ununquadium -	270 Uup ununpentium -	271 Uuh ununhexium -	272 Uuq ununquadium -	273 Uuo ununoctium -	274 Uuq ununquadium -	275 Uup ununpentium -	276 Uuh ununhexium -	277 Uuq ununquadium -	278 Uuo ununoctium -	279 Uuq ununquadium -	280 Uup ununpentium -	281 Uuh ununhexium -	282 Uuq ununquadium -	283 Uuo ununoctium -	284 Uuq ununquadium -	285 Uup ununpentium -	286 Uuh ununhexium -	287 Uuq ununquadium -	288 Uuo ununoctium -	289 Uuq ununquadium -	290 Uup ununpentium -	291 Uuh ununhexium -	292 Uuq ununquadium -	293 Uuo ununoctium -	294 Uuq ununquadium -	295 Uup ununpentium -	296 Uuh ununhexium -	297 Uuq ununquadium -	298 Uuo ununoctium -	299 Uuq ununquadium -	300 Uup ununpentium -	301 Uuh ununhexium -	302 Uuq ununquadium -	303 Uuo ununoctium -	304 Uuq ununquadium -	305 Uup ununpentium -	306 Uuh ununhexium -	307 Uuq ununquadium -	308 Uuo ununoctium -	309 Uuq ununquadium -	310 Uup ununpentium -	311 Uuh ununhexium -	312 Uuq ununquadium -	313 Uuo ununoctium -	314 Uuq ununquadium -	315 Uup ununpentium -	316 Uuh ununhexium -	317 Uuq ununquadium -	318 Uuo ununoctium -	319 Uuq ununquadium -	320 Uup ununpentium -	321 Uuh ununhexium -	322 Uuq ununquadium -	323 Uuo ununoctium -	324 Uuq ununquadium -	325 Uup ununpentium -	326 Uuh ununhexium -	327 Uuq ununquadium -	328 Uuo ununoctium -	329 Uuq ununquadium -	330 Uup ununpentium -	331 Uuh ununhexium -	332 Uuq ununquadium -	333 Uuo ununoctium -	334 Uuq ununquadium -	335 Uup ununpentium -	336 Uuh ununhexium -	337 Uuq ununquadium -	338 Uuo ununoctium -	339 Uuq ununquadium -	340 Uup ununpentium -	341 Uuh ununhexium -	342 Uuq ununquadium -	343 Uuo ununoctium -	344 Uuq ununquadium -	345 Uup ununpentium -	346 Uuh ununhexium -	347 Uuq ununquadium -	348 Uuo ununoctium -	349 Uuq ununquadium -	350 Uup ununpentium -	351 Uuh ununhexium -	352 Uuq ununquadium -	353 Uuo ununoctium -	354 Uuq ununquadium -	355 Uup ununpentium -	356 Uuh ununhexium -	357 Uuq ununquadium -	358 Uuo ununoctium -	359 Uuq ununquadium -	360 Uup ununpentium -	361 Uuh ununhexium -	362 Uuq ununquadium -	363 Uuo ununoctium -	364 Uuq ununquadium -	365 Uup ununpentium -	366 Uuh ununhexium -	367 Uuq ununquadium -	368 Uuo ununoctium -	369 Uuq ununquadium -	370 Uup ununpentium -	371 Uuh ununhexium -	372 Uuq ununquadium -	373 Uuo ununoctium -	374 Uuq ununquadium -	375 Uup ununpentium -	376 Uuh ununhexium -	377 Uuq ununquadium -	378 Uuo ununoctium -	379 Uuq ununquadium -	380 Uup ununpentium -	381 Uuh ununhexium -	382 Uuq ununquadium -	383 Uuo ununoctium -	384 Uuq ununquadium -	385 Uup ununpentium -	386 Uuh ununhexium -	387 Uuq ununquadium -	388 Uuo ununoctium -	389 Uuq ununquadium -	390 Uup ununpentium -	391 Uuh ununhexium -	392 Uuq ununquadium -	393 Uuo ununoctium -	394 Uuq ununquadium -	395 Uup ununpentium -	396 Uuh ununhexium -	397 Uuq ununquadium -	398 Uuo ununoctium -	399 Uuq ununquadium -	400 Uup ununpentium -	401 Uuh ununhexium -	402 Uuq ununquadium -	403 Uuo ununoctium -	404 Uuq ununquadium -	405 Uup ununpentium -	406 Uuh ununhexium -	407 Uuq ununquadium -	408 Uuo ununoctium -	409 Uuq ununquadium -	410 Uup ununpentium -	411 Uuh ununhexium -	412 Uuq ununquadium -	413 Uuo ununoctium -	414 Uuq ununquadium -	415 Uup ununpentium -	416 Uuh ununhexium -	417 Uuq ununquadium -	418 Uuo ununoctium -	419 Uuq ununquadium -	420 Uup ununpentium -	421 Uuh ununhexium -	422 Uuq ununquadium -	423 Uuo ununoctium -	424 Uuq ununquadium -	425 Uup ununpentium -	426 Uuh ununhexium -	427 Uuq ununquadium -	428 Uuo ununoctium -	429 Uuq ununquadium -	430 Uup ununpentium -	431 Uuh ununhexium -	432 Uuq ununquadium -	433 Uuo ununoctium -	434 Uuq ununquadium -	435 Uup ununpentium -	436 Uuh ununhexium -	437 Uuq ununquadium -	438 Uuo ununoctium -	439 Uuq ununquadium -	440 Uup ununpentium -	441 Uuh ununhexium -	442 Uuq ununquadium -	443 Uuo ununoctium -	444 Uuq ununquadium -	445 Uup ununpentium -	446 Uuh ununhexium -	447 Uuq ununquadium -	448 Uuo ununoctium -	449 Uuq ununquadium -	450 Uup ununpentium -	451 Uuh ununhexium -	452 Uuq ununquadium -	453 Uuo ununoctium -	454 Uuq ununquadium -	455 Uup ununpentium -	456 Uuh ununhexium -	457 Uuq ununquadium -	458 Uuo ununoctium -	459 Uuq ununquadium -	460 Uup ununpentium -	461 Uuh ununhexium -	462 Uuq ununquadium -	463 Uuo ununoctium -	464 Uuq ununquadium -	465 Uup ununpentium -	466 Uuh ununhexium -	467 Uuq ununquadium -	468 Uuo ununoctium -	469 Uuq ununquadium -	470 Uup ununpentium -	471 Uuh ununhexium -	472 Uuq ununquadium -	473 Uuo ununoctium -	474 Uuq ununquadium -	475 Uup ununpentium -	476 Uuh ununhexium -	477 Uuq ununquadium -	478 Uuo ununoctium -	479 Uuq ununquadium -	480 Uup ununpentium -	481 Uuh ununhexium -	482 Uuq ununquadium -	483 Uuo ununoctium -	484 Uuq ununquadium -	485 Uup ununpentium -	486 Uuh ununhexium -	487 Uuq ununquadium -	488 Uuo ununoctium -	489 Uuq ununquadium -	490 Uup ununpentium -	491 Uuh ununhexium -	492 Uuq ununquadium -	493 Uuo ununoctium -	494 Uuq ununquadium -	495 Uup ununpentium -	496 Uuh ununhexium -	497 Uuq ununquadium -	498 Uuo ununoctium -	499 Uuq ununquadium -	500 Uup ununpentium -	501 Uuh ununhexium -	502 Uuq ununquadium -	503 Uuo ununoctium -	504 Uuq ununquadium -	505 Uup ununpentium -	506 Uuh ununhexium -	507 Uuq ununquadium -	508 Uuo ununoctium -	509 Uuq ununquadium -	510 Uup ununpentium -	511 Uuh ununhexium -	512 Uuq ununquadium -	513 Uuo ununoctium -	514 Uuq ununquadium -	515 Uup ununpentium -	516 Uuh ununhexium -	517 Uuq ununquadium -	518 Uuo ununoctium -	519 Uuq ununquadium -	520 Uup ununpentium -	521 Uuh ununhexium -	522 Uuq ununquadium -	523 Uuo ununoctium -	524 Uuq ununquadium -	525 Uup ununpentium -	526 Uuh ununhexium -	527 Uuq ununquadium -	528 Uuo ununoctium -	529 Uuq ununquadium -	530 Uup ununpentium -	531 Uuh ununhexium -	532 Uuq ununquadium -	533 Uuo ununoctium -	534 Uuq ununquadium -	535 Uup ununpentium -	536 Uuh ununhexium -	537 Uuq ununquadium -	538 Uuo ununoctium -	539 Uuq ununquadium -	540 Uup ununpentium -	541 Uuh ununhexium -	542 Uuq ununquadium -	543 Uuo ununoctium -	544 Uuq ununquadium -	545 Uup ununpentium -	546 Uuh ununhexium -	547 Uuq ununquadium -	548 Uuo ununoctium -	549 Uuq ununquadium -	550 Uup ununpentium -	551 Uuh ununhexium -	552 Uuq ununquadium -	553 Uuo ununoctium -	554 Uuq ununquadium -	555 Uup ununpentium -	556 Uuh ununhexium -	557 Uuq ununquadium -	558 Uuo ununoctium -	559 Uuq ununquadium -	560 Uup ununpentium -	561 Uuh ununhexium -	562 Uuq ununquadium -	563 Uuo ununoctium -	564 Uuq ununquadium -	565 Uup ununpentium -	566 Uuh ununhexium -	567 Uuq ununquadium -	568 Uuo ununoctium -	569 Uuq ununquadium -	570 Uup ununpentium -	571 Uuh ununhexium -	572 Uuq ununquadium -	573 Uuo ununoctium -	574 Uuq ununquadium -	575 Uup ununpentium -	576 Uuh ununhexium -	577 Uuq ununquadium -	578 Uuo ununoctium -	579 Uuq ununquadium -	580 Uup ununpentium -	581 Uuh ununhexium -	582 Uuq ununquadium -	583 Uuo ununoctium -	584 Uuq ununquadium -	585 Uup ununpentium -	586 Uuh ununhexium -	587 Uuq ununquadium -	588 Uuo ununoctium -	589 Uuq ununquadium -	590 Uup ununpentium -	591 Uuh ununhexium -	592 Uuq ununquadium -	593 Uuo ununoctium -	594 Uuq ununquadium -	595 Uup ununpentium -	596 Uuh ununhexium -	597 Uuq ununquadium -	598 Uuo ununoctium -	599 Uuq ununquadium -	600 Uup ununpentium -	601 Uuh ununhexium -	602 Uuq ununquadium -	603 Uuo ununoctium -	604 Uuq ununquadium -	605 Uup ununpentium -	606 Uuh ununhexium -	607 Uuq ununquadium -	608 Uuo ununoctium -	609 Uuq ununquadium -	610 Uup ununpentium -	611 Uuh ununhexium -	612 Uuq ununquadium -	613 Uuo ununoctium -	614 Uuq ununquadium -	615 Uup ununpentium -	616 Uuh ununhexium -	617 Uuq ununquadium -	618 Uuo ununoctium -	619 Uuq ununquadium -	620 Uup ununpentium -	621 Uuh ununhexium -	622 Uuq ununquadium -	623 Uuo ununoctium -	624 Uuq ununquadium -	625 Uup ununpentium -	626 Uuh ununhexium -	627 Uuq ununquadium -	628 Uuo ununoctium -	629 Uuq ununquadium -	630



MARKING SCHEME  
PRELIM EXAM CHEMISTRY 2020  
SETTER: MDM SHURYATI

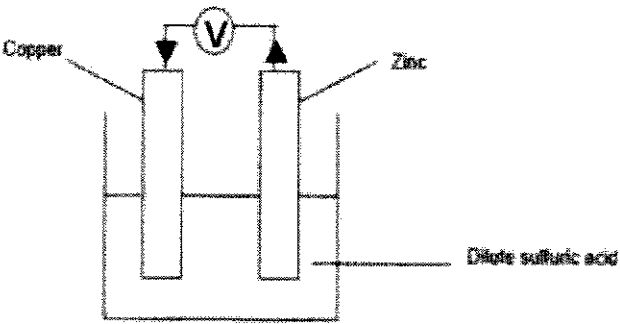
PAPER 1

1	2	3	4	5	6	7	8	9	10
D	C	A	D	A	B	B	A	B	D
11	12	13	14	15	16	17	18	19	20
A	D	C	A	B	B	C	A	D	B
21	22	23	24	25	26	27	28	29	30
B	C	C	C	B	D	B	A	D	B
31	32	33	34	35	36	37	38	39	40
B	C	A	D	A	B	C	A	B	A

MARKING SCHEME  
PRELIM EXAM CHEMISTRY 2020  
SETTER: MDM SHURYATI

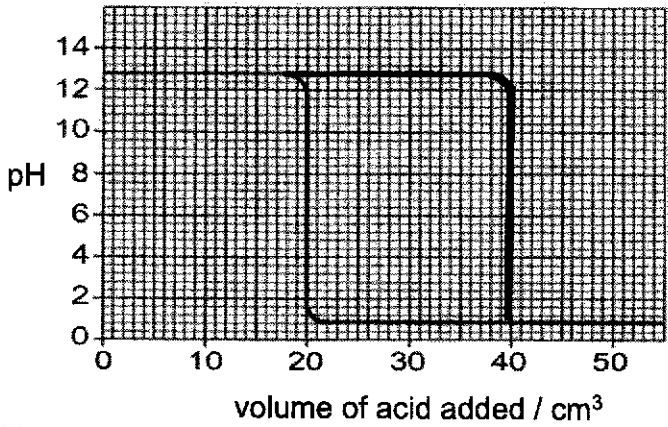
**Paper 2**

A1	(a)	name	formula	number of protons	number of neutrons	number of electrons		
		hydrogen atom	${}^1_1\text{H}$	1	<u>0</u>	1	1	
		deuterium ion	${}^2_1\text{H}^+$	<u>1</u>	<u>1</u>	0	1	
		tritium ion	${}^3_1\text{H}^+$	<u>1</u>	2	2	1	
		Each row – 1m						
	(b)	Ar of Ge = $(24.4/100) \times 70 + (32.4/100) \times 72 + (43.2/100) \times 74$ ; = 72.4 (3sf) ;					1 1	
	(c)	Agree; All isotopes of the same element have same number of valence electrons.					1	
A2	(ai)	Na <sub>2</sub> CO <sub>3</sub> (aq); CuCl <sub>2</sub> (aq)					1	
	(aii)	Ba(NO <sub>3</sub> ) <sub>2</sub> (aq); (NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub> (aq)/ H <sub>2</sub> SO <sub>4</sub> (aq)					1	
	(aiii)	KOH(aq); (NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub> (aq)					1	
	(aiv)	Zn(s); CuCl <sub>2</sub> (aq)					1	
	(av)	H <sub>2</sub> SO <sub>4</sub> (aq); KOH(aq)/ Na <sub>2</sub> CO <sub>3</sub> (aq)					1	
	(b)	Na <sub>2</sub> CO <sub>3</sub> (aq) + CuCl <sub>2</sub> (aq) → 2NaCl(aq) + CuCO <sub>3</sub> (s)					1	
A3	(a)	arrangement : From closely-packed together; orderly to far apart; random					1	
		motion: From vibrate at fixed positions to move randomly and rapidly					1	
	(bi)	<b>C</b>					1	
	(bii)	I disagree because solvent 2 does not allow student to identify the 4 amino acids as B and D have identical R <sub>f</sub> values hence cannot be distinguished;					1	
		Duration of chromatography is also not a source of error, because R <sub>f</sub> is a ratio (of distance travelled by dye to distance travelled by solvent) / R <sub>f</sub> is only dependent of solubility of component in a specific solvent./R <sub>f</sub> values are not time dependent.					1	
A4	(a)	P <sub>4</sub> O <sub>6</sub>					1	

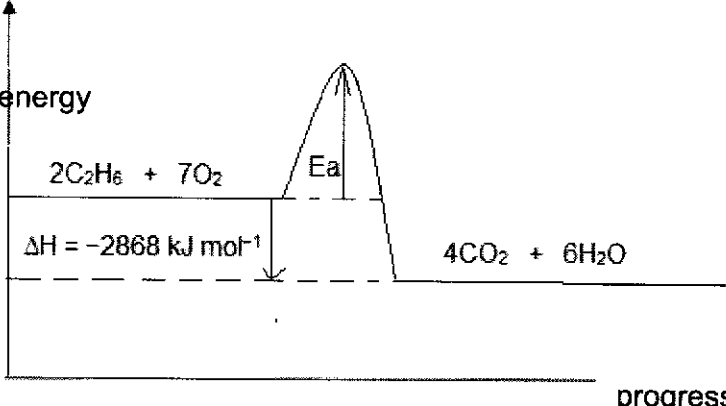
	(b)	Each carbon atom in substance B is bonded to 4 other carbon atoms, hence all 4 valence electrons are used for covalent bonding; There are no mobile ions or electrons to conduct electricity.	1
	(c)	A: discrete single molecules with weak intermolecular forces of attraction; B: an <u>extensive network</u> of many atoms bonded by strong covalent bonds.	1 1
	(d)	Phosphorus is a non-metal and non-metal oxides are usually acidic	1
A5	(ai)	The rate is lowered/ decreased;  Increased in pH occurs when H <sup>+</sup> ions is removed from the solution which lowers the concentration of the H <sup>+</sup> ions;  This means that number of effective collisions per second between H <sup>+</sup> and reactant particles decreases, hence the rate decreases.	1  1
	(a ii)	No of moles of HCl = $50/1000 \times 1 = 0.05$ mol No of moles of sodium thiosulfate = $50/1000 \times 1 = 0.05$ mol;  From equation, 2 mol HCl : 1 mol Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> 0.05 mol HCl : 0.025 mol Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> (needed) < 0.05 mol (given) Hence, HCl is limiting;  The reaction stopped as all the HCl has been used up [1].	1  1
	(a iii)	Graph II: Steeper gradient compared to Graph I Mass of precipitate is the same as in Graph I	1
	(bi)		1

	(bii)	The voltmeter reading will be lower than that with zinc. Iron is below zinc in the reactivity series. Hence, the closer the metals are in the reactivity series, the smaller the difference in voltage across the two electrodes.	1 1
A6	(ai)	Sr has one electron shell more than Ca but one less than Ba;	1
	(aii)	$\text{Sr} + 2\text{H}_2\text{O} \rightarrow \text{Sr}(\text{OH})_2 + \text{H}_2$ ;	1
	(aiii)	Sr is more reactive, Sr is below Ca in the Periodic Table; reactivity increases down a group / Sr loses electrons more easily than Ca;	1
	(b)	temperature of Bunsen / distance of Bunsen from the tube / amount or mass/ no of moles of carbonate used;	1
	(ci)	calcium carbonate decompose faster than strontium carbonate which is faster than barium carbonate / correct trend i.e. decomposition is less rapid further down the group;  The ionic bonds between the ions in barium carbonate are stronger than in strontium carbonate which is stronger than in calcium carbonate/correct trend i.e the ionic bonds become stronger in the metal carbonates from calcium to strontium to barium. or reverse argument	1 1
	(cii)	on the x-axis	1
	(ciii)	Ratio of mole $\text{BaCO}_3$ : $\text{BaO}$ is 1:1 Mass of $\text{BaO}$ = $0.1 \times (137 + 16)$ = 15.3 g Percentage yield of $\text{BaO}$ = $(15.00/15.3) \times 100\%$ = 98% (2sf)	1 1
	(di)	Ratio 1 calcium ion : 1 oxide ion; calcium ion : correct number of valence electrons and charge Oxide ion : correct number of valence electrons and charge	1 1
	(dii)	Barium: conduct electricity in solid and molten; presence of mobile electrons to move and carry current; Barium oxide: does not conduct in solid; ions in fixed positions conduct electricity in molten and aqueous; presence of mobile ions to move and carry current	1 1
	(ei)	$\text{Fe}_2\text{O}_3 + 3\text{CO} \longrightarrow 2\text{Fe} + 3\text{CO}_2$	1
	(eii)	Electrostatic forces of attraction between the positive iron ions and 'sea of mobile /delocalised electrons'	1
	(eiii)	Magnesium is more reactive than iron; Air/Oxygen and water will react with magnesium instead of iron; Magnesium will corrode instead of iron	1 1
7	(a)	$\text{N}_2 + 3\text{H}_2 \rightleftharpoons 2\text{NH}_3$	1



	(b)	C is ammonia as its volume increases from zero. A is hydrogen and B is nitrogen, as a greater volume of hydrogen is used up in the reaction as compared to nitrogen (according to the mole ratio of 3:1).	1 1
<b>SECTION B</b>			
B8	(a)	No of mole hydrochloric acid = $0.2 \times 20/1000$ = 0.004 moles	[1]
		No of mole of NaOH = $\frac{1}{1}$ No of mole HCl = 1 No of mole of NaOH = 0.004 mol <i>ratio to be shown</i>	[1]
		Concentration of NaOH = $0.004 / 0.025$ = 0.16 mol/dm <sup>3</sup>	[1]
	(b)	 <p style="text-align: center;">volume of acid added / cm<sup>3</sup></p>	1
	(c)	pH 9 (accept 9.3 to 9.5)	[1]
	(d)	sodium chloride, NaCl	[1]
	(e)	-pH of NaOH is higher (pH 13). pH of sodium carbonate is lower (pH 11.6) <i>(pH values must be given)</i> -NaOH completely neutralises HCl (end point pH 7) En-point of sodium carbonate and HCl is at acidic pH/(3.5 to 4.2) <i>(pH 7 must be given)</i>	[1] [1]
	(f)	The pH changes from 1.8 to 12(accept 0.8 to 12.2). All the indicators show a colour change within this range.	[1]
	(g)	Cannot detect colour change at stage 1 Can only detect colour change at stage 2	[1]
B9	(a)	X: $2H^+(aq) + 2e^- \rightarrow H_2(g)$ Y: $2Cl^-(aq) \rightarrow Cl_2(g) + 2e^-$ 1 m for correct balanced equations 1 m for correct state symbols	1 1

	<b>(b)</b>	Colourless solution turns brown/A black solid is formed; $Cl_2 + 2I^- \rightarrow I_2 + 2Cl^-$ ; (full equation accepted) Chlorine is more reactive than iodine; So chlorine will displace iodine from potassium iodide	1 1 1
	<b>(c)</b>	Oxygen gas; Over time, concentration of chloride ions decrease and hydroxide ions become preferentially/selectively discharged, producing oxygen.	1 1
	<b>(d)</b>	Student B. Anode decreases in mass/ dissolves; Increase in mass at the cathode/ A reddish-brown solid deposited at the cathode; At anode: Copper electrode dissolves to form copper(II) ions/ accept half equation; At cathode: Copper(II) ions are preferentially/selectively discharged, forming copper metal/ accept half equation. OR	1  1  1
		Student B is correct; The concentration of copper(II) ions in the electrolyte <u>remains the same</u> because copper(II) ions are <u>added</u> to the electrolyte when <u>the anode dissolves</u> to form copper(II) ions; and at cathode, the copper(II) ions are <u>preferentially discharged</u> at the cathode to form copper;  At cathode : $Cu^{2+} (aq) + 2e \rightarrow Cu(s)$ ; At anode : $Cu (s) \rightarrow Cu^{2+} (aq) + 2e$	[1]  [1]  [1]

<p><b>Either</b> <b>B10</b></p>	<p>(a)</p>	 <p>1 mark for correct graph 1 mark for indicating both <math>E_a</math> 1m for <math>\Delta H</math> correctly with labels and direction</p>	
	<p>(b)</p>	<p>Total energy released during bond formation = <math>4 \times 2 \times 805 + 6 \times 2 \times 460 = 11960</math> kJ</p> <p>Total energy absorbed during bond breaking = <math>11960 - 2868 = 9092</math> kJ</p> <p>bond energy for the C – C bond = <math>(9092 - 2 \times 6 \times 410 - 7 \times 496) \div 2 = 350</math> kJ mol<sup>-1</sup></p> <p>Accept any other logical method</p>	<p>[1] [1] [1]</p>
	<p>(c)</p>	<p>No of mol of ethane = <math>48.0 \div 24000 = 0.00200</math> Energy released = <math>0.00200 \times 2 \times 2868 = 2.87</math> kJ</p>	<p>[1] [1]</p>
	<p>(di)</p>	<p>Greenhouse gas; leads to global warming</p>	<p>[1]</p>
	<p>(dii)</p>	<p>At night/in dark, plants continue to respire to produce carbon dioxide but do not undergo photosynthesis</p>	<p>[1]</p>

<b>Or 10</b>	<b>(ai)</b>	name of oxyacid acid	chemical formula	oxidation state of iodine	[2]																
		periodic acid	HIO <sub>4</sub>	+7																	
		iodic acid	HIO <sub>3</sub>	+5																	
		hypoiodous acid	HIO	+1																	
		3 correct : 2m 2 correct : 1m																			
	<b>(aii)</b>	IO <sub>4</sub> <sup>-</sup>																			
	<b>(aiii)</b>	<p>1M for correct sharing of electrons between H and O and O and I 1M for correct number of valence electrons for H, O and I</p>			[2]																
	<b>(b)</b>	Iodine is oxidised as the oxidation state of iodine increases from 0 (in I <sub>2</sub> ) to +5 in (HIO <sub>3</sub> ). [1] Chlorine is reduced as the oxidation state of chlorine decreases from 0 (in Cl <sub>2</sub> ) to -1 (in HCl). [1] It is a redox reaction as iodine is oxidised and chlorine is reduced			[1] [1]																
	<b>(ci)</b>	<table border="1"> <thead> <tr> <th></th> <th>carbon</th> <th>hydrogen</th> <th>oxygen</th> </tr> </thead> <tbody> <tr> <td>mass (in 100g)</td> <td>26.7</td> <td>2.2</td> <td>71.1</td> </tr> <tr> <td>no of moles</td> <td>2.225</td> <td>2.2/1 = 2.2</td> <td>4.44</td> </tr> <tr> <td>lowest ratio</td> <td>1</td> <td>1</td> <td>2</td> </tr> </tbody> </table> <p>or Any logical working</p>		carbon	hydrogen	oxygen	mass (in 100g)	26.7	2.2	71.1	no of moles	2.225	2.2/1 = 2.2	4.44	lowest ratio	1	1	2	1		
	carbon	hydrogen	oxygen																		
mass (in 100g)	26.7	2.2	71.1																		
no of moles	2.225	2.2/1 = 2.2	4.44																		
lowest ratio	1	1	2																		
		Empirical formula of oxalic acid = CHO <sub>2</sub> ;			1																
	<b>(cii)</b>	$n(12 + 1 + 32) = 90$ $n = 2$ molecular formula of oxalic acid = C <sub>2</sub> H <sub>2</sub> O <sub>4</sub>			1																



