CHRIST CHURCH SECONDARY SCHOOL
2022 PRELIMINARY EXAMINATION
FOUR EXPRESS

CANDIDATE NAME		CLASS	
CENTRE NUMBER	S	INDEX NUMBER	

CHEMISTRY

6092/01

Paper 1

15 July 2022

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write your Centre number, index number, name and class on all the work you hand in.
Write in soft pencil on the Multiple Choice Answer Sheet
Do not use staples, paper clips, highlighters, glue or correction fluid.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Multiple Choice Answer Sheet.

Read the instructions on the answer sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
A copy of the Periodic Table is printed on page 14.
The use of an approved scientific calculator is expected, where appropriate.

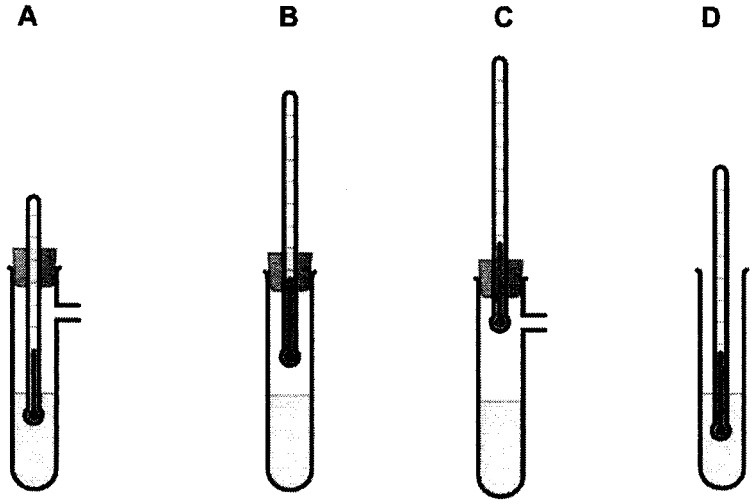
This document consists of **14** printed pages.

1 Which one of the following correctly describes the particles in a dilute sugar solution at room temperature?

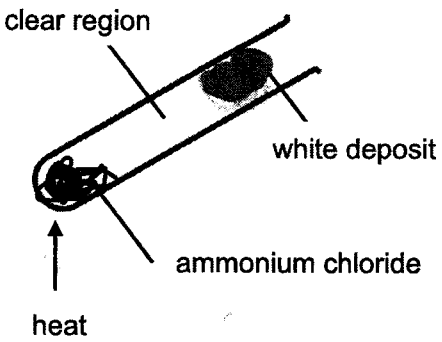
	sugar molecules	water molecules
A	widely separated, moving at random	close together, moving at random
B	widely separated, moving at random	close together, not moving
C	widely separated, not moving	widely separated, moving at random
D	close together, moving at random	widely separated, vibrating slightly

2 The tubes shown in the diagram all contain a dilute solution of a solid X dissolved in a liquid Y.

Which apparatus is most suitable for finding the boiling point of liquid Y?



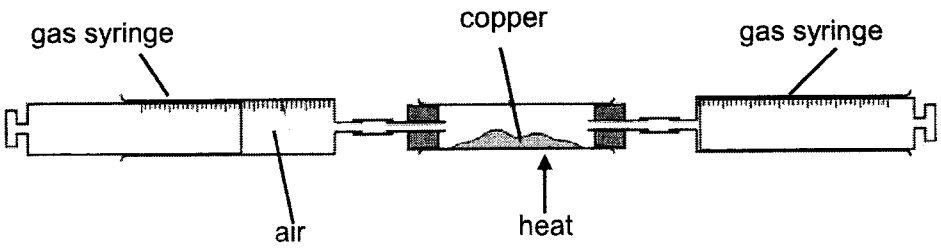
3 The diagram shows some ammonium chloride being heated.



What does the clear region between the ammonium chloride and the white deposit contain?

A ammonia and chlorine
B ammonia and hydrogen chloride
C ammonia and water vapour
D ammonium chloride vapour

4 The percentage of oxygen in the air is found by using the apparatus shown below. The air is passed over heated copper until there is no further decrease in volume.

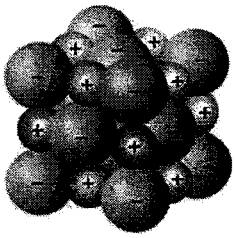


What precaution should be taken before the initial volume of air and final volume of gases remaining in the apparatus are found?

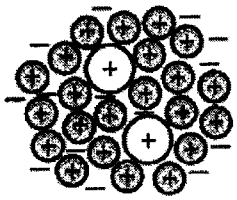
A The tube containing the copper should be removed.
B Both syringes should contain the same volume of air.
C All the copper should have reacted.
D The apparatus should be at room temperature.

5 Which of the following shows the structure of bronze?

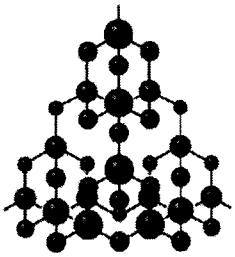
A



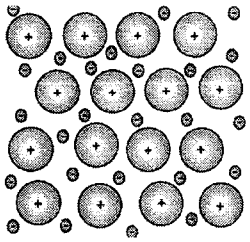
B



C



D



6 Naturally-occurring bromine has a relative atomic mass of 80 and consists entirely of two isotopes of relative atomic masses 79 and 81.

What can be deduced about naturally-occurring bromine from this information only?

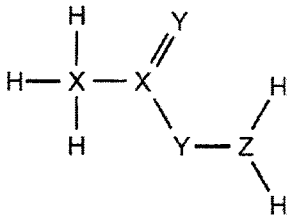
A Bromine is radioactive.
B Bromine has different oxidation states.
C Bromine isotopes have different number of protons.
D Bromine contains the two isotopes in equal proportions.

7 Silicon carbide is a shiny, hard, chemically inert material with a very high melting point. It can be used to sharpen knives and make crucibles.

Which type of structure explains these properties?

A a giant structure with covalent bonds between carbon and silicon atoms
B a giant structure containing metallic bonds
C a giant structure with covalent bonds between atoms and weak forces of attraction between the layers of atoms
D a simple molecular structure with covalent bonds between the carbon and silicon atoms

8 The diagram shows the structure of a covalent compound containing the element hydrogen, H, and the unknown elements X, Y and Z.



To which groups of the Periodic Table do these three elements, X, Y and Z, belong?

	X	Y	Z
A	1	5	6
B	4	5	1
C	4	6	5
D	5	1	4

9 What does a solution of hydrogen chloride and methylbenzene contain?

A methylbenzene ions, hydrogen ions and chloride ions
B methylbenzene ions and hydrogen chloride molecules
C methylbenzene molecules, hydrogen molecules and chlorine molecules
D methylbenzene molecules and hydrogen chloride molecules

10 Which one of the following substances

(i) is an element
(ii) also forms crystals composed of small molecules?

A carbon dioxide
B ice
C iodine
D graphite

11 The table below shows the results of experiments to measure the volume of sulfuric acid (column 1) needed to neutralise the mass of sodium hydroxide (column 2) dissolved in the volume of water (column 3).

experiment	column 1	column 2	column 3
	volume of sulfuric acid required / cm^3	mass of sodium hydroxide / g	volume of water required / cm^3
1	20	1	20
2	40	2	40
3	40	2	20
4	?	1	40

From the results, what volume of sulfuric acid is needed to neutralise the sodium hydroxide in experiment 4?

A 10 cm^3 **B** 20 cm^3
C 40 cm^3 **D** 80 cm^3

12 Dinitrogen tetroxide, N_2O_4 is a poisonous gas. It can be disposed of safely by reaction with sodium hydroxide. In the experiment, the concentration of aqueous sodium hydroxide used is 1.5 mol/dm^3.

$$N_2O_4(g) + 2NaOH(aq) \rightarrow NaNO_3(aq) + NaNO_2(aq) + H_2O(l)$$

What is the least volume of aqueous sodium hydroxide required to dispose of 300 cm^3 of N_2O_4 at room temperature and pressure?

A 10 cm^3 **B** 20 cm^3
C 120 cm^3 **D** 240 cm^3

13 An element X in found in Group VII of the Periodic Table.

Which of the following is a likely behaviour of element X?

A reacts vigorously with water
B forms a hydride of formula XH_7
C reduces hydrogen sulfide
D oxidises SO_3^{2-} to SO_4^{2-}

14 250 cm^3 of 3.00 mol/dm^3 dilute hydrochloric acid is added to 350 cm^3 of 2.00 mol/dm^3 dilute hydrochloric acid.

What is the concentration of the resulting solution?

A 1.45 mol/dm^3
B 2.42 mol/dm^3
C 2.50 mol/dm^3
D 8.33 mol/dm^3

15 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	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	X	Y
B	W	Y	X
C	X	Y	W
D	Y	W	X

16 Nickel is between iron and lead in the reactivity series.

Which of the following can be deduced from this?

A Nickel can be obtained by moderate heating of nickel hydroxide.
B Nickel can displace hydrogen rapidly from hot water.
C Nickel can be displaced from an aqueous solution containing nickel ions.
D Nickel loses electrons more readily than iron

17 Which one of the following reactions could be represented by the ionic equation.
M is the symbol for a metallic element.

$$M(s) + 2H^+(aq) \longrightarrow M^{2+}(aq) + H_2(g)$$

A iron + dilute hydrochloric acid
B lead + dilute sulfuric acid
C iron + steam
D sodium + water

18 A sample of air was shaken with an alkaline solution of a compound called pyrogallol. The gases remaining did not support combustion.

Which one of the following pairs of gases was removed by pyrogallol?

A carbon dioxide and nitrogen
B oxygen and carbon dioxide
C oxygen and nitrogen
D water vapour and hydrogen

19 Which of the following gases is **least** common in air?

A hydrogen
B argon
C carbon dioxide
D nitrogen

20 In an experiment, 6 moles of magnesium ions were discharged in the electrolysis of molten magnesium chloride.

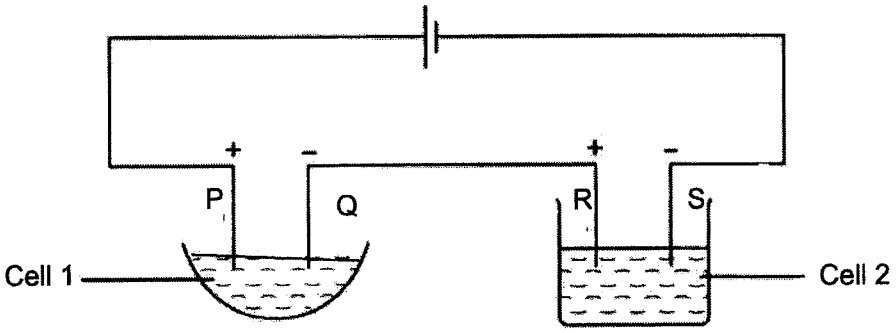
Which amount of metal would be discharged by the same amount of electricity in the following experiments?

A 3 moles of copper(II) ions in the electrolysis of aqueous copper(II) sulfate.
B 6 moles of zinc ions in the electrolysis of aqueous zinc chloride.
C 12 moles of calcium ions in the electrolysis of molten calcium fluoride.
D 12 moles of lithium ions in the electrolysis of molten lithium bromide.

21 Two electrolytic cells are connected as shown in the diagram.

Cell 1: P is a copper electrode while Q is a platinum electrode immersed in dilute copper(II) chloride solution.

Cell 2: R is a platinum electrode while S is a copper electrode immersed in concentrated copper(II) chloride solution.



Which of the following statement(s) describes the observations made after sometime?

1. There is a higher mass gain in Q than S.
2. Both P and R electrodes decrease in mass.
3. Both Cell 1 and 2 electrolytes fade in colour.

A 1 and 2
B 1 and 3
C 2 and 3
D none of the above

22 When sulfur dioxide is bubbled into aqueous bromine, the reddish brown colour fades.

Which of the following describes the role of sulfur dioxide in the above reaction?

A an acid
B an oxidising agent
C a reducing agent
D a catalyst

23 Which one of the following processes does **not** involve either oxidation or reduction?

A manufacture of iron from haematite
B manufacture of ammonium sulfate from ammonia and sulfuric acid
C manufacture of ammonia from nitrogen and hydrogen
D manufacture of zinc from zinc blende (ZnS)

24 Which one of the following statements is always true for all examples of combustion?

A One product is always carbon dioxide.
B It is an exothermic reaction.
C The combustion products have more energy than the original fuel and oxygen.
D No bonds are broken in the reaction.

25 When powdered metal M was placed in aqueous lead(II) nitrate, a grey precipitate was obtained. The temperature rose and some M remained unchanged.

Which of the following conclusions **cannot** be deduced from this information?

A The reaction is exothermic.
B M is more reactive than lead.
C M was in excess.
D M has the same valency as lead.

26 Hydrogen peroxide decomposes to form water and oxygen gas. In two separate experiments, manganese(VI) oxide was added to 50 cm^3 of aqueous hydrogen peroxide.

The measurements taken are shown in the table below.

experiment	mass of MnO_2 / g	tempertaure rise / °C	Total volume of O_2 produced / cm^3
1	0.1	5	50
2	0.2	x	y

What were the values of x and y?

	x	y
A	2.5	50
B	5.0	50
C	5.0	100
D	10.0	100

27 Sulfur dioxide is reacted with oxygen to produce sulfur trioxide. This reaction is catalysed by a metal oxide catalyst.

$$2SO_2(g) + O_2(g) \longrightarrow 2SO_3(g)$$

What will become larger if the experiment is repeated using a better catalyst?

A The total volume of gas produced at the end of the reaction.
B The amount of hydrogen peroxide left over at the end of the reaction.
C The initial gradient of a graph of total volume of gas produced against time.
D The time needed to produce a particular volume of gas.

28 Four oxides are added separately to aqueous sodium hydroxide.

1. aluminium oxide
2. carbon dioxide
3. copper(II) oxide
4. magnesium oxide

Which oxides react with aqueous sodium hydroxide?

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

29 The results of some tests on solid X are listed below.

1. Solid X produced water when it is gently heated alone.
2. When dissolved completely in water and added to aqueous ammonia, it gave a dirty-green precipitate.
3. When dissolved completely in water and added to silver nitrate solution, it gave a white precipitate.

From the above results, what is solid X?

A hydrated copper(II) sulfate
B anhydrous copper(II) chloride
C hydrated iron(II) chloride
D anhydrous iron(II) sulfate

30 Which of the following mixtures below will result in the ionic equation shown?

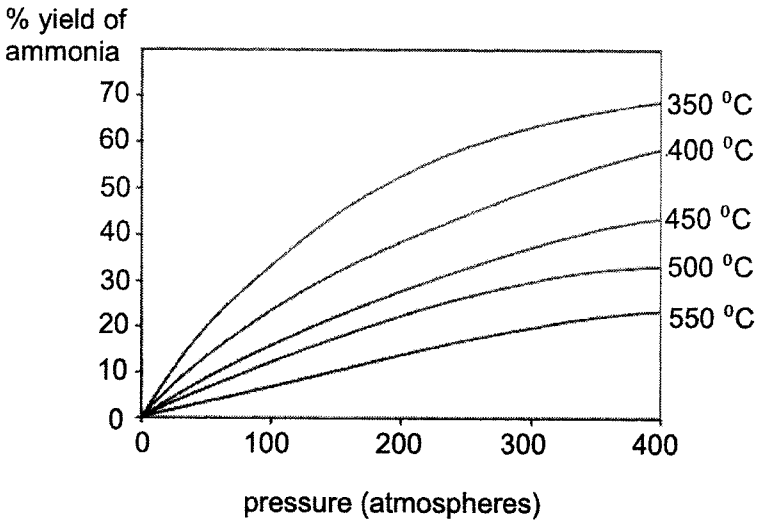
$$Pb^{2+}(aq) + SO_4^{2-}(aq) \longrightarrow PbSO_4(s)$$

A aqueous lead(II) nitrate is added to dilute sulfuric acid
B lead(II) chloride is added to aqueous sodium sulfate
C lead(II) oxide is added to dilute sulfuric acid
D lead(II) sulfate is added to water

31 Nitrogen and hydrogen can react upon heating, according to the chemical equation.

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

The graph below shows the percentage yield of ammonia produced from 1 mole of nitrogen at different temperatures and pressures.



Which of the following statement(s) can be deduced from the information given above?

1. At 200 atmospheres, the number of moles of ammonia produced is greater at 450 °C than at 500 °C.
2. An increase in pressure increases the number of moles of ammonia produced at both 400 °C and at 350 °C.
3. The percentage yield of ammonia will most likely to be 33% at 500 °C and at 400 atmospheres.

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

32 The following ionic equation shows a redox reaction.

$$BrO_3^- + 5\,Br^- + 6H^+ \longrightarrow 3Br_2 + 3H_2O$$

Which one of the following substances is the oxidising agent?

A BrO_3^-
B Br^-
C H^+
D H_2O

33 Which one of the following reagents can be used to distinguish between butane and butanol?

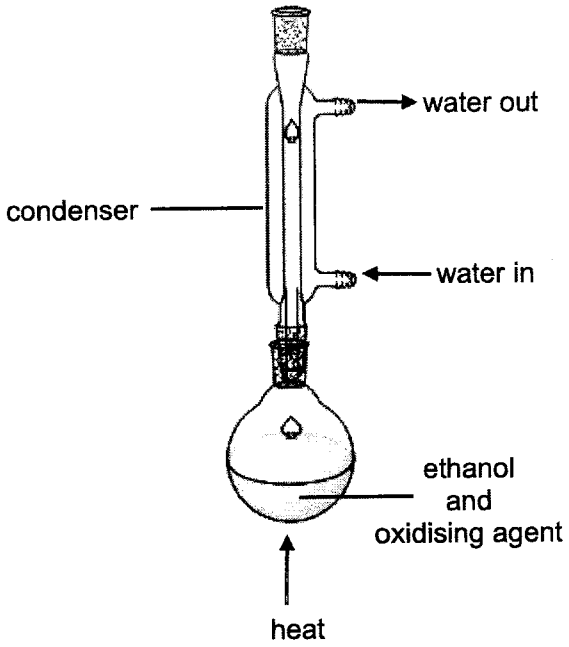
A concentrated sulfuric acid
B aqueous bromine
C phosphoric acid
D acidified potassium manganate(VII)

34 Ethanol is used in some after-shave lotions and deodorants.

Which pair of properties makes it suitable for these uses?

A It is flammable and mixes easily with water.
B It is flammable and vapourises easily.
C It is a good solvent and vapourises easily.
D It is colourless and mixes easily with water.

35 Ethanol was oxidised to ethanoic acid using the apparatus shown below.



What is the purpose of the condenser in the above set-up?

A prevent the conversion of the ethanol to ethene
B prevent the escape of any unchanged ethanol
C prevent the reforming of ethanol from ethanoic acid
D prevent the reaction of ethanoic acid with ethanol

36 Under suitable conditions, concentrated sulfuric acid dehydrates methanoic acid, H_2CO_2, to give carbon monoxide according to the equation below.

$$H_2CO_2 \rightarrow CO + H_2O$$

Concentrated sulfuric acid also dehydrates $H_2C_2O_4$. In this case, what product(s), other than water, would you expect to be formed?

A carbon monoxide only
B carbon dioxide only
C carbon monoxide and hydrogen
D carbon dioxide and carbon monoxide

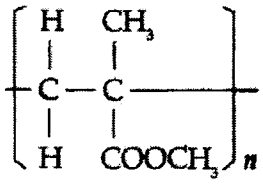
37 Which one of the following correctly describes both ethene and ethane?

A They are both unsaturated hydrocarbons.
B They both readily decolourise bromine water.
C They can both burn to produce carbon dioxide and water.
D They are both readily polymerised.

38 In which process do large molecules become smaller molecules?

A fermentation of sugars
B catalytic reaction between ethene and steam
C reaction between ethene and bromine
D polymerisation of ethene

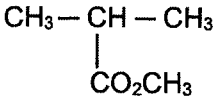
39 The polymer, perspex, has the structural formula.

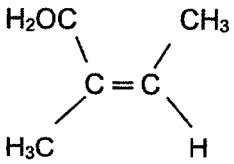


Which of the following structures is the monomer for the polymer?

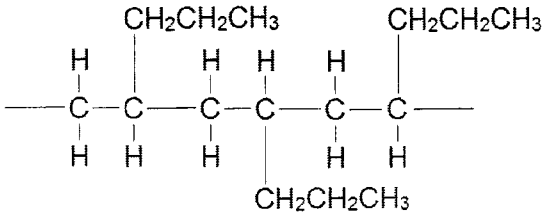
A $CH_2 = C(CH_3)CO_2CH_3$

B $CH_2 = CH - CO_2CH_3$

C 

D 

40 Engine oil is used to lubricate the car engine. Certain polymers are added to engine oil to improve its viscosity. A portion of the chain of one such polymer is shown below.



A molecule of this polymer contains 40 carbon atoms.
How many molecules of monomer are required to form one molecule of this polymer?

A 4
B 5
C 8
D 10

End of Paper

The Periodic Table of Elements

Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group 0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

Key

proton (atomic) number
atomic symbol
name
relative atomic mass

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

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

CHRIST CHURCH SECONDARY SCHOOL
2022 PRELIMINARY EXAMINATION
FOUR EXPRESS

CANDIDATE NAME | CLASS

CENTRE NUMBER S | INDEX NUMBER

CHEMISTRY

6092/02

Paper 2

08 July 2022

1 hour 45 minutes

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

READ THESE INSTRUCTIONS FIRST

Write your Centre number, index number, name 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, 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 on page 24.

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

For Examiner's Use	
Section A	
Section B	
8	
9	
10 Either	
10 Or	
Total	

This document consists of **24** printed pages.

Section A

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

A1 Fig. 1.1 shows part of the Periodic Table. Only some of the elements are shown.

							H										
													C	N	O		
Na	Mg											Al	Si	P			
K	Ca						Fe			Cu	Zn						
Rb																	

Fig. 1.1

(a) Each element may be used once, more than once or not at all.
Use the symbols used in the diagram.

Give **one** element which

(i) has a giant molecular structure,

..... [1]

(ii) combines with oxygen to form a gas which contributes to acid rain,

..... [1]

(iii) forms an ion of type X^+ which has only three completely filled shells of electrons,

..... [1]

(iv) forms a chloride with the formula XCl_2 and forms white precipitate insoluble in excess sodium hydroxide solution.

..... [1]

(b) Arsenic reacts with oxygen to form arsenic(III) oxide, As_2O_3.
Construct a balanced chemical equation for this reaction.

..... [1]

(c) Arsenic(III) oxide is slightly soluble in water. Arsenous acid, H_3AsO_3, a weak acid is formed.

100 cm^3 of 0.05 mol/dm^3 of both arsenous acid and hydrochloric acid are added separately to excess magnesium.

(i) Suggest whether arsenous acid will produce more, less or the same volume of hydrogen compared to hydrochloric acid?

..... [1]

(ii) Will the **pH** of arsenous acid solution be higher, lower or the same as hydrochloric acid?

..... [1]

[Total: 7]

A2 Niobium, Nb, is a transition element. Sodium is an element in Group I of the Periodic Table.

(a) Describe two properties of niobium which are different from sodium.

.....

.....

.....

.....[2]

(b) Niobium chloride is a covalent molecule. Fig. 2.1 shows the structure of niobium chloride.

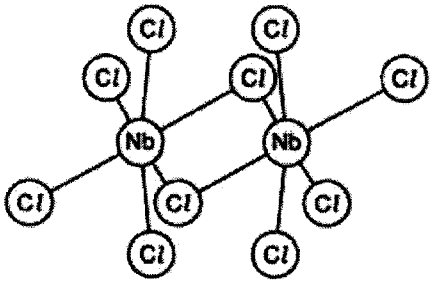


Fig. 2.1

(i) What is unusual about the structure of niobium chloride?

.....

.....

.....[1]

(ii) State the molecular formula of niobium chloride.

.....[1]

(c) Sodium chloride has a much higher melting point than niobium chloride.

(i) Draw a 'dot-and-cross' diagram to show the electronic structure of sodium chloride. You only need to show the outer shell electrons.

[2]

(ii) Use your knowledge of bonding in sodium chloride and niobium chloride to explain the difference in their melting points.

.....

.....

.....

.....

.....[3]

(d) Describe a simple experiment which you could carry out to determine whether an aqueous solution contained an ionic or covalent compound.

Your answer should clearly state all the equipment required and how the observations made would lead to the conclusion.

.....

.....

.....

.....

.....

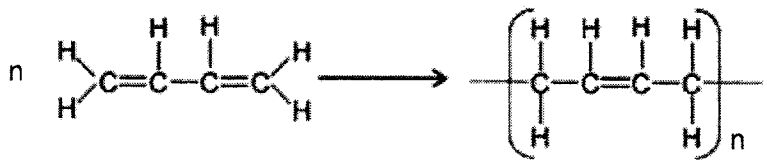
.....

.....

.....[3]

[Total: 12]

A3 **(a)** Polybutadiene is a synthetic rubber which is used in the manufacture of car tyres. It is non-biodegradable. More than 2 million tonnes of polybutadiene are produced annually as shown by the reaction in Fig. 3.1.

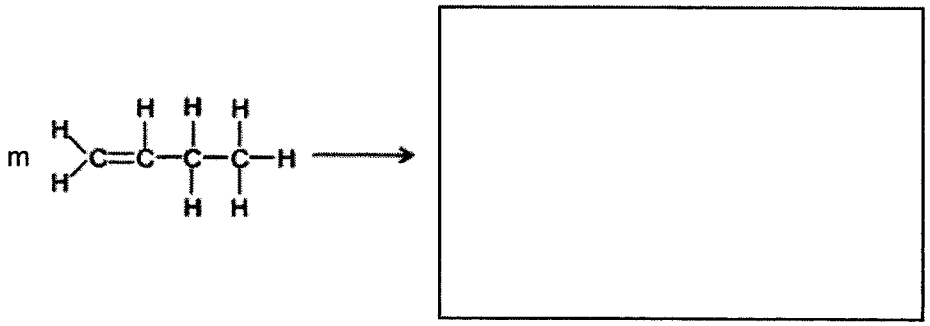


polybutadiene

Fig. 3.1

Polybut-1-ene is a non-toxic, colourless and odourless material which is used in the manufacture of plastics, cosmetics and adhesives. It is made by polymerising but-1-ene.

(i) Complete the equation in Fig. 3.2 by drawing in the box provided the structure of the polybut-1-ene formed.



but-1-ene polybut-1-ene

[1]

Fig. 3.2

(ii) Describe one difference in the structure between polybutadiene and polybut-1-ene.

.....

.....

.....[1]

(iii) Give one chemical test and observations that can be used to distinguish between polybutadiene and polybut-1-ene.

.....

.....

.....

.....

....[2]

(iv) Suggest one property of polybutadiene which makes it a suitable material to make car tyres.

.....

.....[1]

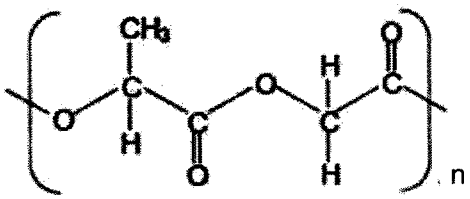
(v) Equal masses of polybutadiene and polybut-1-ene are burnt in air.

Which substance is more likely to burn with a more smoky flame?
Explain your answer.

.....

.....[1]

(b) Some biopolymer stitches are made of materials that the human body produces naturally. These stitches need not be removed as the body can absorb them when the wound is healed. The structure for one of these biopolymers is shown below.



This biopolymer is made from the polymerisation of two different monomers.

Draw the structural formulae of the two monomers in the boxes below.

monomer 1

monomer 2

[2]

[Total: 8]

A4 Hydrazine, N_2H_4, is used as a rocket fuel. The equation for the combustion of hydrazine given below.

$$N_2H_4(g) + O_2(g) \longrightarrow 2H_2O(g) + N_2(g) \qquad \Delta H = -622 \text{ kJ/mol}$$

(a) Explain, in terms of bond breaking and bond forming, why the above reaction is an exothermic reaction.

.....

.....

.....

.....

.....

.....[2]

(b) Draw the energy profile diagram for the reaction between hydrazine and oxygen. On your diagram, label clearly the following.

- axes
- ΔH of reaction,
- activation energy, E_a,
- reactants and products

[3]

(c) Hydrazine also undergoes another reaction with fluorine

$$N_2H_4(g) + 2F_2(g) \longrightarrow 4HF(g) + N_2(g)$$

Table 4.1 gives information about the bond energy of some bonds.

Table 4.1

Bond	bond energy (Kj/mol)
N – N	163
N – H	390
F – F	158
H – F	565
N ≡ N	945

Calculate the ΔH for the reaction between hydrazine and fluorine.

[2]

[Total: 7]

A5 Ammonia gas can be decomposed to nitrogen gas and hydrogen gas.

$$2NH_3(g) \rightleftharpoons N_2(g) + 3H_2(g)$$

(a) Other than the reaction above, name one **other** source of hydrogen gas for the aerospace industry.

.....[1]

(b) One of the uses of ammonia is in the manufacture of nitric acid. This is done by a two-stage process.

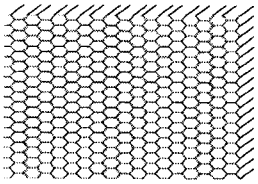
Stage 1: ammonia is converted to nitrogen(II) oxide.

$$4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + 6H_2O(g)$$

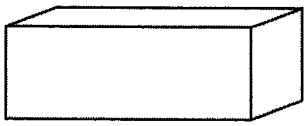
Stage 2: nitrogen(II) oxide is converted to nitric acid.

$$4NO(g) + 2H_2O(l) + 3O_2(g) \rightarrow 4HNO_3(aq)$$

(i) In **stage 1**, ammonia and oxygen are passed through a porous honeycomb-shaped catalyst A and a non-porous block-shaped catalyst B, of the same mass.



catalyst A



catalyst B

Explain, in terms of collision theory, which catalyst, A or B, is more efficient.

.....

.....

.....

.....

.....

.....[2]

(ii) Explain, in terms of oxidation states, why **stage 2** is a redox reaction.

.....

.....

.....

.....[2]

(iii) Calculate the maximum mass of nitric acid which can be produced from 720 dm^3 of ammonia measured at room temperature and pressure.

[2]

(iv) Use the two equations from **stage 1** and **stage 2** to construct an overall equation for the conversion of ammonia to nitric acid.

.....[1]

[Total: 8]

A6 Fig. 6.1 gives the set-up used to investigate the relative reactivity of various metals, A, B, C and D. The metal strips and copper were first cleaned with sandpaper. Various metal strips were connected in turn with the copper sheet and the voltage recorded.

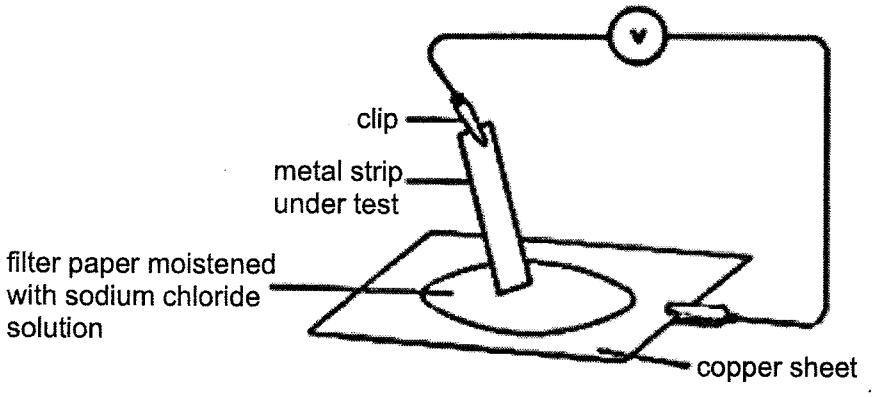


Fig. 6.1

Table 6.1 gives the results of the investigation.

Table 6.1

metal under test	direction of electron flow in the external circuit	voltage recorded (volts)
A	A to Cu	+ 1.40
B	Cu to B	- 2.22
C	A to C	+ 0.77
D	A to D	+ 0.28

(a) Explain why the metal strips and copper sheet were first cleaned with sandpaper.

.....

.....[1]

(b) Which of these metal(s) is/are less reactive than copper?
Explain your answer in terms of electron flow and the results shown in Table 6.1

.....

.....

.....

.....[2]

(c) Using the results in Table 6.1, arrange the four metals A, B, C and D in decreasing order of reactivity.

.....[1]

[Total: 4]

A7 **(a)** Table 7.1 shows data about the melting point and boiling point of three halogens, chlorine, bromine and iodine.

Complete Table 7.1 by filling in the names of the halogens.

Table 7.1

name of halogen	melting point / °C	boiling point / °C
	- 7.2	58.8
	-100.9	-34.7
	113.8	184.5

[1]

(b) Sea water contains potassium bromide.

Bromine can be produced from sea water by displacement.

Name an element that can displace bromine from sea water. Give a reason for your choice.

.....

.....[1]

(c) Table 7.2 shows the colours of some silver halide precipitates and the observations made when the precipitates are left to stand.

Table 7.2

silver halide	colour of precipitate	observations on standing
silver chloride	white	rapid formation of grey solid
silver bromide	cream	slow formation of grey solid
silver iodide		no visible change after several minutes

[1]

(i) Complete Table 7.2 to show the colour of silver iodide precipitate.

(ii) What conclusion can you make about the relationship between the reactivity of halogen and the rate of breakdown of silver halide.

.....

.....[1]

[Total:4]

Section B

Answer all **three** questions from this section.
The last question is in the form **EITHER / OR** and only **one** of the alternatives should be attempted.

B8 Chlorofluorocarbons (CFCs) are inert on the Earth's surface. However in the stratosphere, they are very reactive. CFCs are part of a group of compounds which can be classfied as ozone depleting compounds. Other than CFCs, there are also hydrofluorocarbons (HFCs), hydrochlorofluorocarbons (HCFCs) and perfluorocarbons (PFCs).

Some common examples of CFC and HCFC molecules are shown in Fig. 8.1 below with their names.

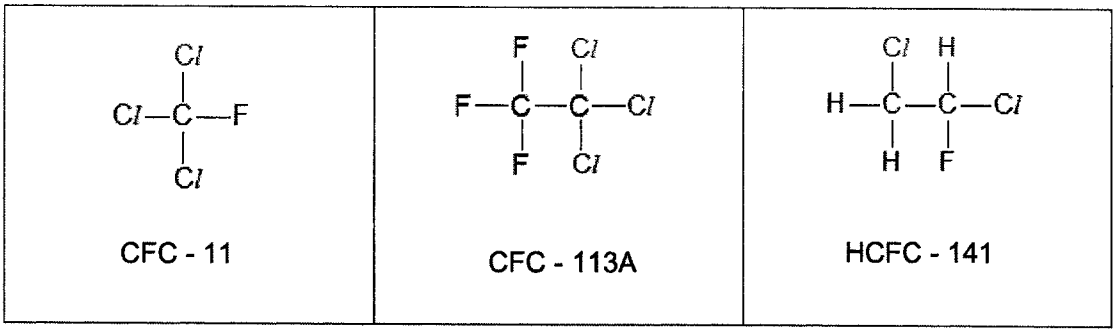


Fig. 8.1

A naming system for these substances was devised several decades ago. The prefixes to the name tell us the elements present in the compound as shown in Table 8.1 below.

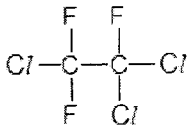
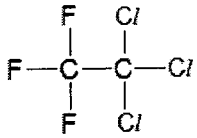
Table 8.1

prefix	elements present
PFC	carbon, fluorine
CFC	carbon, fluorine, chlorine
HFC	hydrogen, carbon, fluorine
HCFC	hydrogen, carbon, fluorine, chlorine

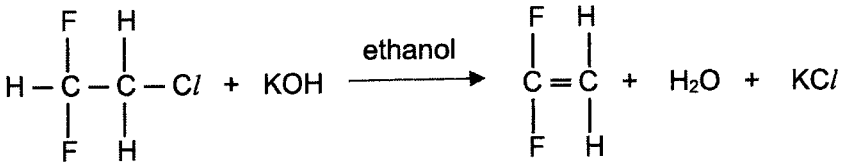
The numbers suffixed to the names of the compounds give us the number of each type of atom present in one molecule of the compound. The key to decoding the number is simply to add 90 to the number suffixed to the name.

For example, to decode the number of atoms in CFC - 113A, we add 113 to 90 to obtain 203. The first number, 2, tells us the number of carbon atoms, the second number, 0, tells us the number of hydrogen atoms and the third number, 3, tells us the number of fluorine atoms. Chlorine atoms make up the remaining bonds since all these compounds are saturated.

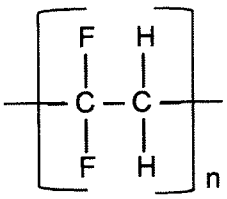
The letter 'a' in CFC - 113a tells us about the structural formula of the compound. The arrangement of the type of atoms in the compound that most evenly distributes atomic masses has no letter. The second most even distribution is given the letter 'a', the third most even distribution is given the letter 'b', so on and so forth.

molecule	atomic mass of left carbon	atomic mass of right carbon
 CFC - 113	73.5	90
 CFC - 113a	57	106.5

Although most of these substances are harmful to the ozone layer, they can also be used to make polymers by first converting them to alkenes. For example, HCFCs react with potassium hydroxide which is dissolved in ethanol (solvent) to give an alkene, potassium chloride and water. An example of the reaction is shown below.



The alkene produced from the above reaction can be used to make useful polymers such as the one shown below.



(a) Draw the structure of a PFC molecule with two carbon atoms.

[1]

(b) In the table given below, draw the **other** two isomers of HCFC -141 in the correct respective boxes.

HCFC -141a	HCFC - 141b

[2]

(c) A student comments that HFCs are safer alternatives to CFCs as HFCs do not harm the environment like CFCs do.

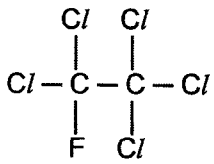
Explain why the student is correct.

.....

.....[1]

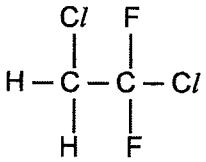
(d) Use the naming system discussed in the passage, write down the names of the following molecules.

(i)



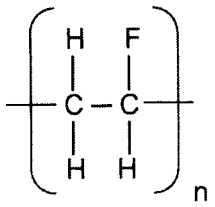
.....[1]

(ii)



.....[2]

(e) **(i)** A scientist wants to produce the polymer, polyvinyl fluoride, using HCFCs.



Using a suitable HCFC, write down **two** equations showing the reactions he has to carry out to produce polyvinyl fluoride.

Show the structures of all the organic compounds in your equations.

[3]

(ii) Samples of the polyvinyl fluoride polymer produced were analysed and found to have a maximum relative molecular mass of 12000.

Calculate the maximum number of repeating units for this polymer?

[2]

[Total: 12]

B9 **(a)** Six samples of carbonates are heated strongly until there is no further change in mass.

Table 9.1 shows the mass of solid remaining at the end of the heating.

Table 9.1

carbonate	mass before heating / g	mass after heating / g
calcium carbonate	2.00	1.12
copper(II) carbonate	2.00	1.29
iron(II) carbonate	2.00	1.24
magnesium carbonate	2.00	0.95
sodium carbonate	2.00	2.00
zinc carbonate	2.00	1.30

(i) Explain why there is a decrease in mass for most carbonates except sodium carbonate.

.....

.....

.....

.....[2]

(ii) Which of the above carbonates is the **least** thermally stable?
Explain your answer.

.....

.....

.....

.....[2]

(iii) For each carbonate, a 2.00 g sample was heated.

Explain why the mass of solid obtained after heating is different for each carbonate.

.....

.....

.....

.....[2]

(b) A student carried out an experiment to investigate the rusting of iron nails. He joined small pieces of different metals to identical iron nails and placed the nails in open test-tubes which contained a little water.

The observations that he made some days later are as shown in Fig. 9.1.

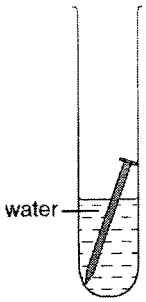
metal joined to nail	none (control)	tin	magnesium	zinc	copper
diagram of set-up					
observation	slight rusting	heavy rusting	no rusting	no rusting	heavy rusting

Fig. 9.1

What conclusions could the student draw from these observations?

.....

.....

.....

.....[2]

[Total: 8]

Either

B10 The speed of reaction between three compounds, hydrogen peroxide, hydrochloric acid and potassium iodide, was studied in a series of experiments.

$$H_2O_2(aq) + 2KI(aq) + 2HCl(aq) \longrightarrow 2H_2O(l) + I_2(aq) + 2KCl(aq)$$

The speed of reaction was measured using the rate of production of iodine as shown below.

$$\text{rate of production of iodine} = \frac{\text{change in concentration of iodine}}{\text{change in time}}$$

Table 10.1 shows the results obtained.

Table 10.1

experiment	concentration of H_2O_2 (mol/dm^3)	concentration of HCl (mol/dm^3)	concentration of KI (mol/dm^3)	rate of production of I_2 ($mol/dm^3/s$)
1	0.1	0.1	0.1	0.0001
2	0.2	0.1	0.1	0.0002
3	0.4	0.1	0.1	0.0004
4	0.1	0.2	0.1	0.0001
5	0.2	0.1	0.2	0.0004

(a) (i) Using the information given in Table 10.1, state how the concentration of potassium iodide affects the speed of reaction.

.....

.....

.....[2]

(ii) Besides potassium iodide, identify another reactant whose concentration affects the speed of reaction and suggest how the speed is affected.

Explain your answer using the data provided in Table 10.1.

.....

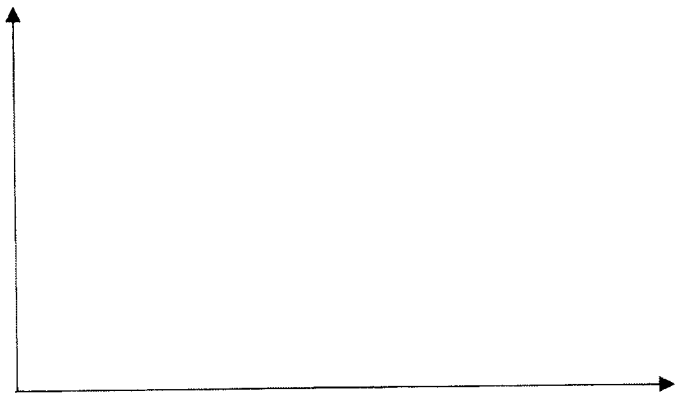
.....

.....

.....

.....[2]

(b) Sketch the graph of the concentration of hydrogen peroxide against the speed of reaction using the axes provided below.



[2]

(c) Besides concentration, state and explain using collision theory one **other** factor that increases the speed of reaction.

.....

.....

.....

.....

.....[2]

(d) From experiment 1, assuming that hydrogen peroxide is the limiting reagent, calculate the mass of iodine formed in the reaction when the volume of hydrogen peroxide used is 100 cm^3.

[2]

[Total: 10]

Or

B10 A student electrolysed 2 dm^3 aqueous copper(II) sulfate using platinum electrodes. A current of 1 ampere was passed. The graph of gain in mass of the cathode against time is given in Fig 10.1.

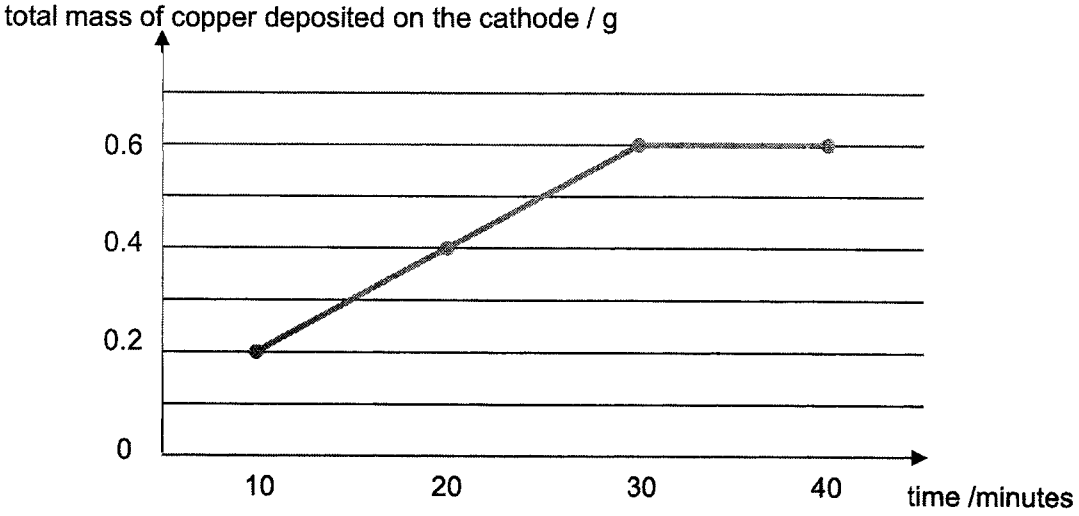


Fig 10.1

(a) Write ionic equations, including state symbols, to represent the formation of

(i) copper at the cathode,

.....[1]

(ii) oxygen at the anode.

.....[1]

(b) The solution initially contained 2.50 g of copper(II) sulfate crystals ($CuSO_4.5H_2O$).

(i) Calculate the initial concentration of the copper(II) sulfate solution in mol/dm^3.

[1]

(ii) From the graph, what mass of copper was deposited after 10 minutes? How many moles of copper is this?

[1]

(iii) What is the concentration of the copper(II) sulfate, in mol/dm^3, after 10 minutes?

[2]

(c) Describe and explain the change in the appearance of aqueous copper(II) sulfate over time.

.....

.....

.....

.....

.....[2]

(d) Why does the mass of copper deposited at the cathode not increase after 30 minutes, although the volume of oxygen given off at the anode continues to increase after this time?

.....

.....

.....

.....

.....

.....[2]

[Total 10]

End of Paper

The Periodic Table of Elements

Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group 0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

Key

proton (atomic) number
atomic symbol
name
relative atomic mass

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

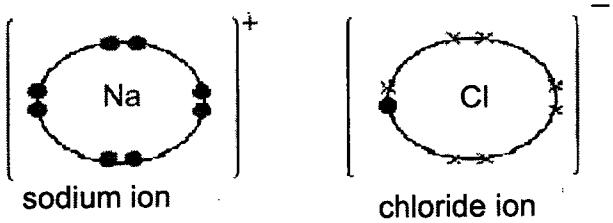
The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

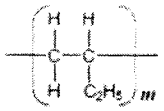
4E Chemistry 2022 Prelim
Marking Scheme

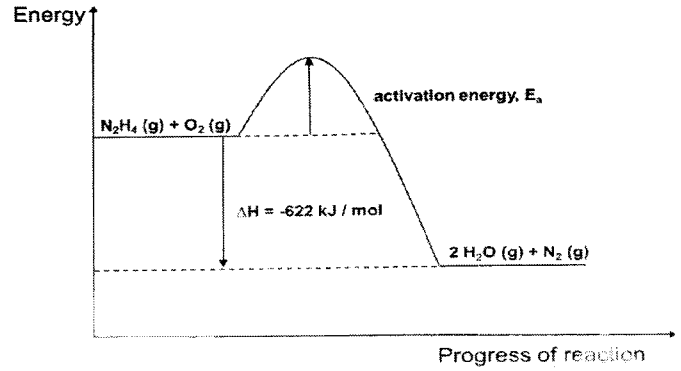
Paper 1 6092/01

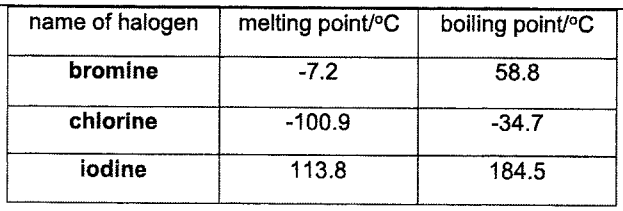
1	A	**2**	C	**3**	B	**4**	D	**5**	B
6	D	**7**	A	**8**	C	**9**	D	**10**	C
11	B	**12**	B	**13**	D	**14**	B	**15**	B
16	C	**17**	A	**18**	B	**19**	A	**20**	D
21	D	**22**	C	**23**	B	**24**	B	**25**	D
26	B	**27**	C	**28**	B	**29**	C	**30**	A
31	D	**32**	A	**33**	D	**34**	C	**35**	B
36	D	**37**	C	**38**	A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

Paper 2 6092/02
Section A

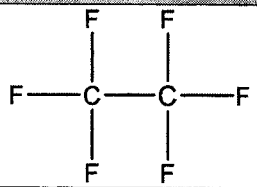
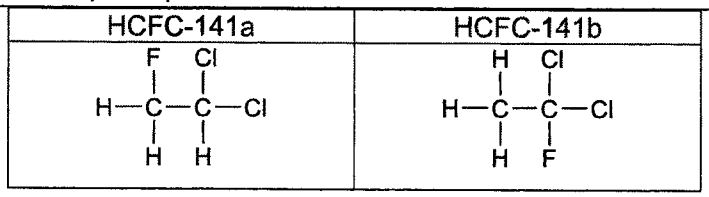
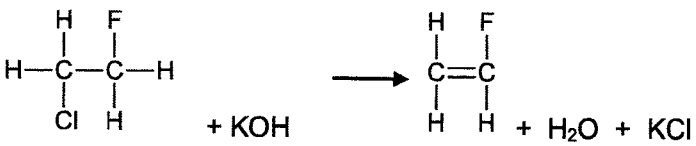
Qn		Answer	Marks/ Remarks
A1	**(a)(i)**	C	1
	(a)(ii)	N	1
	(a)(iii)	K	1
	(a)(iv)	Ca	1
	(b)	$4As + 3O_2 \rightarrow 2As_2O_3$	1
	(c)(i)	more	1
	(c)(ii)	higher	1
			[Total: 7]
A2	**(a)**	any 2 from: • high melting point /high boiling point • high density • catalytic activity • form ions with different oxidation state/has several oxidation states in the compounds • forms coloured compounds	2
	(b)(i)	Niobium is a metal and is expected to form ionic compounds but forms covalent compound instead here.	1
	(b)(ii)	Nb_2Cl_{10}	1
	(c)(i)	1 mark per correct ion  sodium ion chloride ion	2
	(ii)	Strong electrostatic forces between Na^+ and Cl^- ions [1] Weak intermolecular forces of attraction between niobium chloride molecules. [1] **More** heat energy is required to overcome the bonds in sodium chloride than niobium chloride. [1]	3

Qn		Answer	Marks/ Remarks
	(d)	Ionic compounds conduct electricity in aqueous state but covalent compounds do not A circuit is set up using 2 carbon electrode (or any other inert electrode) dipped in the solutions. The electrodes are then connected to a battery and a light bulb/ and or ammeter. [1] In an ionic compound, the mobile ions help to conduct electricity and the bulb will light up. [1] In a covalent compound, there are no mobile electrons or ions to help conduct electricity and the bulb will not light up. [1]	3
			[Total: 12]
A3	(a)(i)	 Polybut-1-ene	1
	(a)(ii)	Polymer formed by butadiene contains carbon-carbon double bond/(C=C) bonds while polymer formed by but-1-ene does not contain carbon-carbon double bonds/(C=C) bonds	1
	(a)(iii)	React both polymers with aqueous bromine. Polybutadiene will decolourise aqueous bromine [1] but with polybut-1-ene, aqueous bromine remains reddish brown. [1]	2
	(a)(iv)	Strong/durable / resistance to wear/ resistant to heat (heat caused by friction/flexible)	1
	(a)(v)	**Percentage** of **carbon** in polybutadiene **is greater** than in polybut-1-ene thus combustion of polybutadiene produces a more smoky flame.	1
	(b)	$HOCH(CH_3)COOH$ [1] $HOCH_2COOH$ [1]	2
			Total : 8
A4	(a)	The total **energy absorbed to break/overcome the bonds of 2 mol N_2H_4 and 1 mol O_2** is **lesser** [1] than the **energy released to form the bonds in 2 mol H_2O and 1 mol N_2** [1]. Zero marks if simply state that the energy absorbed for bond breaking is lesser than energy released for bond forming.	2

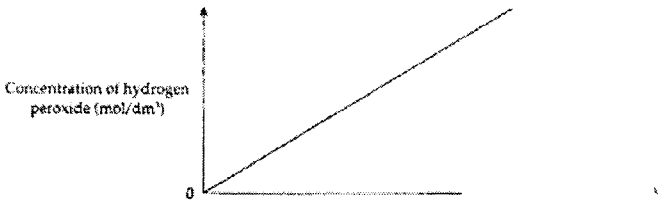
Qn		Answer	Marks/ Remarks
	(b)		1 m – correct shape of graph 1 m – for correct labelling of enthalpy change, activation energy, products &reactants If direction of any arrow is wrong [0] 1m – correct axes 3
	(c)	Energy absorbed = 163 + 390 (4) + 158 (2) = 2039 kJ Energy released = 565 (4) + 945 = 3205 kJ [1] ΔH = 2039 – 3205 = -1166 kJ / mol [1]	2
			[Total: 8]
A5	(a)	Any one of the following: • Cracking of petroleum • Electrolysis of water	1
	(b)(i)	A because A has larger surface area of contact than B. This allows higher frequency of effective collisions and higher rate of reaction than B.	1[no mark if explanation is wrong] 1
	(b)(ii)	Oxidation state of N increases from +2 in NO to +5 in HNO_3, as N is oxidised. Oxidation state of O decreases from 0 in O_2 to -2 in HNO_3, as O is reduced.	1 1
	(b)(iii)	720 dm^3 NH_3 = 30 mol NH_3 NH_3:NO:HNO_3 = 4:4:4 = 1:1:1 Mr of HNO_3 = 1+14+3(16) = 63 30 mol HNO_3 = 30x63 = 1890g [1]	1 1
	(b)(iv)	$NH_3 + 2O_2 \rightarrow H_2O + HNO_3$	1
			[Total: 8]
A6	(a)	Sandpaper removes the **surface layer of metal oxide** that may prevent the metal sheet from conducting electricity.	1
	(b)	Metal B. Electrons flow from Cu to B/ copper has a greater tendency/potential to lose electrons than B/Since reactive metals have a greater tendency to lose electrons, B is less reactive than copper.	1 1
	(c)	A, D, C, B	1

Qn		Answer	Marks/ Remarks
			[Total: 4]
A7	(a)		1
	(b)	Chlorine or fluorine – more reactive than bromine and can displace bromine from its compound.	1
	(c)(i)	pale yellow	1
	c)(ii)	The less reactive the halogen, the slower the breakdown of silver halide.	1
			[Total:4]

Section B

Qn		Answer	Marks/ Remarks
B8	(a)		1
	(b)		1 mark per correct structure 2
	(c)	HFCs do not contain chlorine atoms which will deplete the ozone layer.	1
	(d)(i)	CFC-111	1
	(d)(ii)	HCFC-132a Note: 1 mark for **HCFC-132**, 1 mark for **a**	2
	(e)(i)	Reaction I  1 mark for correct HCFC used; 1 mark for equation. Reaction 2  [1]	3

Qn		Answer	Marks/ Remarks
	(e)(ii)	M_r of repeating unit: 12 x 2 + 19 + 1 x 3 = 46 [1] No. of repeating units: 12000/46 = 260 (round down) [1]	2
			[Total: 12]
B9	(a)(i)	Except for sodium carbonate which is thermally stable;all other carbonates decompose (on heating) to form corresponding oxide and carbon dioxide; [1] carbon dioxide gas goes into the air so its mass is not captured. [1]	2
	(a)(ii)	Copper(II) carbonate; [1] Copper is the least reactive metal (hence its compound is the least stable) [1]	2
	(a)(iii)	The relative molecular mass / molar mass of each carbonate differs; [1] Hence the number of moles of each carbonate in a 2g sample differs (so number of moles of oxide left also differs) [1]	2
	(b)	Rusting is prevented if the metal attached is more reactive than iron; Iron rusts if attached metal is less reactive than iron; Rusting is worse than control if less reactive metal is attached (any 2)	2
			[Total: 8]
Either			
B10	(a)(i)	Using Expt 2 and 5, when the concentration of potassium iodide doubles from 0.1 to 0.2 mol/dm^3 and with the concentrations of hydrogen peroxide and HCl kept constant at 0.2 mol/dm^3 and 0.1 mol/dm^3 respectively, [1] the speed of reaction doubles from 0.0002 to 0.0004 mol/dm^3 /s. [1] (quotation of data in order to get the full 1m.)	2
	(a)(ii)	The other reactant is hydrogen peroxide. [1] Using Expt 1 and 2, when the concentration of hydrochloric acid and potassium iodide kept constant at 0.1 mol/dm^3, doubling the concentration of hydrogen peroxide from 0.1 to 0.2 mol/dm^3 doubles the speed of reaction from 0.0001 to 0.0002 mol/dm3 /s. [1] OR Using Expt 2 and 3, when the concentration of hydrochloric acid and potassium iodide are kept constant at 0.1 mol/dm^3, doubling the concentration of hydrogen peroxide from 0.2 to 0.4 mol/dm^3 doubles the speed of reaction from 0.0002 to 0.0004 mol/dm3 /s.	2

Qn		Answer	Marks/ Remarks
		OR Using Expt 1 and 3, when the concentration of hydrochloric acid and potassium iodide are kept constant at 0.1 mol/dm^3, increasing the concentration of hydrogen peroxide from 0.1 to 0.4 mol/dm^3 ,the speed of reaction increases four times from 0.0001 to 0.0004 mol/dm3 /s.	
	(b)	 Positive straight line from origin [1] Correct axes labelled when graph is correct. [1]	2
	(c)	With an increase in temperature, particles gain kinetic energy and move faster. More particles possess energy levels equivalent to or greater than the activation energy. This leads to an increase in the frequency of effective collisions between particles.	2
	(d)	No. of mole of H_2O_2 = 0.1 x 0.1 = 0.01 mol [1] Since H_2O_2 : I_2 is 1:1, therefore the number of moles of I_2 is also 0.01 mol Mass of I_2 formed = 0.01 x (127x2) = 2.54g [1]	2
			[Total : 10]
Or			
B10	**(a)(i)**	$Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$	1
	(a)(ii)	$4OH^-(aq) \rightarrow 2H_2O(l) + O_2(g) + 4e^-$	1
	(b)(i)	2 dm^3 contains 2.5 g of copper (II) sulfate. Mass in 1 dm^3 = 2.5/2 = 1.25 g No of moles = 1.25 / 250 = 0.005 Hence, concentration is 0.005 mol/dm^3 [1]	1 (no working shown – no marks awarde)
	(b)(ii)	Mass of copper deposited = 0.2 g Number of moles = 0.2/64 = 0.003125 = 0.00313 mol (3sf)	1
	(b)(iii)	Initial number of moles of copper(II) sulfate in 2 dm^3 of solution = 0.005 x 2 = 0.01 mol No of mol of copper deposited = 0.00313 No of mol left in 2 dm^3 of solution = 0.01 – 0.00313 = 0.00687mol No of mol in 1 dm^3 of solution = 0.00687/2 = 0.00345 [1] Concentration after 10 mins = 0.00345 mol/dm^3 [1]	2

Qn		Answer	Marks/ Remarks
	(c)	The blue colour of the solution will fade and eventually become colourless. [1] As the Cu^{2+} ion are discharged from the solution at the cathode, the concentration Cu^{2+} ions decreases and when eventually all Cu^{2+} are discharged, the solution turns colourless. [1]	2
	(d)	After 30 mins, mass of copper deposited is 0.6g which is 0.01 moles. This means all the copper(II) ions present have been discharged [1] but the solution contains hydroxide ion which continue to evolve oxygen gas [1]	2
			[Total: 10]