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Anglo-Chinese School
(INDEPENDENT)



Year 4 Express
Preliminary Examination 2015

CHEMISTRY
PAPER 1 Multiple Choice
Wednesday

12 August 2015

5073/1

1 hour

Additional materials
Calculator
Multiple Choice answer sheet
Soft clean eraser
Soft pencil (type 2B recommended)

TIME 1 hour

INSTRUCTIONS TO CANDIDATES

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

Write and shade your Candidate number on the answer sheet in the spaces provided

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

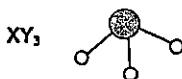
Read very carefully the instructions on the answer sheet.

INFORMATION FOR CANDIDATES

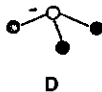
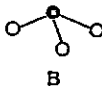
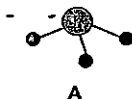
**Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
You may use a calculator.
A copy of the Periodic Table is printed on page 14.**

This question paper consists of 14 printed pages

- 5 The models and formulae for some molecules are shown below



Which of the following is the correct model for a molecule of the compound formed between Y and Z?



- 6 The electrical properties of four substances W, X, Y and Z are shown below

Substance	Electrical Property
W	Conducts electricity only in aqueous state
X	Conducts electricity when molten and in solid state
Y	Conducts electricity when molten and in aqueous state
Z	Does not conduct electricity under any conditions

What could these four substances be?

	W	X	Y	Z
A	$CaCl_2$	HCl	P	Pb
B	HCl	Pb	$CaCl_2$	P
C	P	$CaCl_2$	HCl	$CaCl_2$
D	Pb	P	Pb	HCl

- 7 Which solid does not contain covalent bonds?

- A Gold
B Graphite
C Ice
D Silicon dioxide

- 8 Which substance contains the greatest number of molecules in 1 g?

- A O_2 B NO_2
C CO D SO_2

- 9 Which one of the following has a mass equal to the mass of one mole of H_2O ?
- A One molecule of water
 B 24 dm^3 of water
 C Two moles of H_2 and one mole of O_2
 D One mole of steam
- 10 20 cm^3 of oxygen reacts with 20 cm^3 of carbon monoxide to form carbon dioxide. What is the volume of the gases remaining at the end of the reaction? All volume are measured at room temperature and pressure

	Oxygen / cm^3	Carbon monoxide / cm^3	Carbon dioxide / cm^3
A	10	0	20
B	10	10	20
C	0	0	20
D	0	0	40

- 11 Two aqueous solutions X and Y are mixed together. Which of the following pairs would not give a white precipitate?

	X	Y
A	Lead(II) nitrate	Sodium sulfate
B	Zinc nitrate	Sodium carbonate
C	Silver nitrate	Sodium chloride
D	Magnesium nitrate	Sodium sulfate

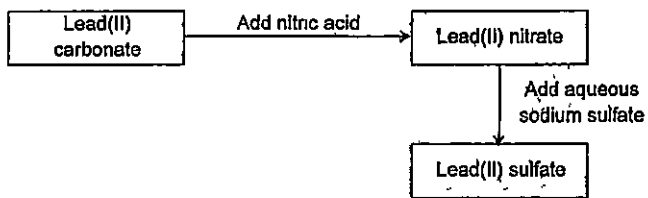
- 12 Which one of the options below shows the best methods used to prepare the following salts?

	Titration	Precipitation	Adding excess carbonate reactants with acid
A	potassium ethanoate	silver chloride	zinc sulfate
B	ammonium nitrate	barium sulfate	sodium chloride
C	barium carbonate	calcium sulfate	magnesium chloride
D	copper(II) sulfate	ammonium chloride	iron(II) nitrate

- [illegible]

A V is more reactive than X
B X has a lower melting point than V.
C Y is in the same Group as X
D Z is more reactive than W

- 15 The diagram shows two sets of reactions used to prepare lead(II) sulfate from lead(II) carbonate



- A Add lead(II) carbonate until no more gas is produced
- B Filter off unreacted lead(II) carbonate
- C Evaporate the filtrate until lead(II) nitrate crystallises
- D Collect lead(II) sulfate by filtration

- 16 Germanium(IV) oxide is an amphoteric oxide. Which substance A, B, C or D in the following table could be germanium(IV) oxide?

	reaction with dilute hydrochloric acid	reaction with water	reaction with sodium hydroxide
A	dissolves	insoluble	dissolves
B	dissolves	insoluble	insoluble
C	insoluble	dissolves	insoluble
D	insoluble	insoluble	dissolves

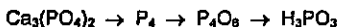
- 17 In an accident at a factory, some hydrochloric acid was spilt on the floor. Which substance, when added in excess would neutralise the acid without leaving an alkaline solution?

- A Calcium carbonate B Sodium hydroxide
C Aqueous ammonia D Magnesium chloride

- 18 Which of the following salts gives only a low yield when it is made by reacting a metal oxide with dilute sulfuric acid?

- A Calcium sulfate B Iron(II) sulfate
C Copper(II) sulfate D Zinc sulfate

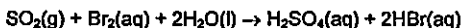
- 19 The following sequence shows the steps in the conversion of calcium phosphate, $\text{Ca}_3(\text{PO}_4)_2$, to phosphorus acid, H_3PO_3



The respective oxidation numbers of phosphorus in the above sequence are

- A +5, 0, +3, +3
B +5, 0, +5, +5
C +2, +4, +4, +1
D +1, +4, +3, +1

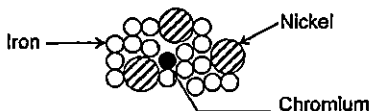
- 20 Sulfur dioxide reacts with aqueous bromine according to the following equation



Which element has been oxidised?

- A bromine B oxygen
C hydrogen D sulfur

21 Stainless steel is an alloy made up of iron with other elements such as nickel and chromium. The diagram below represents the particles in a certain grade of stainless steel.



Which of the following shows the composition (of the number of particles) of the stainless steel as shown in the diagram?

	Iron (%)	Nickel (%)	Chromium (%)
A	68	18	14
B	72	20	8
C	78	12	10
D	80	15	5

22 When gas Z is passed over heated copper(II) oxide, the products are copper and steam only. What is gas Z?

- | | | | |
|----------|------------------------|----------|-----------------|
| A | Ammonia | B | Hydrogen |
| C | Carbon monoxide | D | Methane |

23 Copper(II) carbonate, calcium carbonate and zinc carbonate decompose when heated. The temperature at which decomposition takes place depends upon the position of the metal in the reactivity series.

What is the correct order for their decomposition?

	Highest temperature	→	Lowest temperature
A	Copper(II) carbonate		Calcium carbonate
B	Calcium carbonate		Copper(II) carbonate
C	Calcium carbonate		Zinc carbonate
D	Zinc carbonate		Copper(II) carbonate

24 What is the effect of a catalyst on the activation energy and enthalpy change of a reaction?

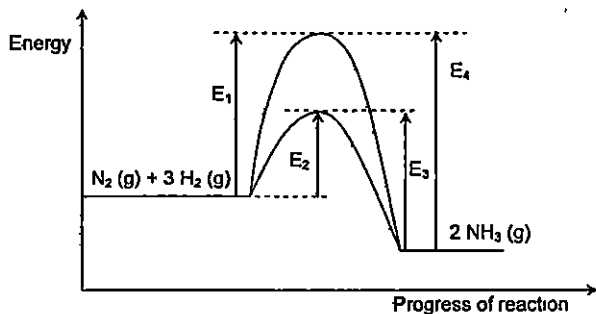
	Activation energy	Enthalpy change
A	Decreases	Decreases
B	No change	Decreases
C	Decreases	No change
D	Decreases	Increases

- 25 A student set up three different electrochemical cells each containing two of the metals, W, Y and Z, immersed in an electrolyte. The table below shows the voltage and the positive terminal of each electrochemical cell.

Electrochemical Cell	Metals Used	Voltage / V	Positive Terminal
1	Z and Y	+1.60	Y
2	W and Y	+1.10	W
3	W and Z	+2.70	W

Which is the order of decreasing reducing power of the metals W, Y and Z?

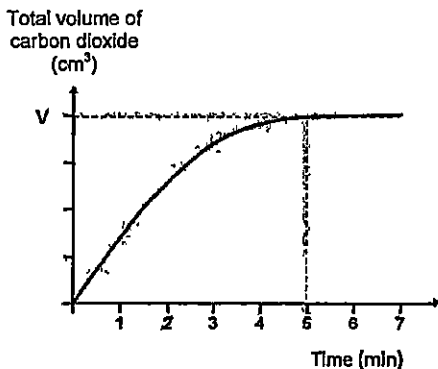
- A $Y > W > Z$ B $Y > Z > W$
 C $Z > Y > W$ D $W > Z > Y$
- 26 In the Haber process, the synthesis of ammonia from hydrogen and nitrogen is a reversible reaction. The energy profile of the reaction with or without a catalyst is shown below.



Which of the following statements is correct when describing the energy changes involved in the reaction?

- A The forward catalysed reaction is endothermic
 B $(E_1 - E_2)$ is the enthalpy change of the forward reaction
 C E_3 is the activation energy for the backward catalysed reaction
 D E_2 is the enthalpy change of the backward catalysed reaction

- 27 The reaction between marble chips and 200 cm^3 of 0.2 mol/dm^3 hydrochloric acid (in excess) was studied by collecting the carbon dioxide gas released in a burette. The results are shown in the graph below.

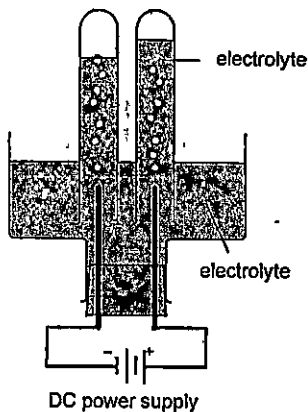


How would the result change if the experiment is repeated by using same mass of marble chips and 200 cm^3 of 0.4 mol/dm^3 hydrochloric acid?

	Maximum volume of CO_2 collected (cm^3)	Time at which the maximum volume is first reached (min)
A	V	More than 5 minutes
B	V	Less than 5 minutes
C	2 V	More than 5 minutes
D	2 V	Less than 5 minutes

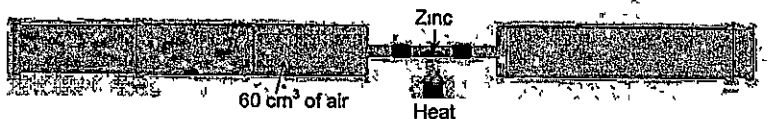
- 28 Which of the following electrolytes will increase in pH when electrolysed using platinum electrodes?
- A Aqueous copper(II) sulfate
 - B Concentrated sodium chloride solution
 - C Aqueous calcium nitrate solution
 - D Dilute nitric acid

- 29 A student electrolysed a solution using carbon electrodes. Two gases were collected as shown



Which electrolyte was used?

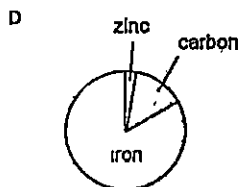
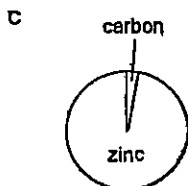
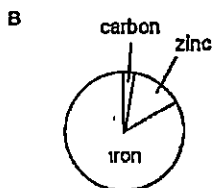
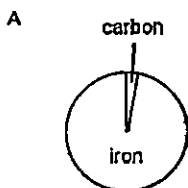
- | | |
|------------------------|----------------------------------|
| A Dilute sulfuric acid | B Concentrated hydrochloric acid |
| C Copper(II) sulfate | D Concentrated potassium iodide |
- 30 A 60 cm³ sample of air is trapped in a gas syringe. The air is slowly passed over heated zinc in a tube until there is no further change in the volume of air



What is the final volume of air in the gas syringe?

- | | |
|----------------------|----------------------|
| A 40 cm ³ | B 60 cm ³ |
| C 48 cm ³ | D 72 cm ³ |
- 31 Which of following reactions does not occur in a blast furnace in the extraction of iron?
- | |
|--|
| A $\text{CaO} + \text{CO}_2 \rightarrow \text{CaCO}_3$ |
| B $\text{CaO} + \text{SiO}_2 \rightarrow \text{CaSiO}_3$ |
| C $\text{CO}_2 + \text{C} \rightarrow 2\text{CO}$ |
| D $\text{Fe}_2\text{O}_3 + 3\text{CO} \rightarrow 2\text{Fe} + 3\text{CO}_2$ |

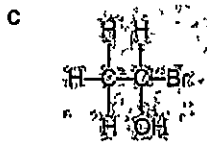
32 Which pie-chart represents the composition of a galvanised steel roof?



33 Useful fractions are obtained by the fractional distillation of petroleum. Which fraction is matched by its use?

	fraction	use
A	bitumen	for making roads
B	lubricating oils	aircraft fuel
C	paraffin (kerosene)	fuel in cars
D	petrol (gasoline)	for making waxes and polishes

34 Which of the following is a product formed when ethene is passed through bromine water?



- 35 Hydrogen gas is used in the production of margarine. The word equation for the production of margarine is shown below



Which of the following options correctly lists the nature of vegetable oils, the type of reaction occurring and the catalyst used?

	Nature of vegetable oil	Type of reaction	Catalyst used
A	saturated compound	substitution reaction	iron
B	unsaturated compound	addition reaction	nickel
C	saturated compound	addition reaction	iron
D	unsaturated compound	substitution reaction	nickel

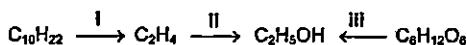
- 36 A compound X has all of the following properties

- It is a liquid at room temperature and atmospheric pressure
- It dissolves in water.
- It decolourises acidified potassium manganate(VII)

What could X be?

- | | | | |
|---|---------|---|---------------|
| A | ethane | B | ethanoic acid |
| C | ethanol | D | ethene |

- 37 Study the reaction scheme below



What are reactions I, II and III?

	Reaction I	Reaction II	Reaction III
A	Fractional distillation	Addition reaction	Esterification
B	Cracking	Addition reaction	Fermentation
C	Fractional distillation	Substitution reaction	Addition reaction
D	Cracking	Addition reaction	Oxidation

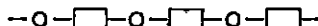
38 Which of the following statements is correct?

- A Complete combustion of poly(chloroethene) produces carbon dioxide and water only
- B In the polymerisation of 100 g of chloroethene, 100 g of poly(chloroethene) is formed
- C In the polymerisation of chloroethene to form poly(chloroethene), there is no change in the density
- D Both poly(chloroethene) and chloroethene decolourise aqueous bromine rapidly.

39 The following monomer undergoes condensation polymerisation to produce a polymer



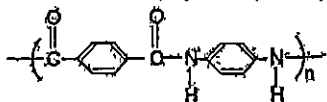
Three repeat units of this polymer are shown below



What by-product is formed each time a monomer is added to the polymer?

- | | |
|------------|---------------------|
| A Chlorine | B Water |
| C Hydrogen | D Hydrogen chloride |

40 Kevlar is a new product which is a polyamide (aramid). Its structure is



Which two molecules could be condensed to form Kevlar?

- A $\text{H}_2\text{N}-\text{C}_6\text{H}_4-\text{NH}_2$ and $\text{HOOC}-\text{C}_6\text{H}_4-\text{COOH}$
- B $\text{HOOC}-\text{C}_6\text{H}_4-\text{NH}_2$ and $\text{HOOC}-\text{C}_6\text{H}_4-\text{NH}_2$
- C $\text{H}-\text{C}_6\text{H}_4-\text{H}$ and $\text{NH}_2-\text{C}_6\text{H}_4-\text{COOH}$
- D $\text{H}_2\text{NOC}-\text{C}_6\text{H}_4-\text{CONH}_2$ and $\text{H}_2\text{NOC}-\text{C}_6\text{H}_4-\text{CONH}_2$

The Periodic Table of the Elements

Group																	
I	II											III	IV	V	VI	VII	0
1 H hydrogen																	
7 Li lithium 3	8 Be beryllium 4											11 B boron 5	12 C carbon 6	13 N nitrogen 7	14 O oxygen 8	15 F fluorine 9	16 Ne neon 10
23 Na sodium 11	24 Mg magnesium 12											27 Al aluminum 13	28 Si silicon 14	29 P phosphorus 15	30 S sulfur 16	31 Cl chlorine 17	32 Ar argon 18
39 K potassium 19	40 Ca calcium 20	41 Sc scandium 21	42 Ti titanium 22	43 V vanadium 23	44 Cr chromium 24	45 Mn manganese 25	46 Fe iron 26	47 Co cobalt 27	48 Ni nickel 28	49 Cu copper 29	50 Zn zinc 30	51 Ga gallium 31	52 Ge germanium 32	53 As arsenic 33	54 Se selenium 34	55 Br bromine 35	56 Kr krypton 36
85 Rb rubidium 37	86 Sr strontium 38	87 Y yttrium 39	88 Zr zirconium 40	89 Nb niobium 41	90 Mo molybdenum 42	91 Tc technetium 43	92 Ru ruthenium 44	93 Rh rhodium 45	94 Pd palladium 46	95 Ag silver 47	96 Cd cadmium 48	97 In indium 49	98 Sn tin 50	99 Sb antimony 51	100 Te tellurium 52	101 I iodine 53	102 Xe xenon 54
133 Cs cesium 55	134 Ba barium 56	135 La lanthanum 57	136 Ce cerium 58	137 Pr praseodymium 59	138 Nd neodymium 60	139 Pm promethium 61	140 Sm samarium 62	141 Eu europium 63	142 Gd gadolinium 64	143 Tb terbium 65	144 Dy dysprosium 66	145 Ho holmium 67	146 Er erbium 68	147 Tm thulium 69	148 Yb ytterbium 70	149 Lu lutetium 71	150 Hf hafnium 72
171 Fr francium 87	172 Ra radium 88	173 Ac actinium 89	174 Th thorium 90	175 Pa protactinium 91	176 U uranium 92	177 Np neptunium 93	178 Pu plutonium 94	179 Am americium 95	180 Cm curium 96	181 Bk berkelium 97	182 Cf californium 98	183 Es einsteinium 99	184 Fm fermium 100	185 Md mendelevium 101	186 No nobelium 102	187 Lr lawrencium 103	188 Rn radon 104

Key

a

X

b

a = relative atomic mass

x = element symbol

b = proton (atomic) number

158-71 Lanthanoid series

790-103 Actinoid series

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

Candidate Number

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Anglo-Chinese School

(INDEPENDENT)



Year 4 Express Preliminary Examination 2015

CHEMISTRY
PAPER 2 Theory
Wednesday

5073/2

29 July 2015

1 hour 45 minutes

Additional materials:

Answer paper
Calculator

TIME 1 hour 45 minutes

INSTRUCTIONS TO CANDIDATES

Write your Candidate number in the spaces at the top of this page and on any separate answer paper used.

Section A

Answer all questions.

Write your answer in the spaces provided on the question paper.

Section B

Answer all three questions from this section

The last question is in the form **EITHER / OR** and only one alternative should be attempted

Write your answers on the answer paper provided.

At the end of the examination, hand up the paper in one bundle

INFORMATION FOR CANDIDATES

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 20.

You may use a calculator.

FOR EXAMINER'S USE	
Section A	
B7	
B8	
B9	
TOTAL	

This question paper consists of 20 printed pages.

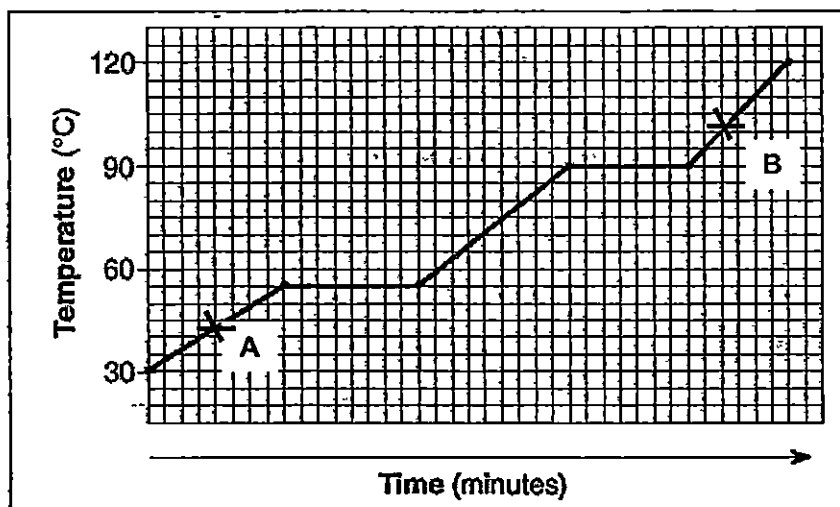
[Turn over

Section A

Answer all questions in the spaces provided.

The total mark for this section is 50.

- A1 The graph below shows the heating curve for a pure compound at room temperature and pressure.



- a Explain why this compound is not water. [2]

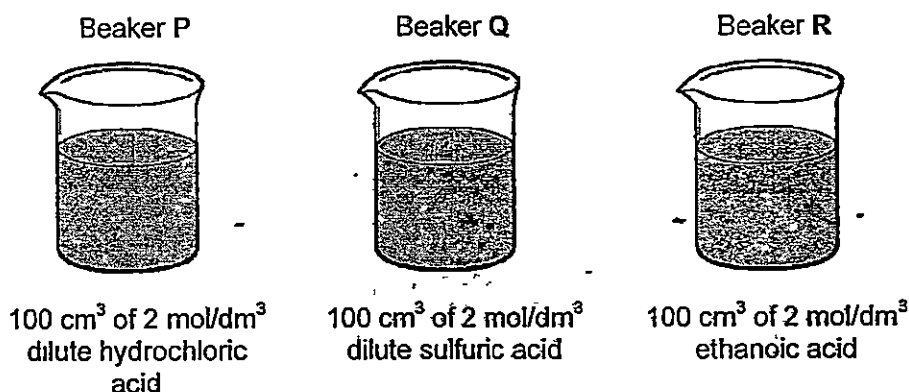
- b Draw the arrangement of particles in the compound at point A and B. [2]

Point A	Point B

- c State the type of bonding present in this compound and explain in terms of its structure why the melting point and boiling point are below 120°C. [3]

[Total : 7]

A2 Equal masses of magnesium carbonate were added into three beakers P, Q and R as shown below



After some time all the magnesium carbonate in the three beakers was reacted completely leaving behind colourless solutions.

- a Write a chemical equation for the reaction between magnesium carbonate and ethanoic acid, CH_3COOH . [1]

- b 200 cm^3 of gas was collected from beaker P when it is connected to a gas syringe. Would the gas collected from each of the other 2 beakers be **more than, equal to, or less than** 200 cm^3 when they are connected to gas syringes? [2]

i Volume of gas from beaker Q _____

ii Volume of gas from beaker R _____

- c i Arrange the rates of reaction in ascending order for the reactions in beakers P, Q and R. [1]

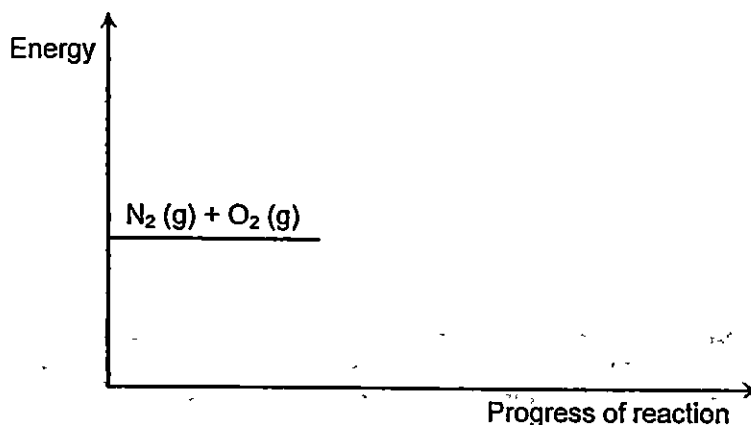
- ii Explain the differences in the rates of reaction in the three reactions. [3]

[Total : 7]

- A3** In the combustion engine, nitrogen and oxygen reacts to form nitrogen monoxide as shown in the equation below:



- a** Calculate the energy change when 6 dm^3 of NO is produced at room temperature and pressure. [2]
- b** Complete the energy profile diagram below and label clearly the products, activation energy and the enthalpy change. [2]

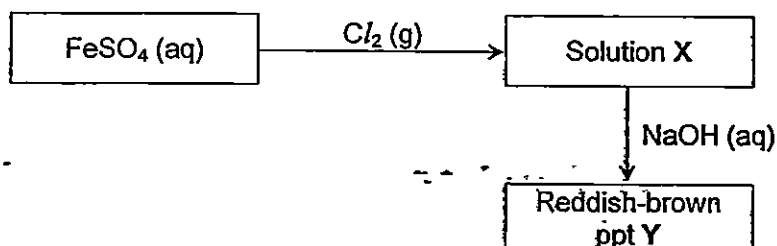


- c** Explain in terms of bond breaking and bond forming whether the reaction is exothermic or endothermic. [2]
- _____
- _____
- d** State the source of nitrogen for the above reaction? [1]
- _____
- e** Nitrogen monoxide can be removed in the catalytic converters installed in cars. Write an equation for the reaction of nitrogen monoxide and carbon monoxide in the catalytic converters [1]
- _____
- f** In addition to nitrogen monoxide, nitrogen dioxide is also produced in the combustion engines. Which of these two gases is directly responsible for acid rain? Explain your reasoning. [2]
- _____
- _____

[Total : 10]

- A4 In an experiment, chlorine gas was bubbled into aqueous iron(II) sulfate solution to form solution X. This is followed by adding aqueous sodium hydroxide and a reddish brown precipitate Y is produced.

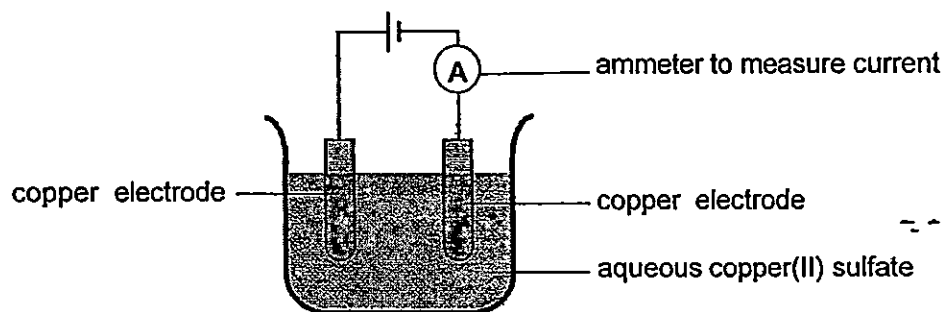
The reactions are summarized in the reaction scheme below.



- a i Name the precipitate Y. [1]
- ii Write the ionic equation with state symbols for the precipitation of Y. [2]
- b Solution X is thought to contain chloride ions. Describe the qualitative analysis test to show chloride ion is present. [2]
- c The reaction between iron(II) sulfate and chlorine is a redox reaction. Explain this in terms of electron transfer. [2]

[Total : 7]

- A5 A student carried out a series of electrolysis experiments using aqueous copper(II) sulfate as shown in the diagram below.



He used the same concentration of aqueous copper(II) sulfate each time, but changed the current that passed through the solution. He consistently performed each electrolysis for 10 minutes.

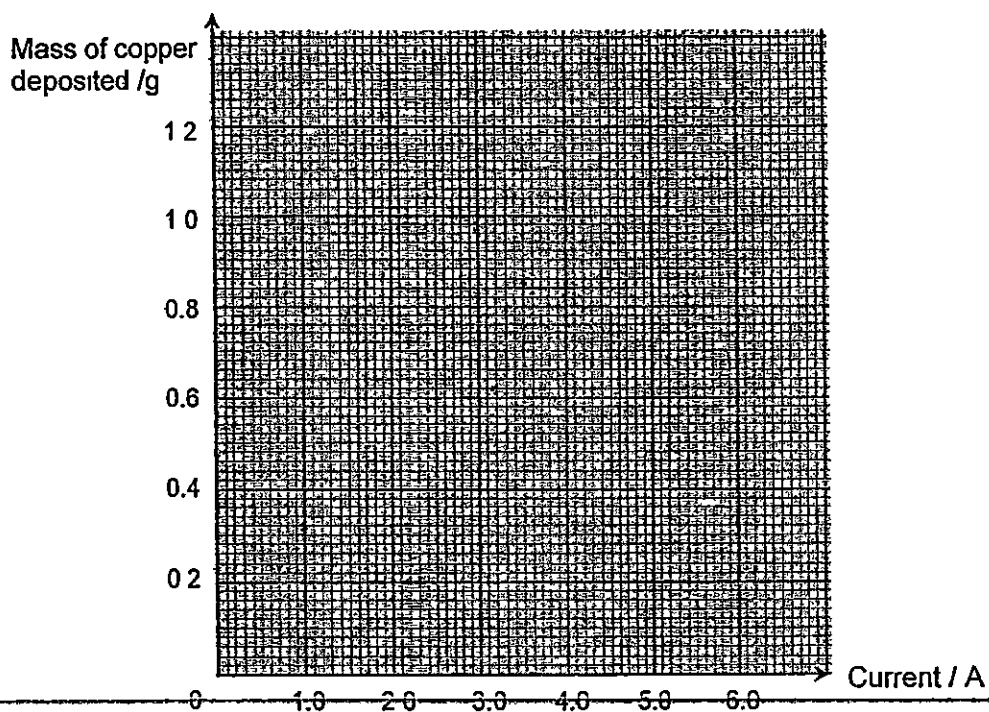
The student weighed the negative electrode before and after each experiment and worked out the mass of copper deposited.

The table shows the results of his experiments.

experiment	time / mins	current / A	mass of copper deposited / g
A	10	1.0	0.21
B	10	2.0	0.40
C	10	3.0	0.58
D	10	4.0	0.81
E	10	6.0	1.22

- a Plot a graph of mass of copper deposited against current

[1]



- b Describe the relationship between the mass of the copper deposited and current as shown by your graph in (a). [1]

- c The student carried out another experiment by passing a current of 5.0 A through the solution of copper(II) sulfate for 5 minutes.
Use the graph from (a) and the information above, predict the mass of copper that would form in the experiment. [1]

- d With reference to the above electrolysis, suggest the modifications made to the copper electrodes in the industrial purification of impure copper. [1]

- e The student carried out another electrolysis experiment using aqueous silver nitrate and silver electrodes. His results are shown in the table below.

electrolyte	time / mins	current / A	mass of silver deposited / g
aqueous silver nitrate	10	4.0	2.7

- i Write a half equation with state symbols for the reaction that occurs at the negative and positive electrodes respectively. [2]

- ii Calculate the number of moles of copper and the number of moles of silver that were formed when a current of 4.0 A was used for 10 minutes. [2]

- iii Compare and comment on the difference between the number of moles of copper formed and the number of moles of silver formed when the same experimental conditions are used. Suggest an explanation to account for the difference. [2]

[Total : 10]

A6 The table below shows a homologous series of organic compounds called ether.

Name	Number of carbon atoms	Structural formula	Boiling point/ $^{\circ}\text{C}$
Dimethyl ether	2	$\begin{array}{c} \text{H} & & \text{H} \\ & & \\ \text{H}-\text{C}-\text{O}-\text{C}-\text{H} \\ & & \\ \text{H} & & \text{H} \end{array}$	-23.0
Ethylmethyl ether	3	$\begin{array}{c} \text{H} & \text{H} & & \text{H} \\ & & & \\ \text{H}-\text{C}-\text{C}-\text{O}-\text{C}-\text{H} \\ & & & \\ \text{H} & \text{H} & & \text{H} \end{array}$	7.0
Diethyl ether	4	$\begin{array}{c} \text{H} & \text{H} & & \text{H} & \text{H} \\ & & & & \\ \text{H}-\text{C}-\text{C}-\text{O}-\text{C}-\text{C}-\text{H} \\ & & & & \\ \text{H} & \text{H} & & \text{H} & \text{H} \end{array}$	34.4

- a Suggest two evidences from the structural formulae to show the organic compounds belong to the same homologous series [2]

- b What is the molecular formula of the ether molecule that contains 5 carbon atoms. [1]

- c i Define isomers [1]

- ii Draw the full structural formula of the alcohol which is an isomer of dimethyl ether. [1]

- iii Describe a suitable chemical reaction to differentiate between the alcohol and dimethyl ether. [2]

- iv The alcohol in part (ii) reacts with butanoic acid under suitable conditions to form a sweet smelling substance. Name and draw the full structural formula of this sweet smelling compound. [2]

[Total : 9]

Section B

Answer all three questions from this section.

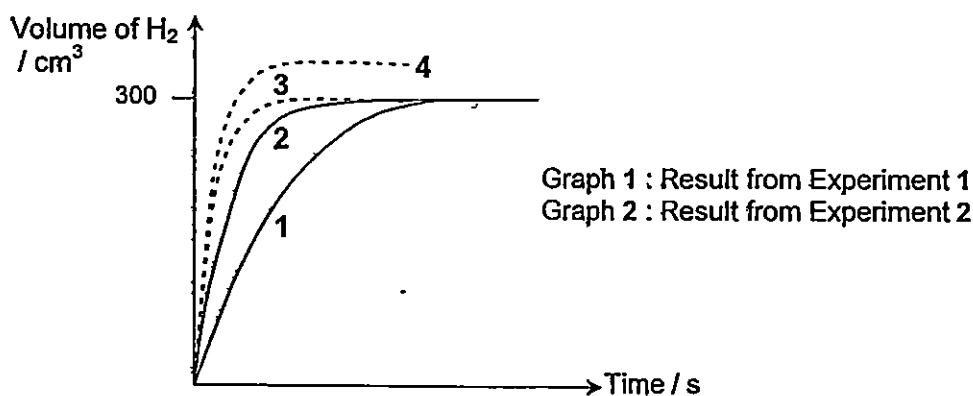
The last question is in the form EITHER / OR and only one alternative should be attempted.

Tie any extra sheets used loosely to this booklet.

- B7 Metal X is found in Group II of the Periodic Table. A student placed 0.50 g of metal X into a flask containing 80 cm³ of 1.00 mol/dm³ HCl. The volume of hydrogen gas was measured at regular intervals at 25°C. The experiment was repeated using 0.50 g of metal X and 50 cm³ of 2.00 mol/dm³ HCl.

Experiment	Mass of Metal X	Volume and concentration of HCl
1	0.50 g	80 cm ³ , 1.00 mol/dm ³
2	0.50 g	50 cm ³ , 2.00 mol/dm ³

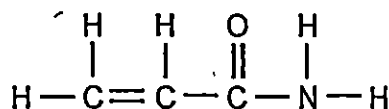
The results obtained are shown on the following graphs:



- In Experiment 1, which reagent is in excess, metal X or HCl? Explain your answer. [2]
- Calculate the relative atomic mass of metal X. [3]
- Experiment 2 was repeated and an additional 0.1 g of copper was added during the reaction. The result is shown in graph 3. State and explain how copper affects the results obtained in this reaction. [2]
- Experiment 2 was carried out again but this time an additional 0.1 g of zinc was added during the reaction. The result is shown in graph 4. Explain the result. [2]

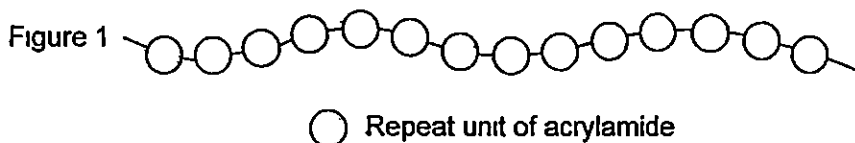
[Total : 9]

B8 Polyacrylamide abbreviated as PAM is a polymer formed from acrylamide monomer.

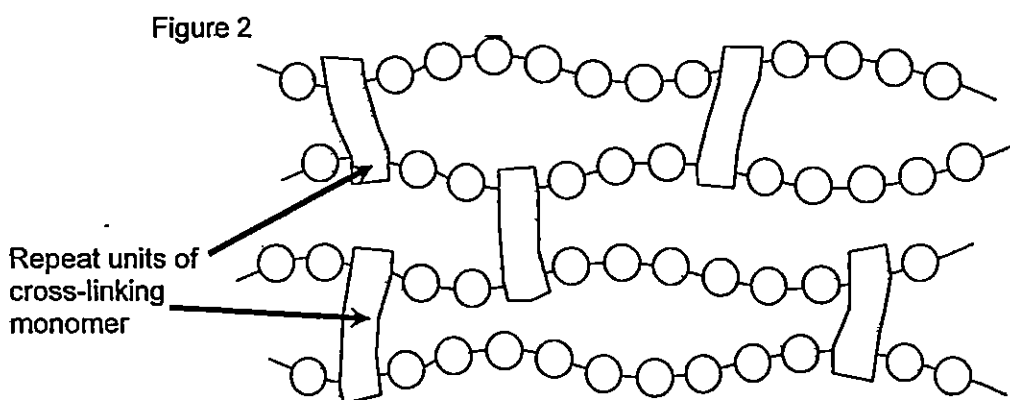
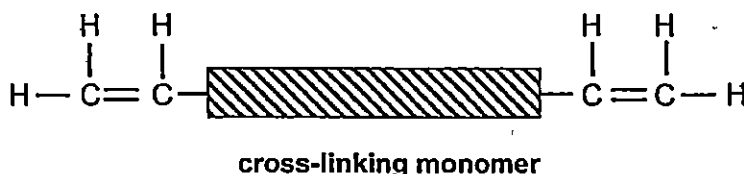


acrylamide, monomer

It can be synthesized as a simple linear-chain structure or cross-linked. A polymer is called a linear polymer (Figure 1) because it consists of a long string of carbon-carbon bonds



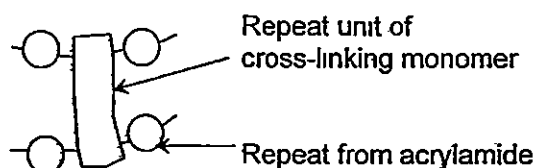
The cross-linked polymer (Figure 2) uses a cross-linking monomer to criss-cross with the long chain polymers. Each cross-linking monomer has two carbon-carbon double bonds that enables it to do so.



The polymers are used in the manufacture of soft contact lenses. More recently, it is used in aesthetic facial plastic surgery as filler placed beneath the skin.

<http://en.wikipedia.org/wiki/Polyacrylamide>
<http://en.wikipedia.org/wiki/N,N%27-Methylenebisacrylamide>
<http://chemed.chem.purdue.edu/genchem/topicreview/bp/1/polymer/terms.html>

- a Is the monomer **acrylamide** saturated or unsaturated? Explain with reference to its structure - [2]
- b Using the structural formula of the monomer given,
- draw the structure of the **linear polyacrylamide**. Your answer must show at least two repeat units. [2]
 - draw the structure of a segment of the **cross-linked polymer**. Your answer should include four **acrylamide** monomers and one **cross-linking monomer**. An outline of the required segment is shown below. [2]



- c Suggest which polymer, linear or cross-linked would more likely be
- a fluid and
 - a solid.

Hence, suggest which is used to manufacture contact lenses and which is used as filler in aesthetic facial surgery? [2]

- d In an addition reaction, 77 g of **cross-linking monomer** is reacted with excess iodine molecules.

Calculate the number of moles and the mass of iodine molecules required for complete addition reaction.

(relative molecular mass of the cross-linking monomer = 154) [3]

[Total : 11]

EITHER

- B9** In the experiment to find how three gases, ammonia, carbon monoxide and sulfur dioxide, affect the rate at which metals corrode, strips of four different metals were left in contact with each gas in moist air.

After two weeks, the appearance of each metal strips was recorded as shown in the table below.

Metal	Moist air alone	Moist air polluted with		
		Ammonia	Carbon monoxide	Sulfur dioxide
Aluminium	Still shiny	Still shiny	Still shiny	Still shiny
Copper	Small patch of green solid	Coating of blue-green solid	Small patch of green solid	Coating of a black and blue solid
Iron	Coating of red-brown solid	Thin coating of red-brown solid	Coating of red-brown solid	Thin coating of red-brown solid
Lead	Still shiny	Still shiny	Still shiny	Coating of black solid

- Name the gas that gives rise to the fastest rate of corrosion and explain why this is so. [1]
- Name and explain which metal is most suitable for storing vinegar. [2]
- One more set of experiments were carried out using strips of welded iron and zinc. The welded strips were then exposed to the each of the gases in moist air.
Describe and explain the appearance of iron after two weeks. [3]
- Carbon monoxide and sulfur dioxide are atmospheric pollutants. Describe how they are introduced into the atmosphere. [2]
- State and explain the changes observed on red litmus paper when placed in a jar containing ammonia mixed with moist air versus a jar containing dry ammonia. [2]

[Total : 10]

OR

B9 a Explain the properties of the following underlined substances in terms of their bonding and structures:

- i Graphite is a good conductor of electricity and is also used as a lubricant at high temperature. [3]
- ii Particles of silicon carbide are laminated to paper to create sandpapers. (hint: Silicon is a group IV element just like carbon. Silicon carbide is a compound that has a structure similar to that of diamond.) [2]

b Reactions of five metals P, Q, R, S and T are given below.

Metals	Reactions
P	Does not react with steam but oxidizes slowly in air.
Q	Explodes in cold water.
R	Extracted industrially by reduction with coke. Reacts with steam.
S	Does not react with oxygen at room conditions
T	Sinks and reacts with water.

- i Arrange the metals in descending order of reactivity. [1]
- ii Identify which metal is calcium and write the equation for its reaction given in the table above. [2]
- iii In an experiment, a strip of metal R is placed in an aqueous nitrate of P. Explain the reaction that would occur. [2]

[Total : 10]

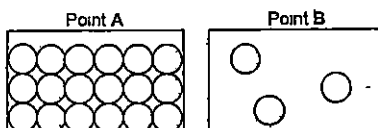
P1

D	D	C	B	B	B	A	C	D	A	D	A	B	D	C	A	A	A	A	D
D	B	B	C	C	C	B	B	A	C	A	B	A	D	B	C	B	B	D	A

P2

- A1 a Melting point and boiling point of the compound are 55°C and 90°C respectively. But melting point and boiling point of water are 0°C and 100°C respectively.

b

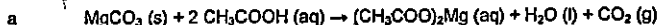


c

Covalent bonding

The compound has a simple molecular structure where the discrete molecules are held together by weak intermolecular forces. These forces are easily overcome.

A2



b

- i Volume of gas from beaker Q : Equal to 200cm³
ii Volume of gas from beaker R : Equal to 200cm³

c

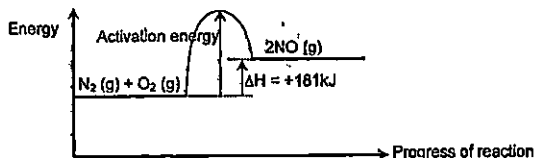
i Beaker R, beaker P, beaker Q

ii Ethanoic acid is a weak acid and it is only partially dissociated to give a low concentration of hydrogen ions. Dilute hydrochloric acid and dilute sulphuric acid are strong acids the dissociate completely. However, dilute sulphuric acid is a dibasic acid and it produces twice the concentration of hydrogen ions compared to dilute hydrochloric acid which is a monobasic acid.

A3

- a No. of mol of NO = 6/24 = 0.25 mol
Energy given out = 0.25/2 × 181 = 22.6 kJ

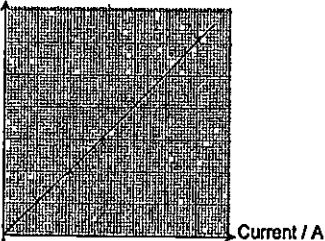
b



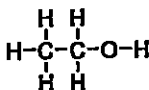
c

Endothermic.

The energy taken in to break the bonds in 1 mole of nitrogen gas and 1 mole of oxygen gas is greater than the energy given out to form the bonds in 2 moles of nitrogen monoxide gas.

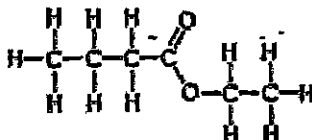
- d Air
- e $2 \text{NO (g)} + 2 \text{CO (g)} \rightarrow \text{N}_2 \text{(g)} + 2 \text{CO}_2 \text{(g)}$
- f Nitrogen dioxide as it is an acidic oxide and could oxidise in atmosphere and reacts with rainwater to form acid rain Nitrogen monoxide is a neutral oxide.
- A4 a i Iron(III) hydroxide
- ii $\text{Fe}^{3+} \text{(aq)} + 3 \text{OH}^- \text{(aq)} \rightarrow \text{Fe(OH)}_3 \text{(s)}$
- b To a sample of solution X, add dilute nitric acid followed by aqueous silver nitrate A white precipitate will be formed if chloride ion is present
- c Iron(II) ion loses an electron to form iron(III) ions, this is oxidation
Chlorine gas gains electrons to form chloride ions, this is reduction
- A5 a
- Mass of copper deposited / g
- 
- Current / A
- b Mass of copper deposited is directly proportional to the current applied
- c 0.508 g
- d Anode: impure copper, Cathode: a small piece of pure copper
- e i Negative electrode $\text{Ag}^+ \text{(aq)} + \text{e}^- \rightarrow \text{Ag (s)}$
Positive electrode $\text{Ag (s)} \rightarrow \text{Ag}^+ \text{(aq)} + \text{e}^-$
- ii No. of mole of silver = $2.7 / 108 = 0.025 \text{ mol}$
No. of mole of copper = $0.81 / 64 = 0.0127 \text{ mol}$
- iii Number of mole of silver is twice that of copper
(number of mole of copper is half that of silver)
The charge of copper(II) ion is +2 and the charge of silver ion is +1
Given the same quantity of electrons, the number of copper(II) ions discharged is half that of silver ions
- A6 a They have the same general formula, $\text{C}_n\text{H}_{2n+2}\text{O}$
The consecutive members increase by a $-\text{CH}_2-$ group of atoms
- b $\text{C}_8\text{H}_{18}\text{O}$
- c i Isomers are molecules that have the same molecular formula but different structural formulae

ii



iii In separate test tubes, add acidified potassium manganate(VII) to samples of ethanol and dimethyl ether and warm. Ethanol decolourises the purple solution but not dimethyl ether

iv

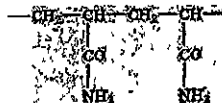


Ethyl butanoate

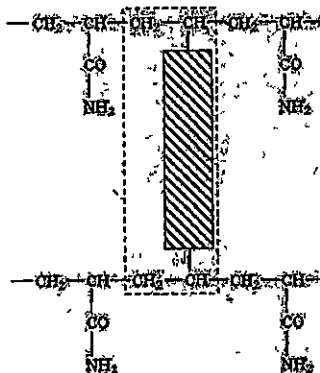
- B7 a HCl is in excess
Metal X is the limiting reagent and in both experiments, the same mass of metal is used up and same volume of gas produced
- b No of mole of H_2 gas = $300/24000 = 0.0125$ mol
No of mole of X = 0.0125 mol
Relative atomic mass of X = mass/mole
= $0.5/0.0125 = 40$
- c Copper is a catalyst
It speeds up the reaction by providing an alternative reaction pathway which has a lower activation energy
- d The dilute hydrochloric acid is in excess. Zinc and magnesium react concurrently to produce a higher volume of gas and faster rate than experiment 2

B8 a Unsaturated because of a carbon-carbon double bond

b i



ii



- c Fluid is more likely to be the Linear polymer
Solid is more likely to be the Cross-linked polymer
Filler is linear polymer and contact lenses are cross-linked polymer

- d No of mole of monomer = $77/154 = 0.5$ mol
No of mole of Iodine = $2 \times 0.5 = 1$ mole
Mass of Iodine = $4 \times 0.5 \times 127 = 254$ g

EITHER

- B9 a Sulphur dioxide is an acidic oxide and dissolves in water to form acid
- b Aluminium It has a protective layer of aluminium oxide
- c Iron remains shiny grey. Zinc provides sacrificial protection for iron. Zinc is more reactive than iron and loses electrons more easily. It corrodes in place of iron.
- d Carbon monoxide is produced from the incomplete combustion of carbon-containing substances due to the lack of oxygen
Sulphur dioxide is produced at the power station when fossil fuel is burned
- e Red litmus turns blue in moist air and ammonia gas mixture but remains red in dry ammonia
Ammonia needs to dissolve in water to become an alkali and releases aqueous hydroxide ions

OR

- B9 a i In the structure of graphite, each carbon bonds to other carbon atoms using three of the four valence electrons. The non-bonding valence electrons of the carbon atoms form the sea of delocalised electrons that made graphite a conductor of electricity.
- The carbon atoms are covalently bonded in layers consisting of hexagonal rings. Between the layers are weak forces that can be easily overcome which make the layers slide over each other easily. Graphite can be used as a lubricant at high temperature due to the many strong covalent bonds between the carbon atoms
- ii Silicon carbide has a giant molecular structure. A large number of carbon and silicon atoms are all joined together by strong covalent bonds in a giant three-dimensional lattice structure. A lot of energy would be needed to break these bonds and the structure is hard and rigid
- b i Q, T, R, P, S
- ii T
 $\text{Ca (s)} + 2 \text{H}_2\text{O (l)} \rightarrow \text{Ca(OH)}_2 \text{(aq)} + \text{H}_2 \text{(g)}$
- iii Displacement reaction
R is more reactive than P. R loses electron more easily than P and it displaces P from the aqueous nitrate solution

Name of Candidate _____ () Class _____ Index No _____

1. 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 contains the two isotopes in equal proportions
- B Bromine has different oxidation states
- C Bromine isotopes have different numbers of protons
- D Bromine is a gaseous mixture of atoms and molecules at room temperature

- 2 Silicon carbide, SiC, has a structure similar to diamond. Boron nitride, BN, has a structure similar to graphite. Bronze is an alloy of copper and tin. Which statements about SiC, BN and bronze are correct?

- 1 All are bonded covalently
- 2 All except silicon carbide conduct electricity when solid.
- 3 All have high melting points

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

- 3 What correctly describes the molecules in very dilute sugar solution at room temperature?

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

4. What can be deduced about two gases that have the same relative molecular mass?

- A They have the same boiling point
- B They have the same number of atoms in one molecule
- C They have the same rate of diffusion at room temperature and pressure
- D They have the same solubility in water at room temperature

- 5 One volume of a gaseous element X_2 combines with an equal volume of gaseous hydrogen to form two volumes of a gaseous hydride.

What is the formula for the hydride of X?

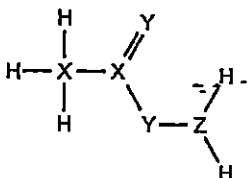
- A H_2X
- B HX
- C HX_2
- D H_2X_2

- 6 The mass of one mole of a chloride formed by a metal Y is 74.5 g. The formula of the chloride could be

- A Y_3Cl
- C YCl

B Y_2Cl D YCl_2

- 7 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?

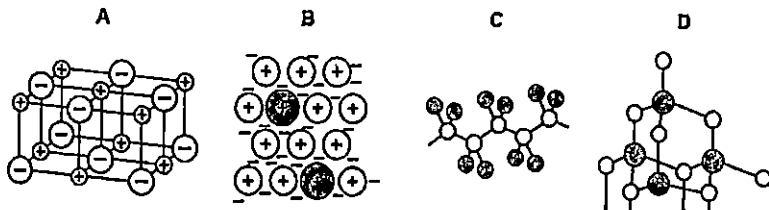
	X	Y	Z
A	1	5	6
B	4	5	1
C	4	6	5
D	5	1	4

- 8 How could a sample of potassium be obtained from potassium chloride, KCl ?

method 1 adding zinc to a solution of KCl
 method 2 electrolysis of an aqueous solution of KCl
 method 3 electrolysis of molten KCl

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

9. Which diagram represents the structure of an alloy?



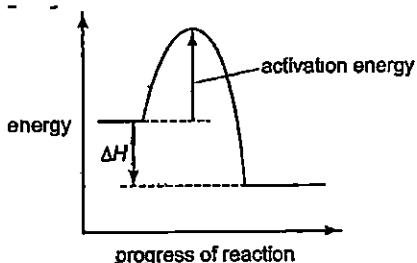
10. When a volcano erupts, which gas is produced in significant amounts?

- A carbon monoxide
 B chlorofluorocarbons
 C methane
 D sulfur dioxide

11. A concentrated aqueous solution of copper(II) chloride is electrolysed using inert electrodes. What is the product at the negative electrode?

- A chlorine
- B copper
- C hydrogen
- D oxygen

12. The energy profile for the forward direction of a reversible reaction is shown



Which row correctly shows both the sign of the activation energy and the type of the enthalpy change for the reverse reaction?

	sign of activation energy	enthalpy change
A	negative	endothermic
B	negative	exothermic
C	positive	endothermic
D	positive	exothermic

13. Which is an anion that is present in the solution formed when an excess of dilute hydrochloric acid is added to calcium carbonate?

- A Ca^{2+}
- B Cl^-
- C CO_3^{2-}
- D H^+

14. Which ionic equation describes a redox reaction?

- A $\text{Ag}^+(\text{aq}) + \text{Cl}^-(\text{aq}) \rightarrow \text{AgCl}(\text{s})$
- B $2\text{H}^+(\text{aq}) + \text{CO}_3^{2-}(\text{aq}) \rightarrow \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{l})$
- C $\text{H}^+(\text{aq}) + \text{OH}^-(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l})$
- D $\text{Zn}(\text{s}) + \text{Cu}^{2+}(\text{aq}) \rightarrow \text{Zn}^{2+}(\text{aq}) + \text{Cu}(\text{s})$

15. Carbon and silicon are both in Group IV of the Periodic Table. Which statement is correct for both carbon dioxide and silicon dioxide?

- A They are acidic oxides.
- B They are readily soluble in water.
- C They contain ionic bonds.
- D They have giant molecular structures.

16 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 1 and 2 only
- B 1, 3 and 4 only
- C 2 only
- D 3 and 4 only

17 Which is most likely use of sulfuric acid?

- A as a bleach
- B in the manufacture of ammonia
- C in the manufacture of fertilisers
- D in the manufacture of battery acid

18 Which property is common to calcium, potassium and sodium?

- A Their atoms all have one electron in the outermost shell
- B Their ions all have eight electrons in their outermost shell
- C The ions have are attracted to the positive electrode
- D They are all deposited at the anode when their molten chloride is electrolysed

19 Which two statements indicate that metal M may have a proton number between 21 and 30?

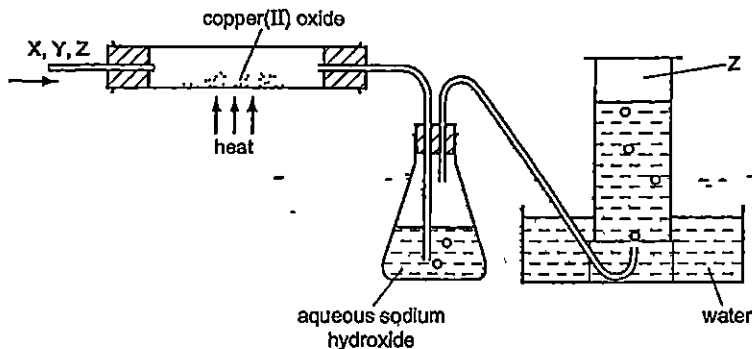
- 1 It conducts electricity
- 2 It does not react with water
- 3 It forms two basic oxides with formulae MO and M_2O_3
- 4 It forms two coloured sulfates

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

20 Which substance, in the given physical state, is found at the bottom of the blast furnace?

	substance	physical state
A	calcium carbonate	solid
B	calcium silicate	liquid
C	carbon	liquid
D	iron	solid

21 Gas Z is to be separated from a mixture of gases X, Y and Z by the apparatus shown in the diagram



For which mixture will this system work successfully?

	X	Y	Z
A	hydrogen	carbon dioxide	nitrogen
B	oxygen	hydrogen	carbon monoxide
C	nitrogen	oxygen	hydrogen
D	carbon dioxide	nitrogen	oxygen

22 Which reaction does not involve either oxidation or reduction?

- A $\text{CH}_4(\text{g}) + 2\text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{g})$
 B $\text{Cu}^{2+}(\text{aq}) + \text{Zn}(\text{s}) \rightarrow \text{Cu}(\text{s}) + \text{Zn}^{2+}(\text{aq})$
 C $\text{CuO}(\text{s}) + \text{H}_2\text{SO}_4(\text{aq}) \rightarrow \text{CuSO}_4(\text{aq}) + \text{H}_2\text{O}(\text{l})$
 D $\text{Zn}(\text{s}) + \text{H}_2\text{SO}_4(\text{aq}) \rightarrow \text{ZnSO}_4(\text{aq}) + \text{H}_2(\text{g})$

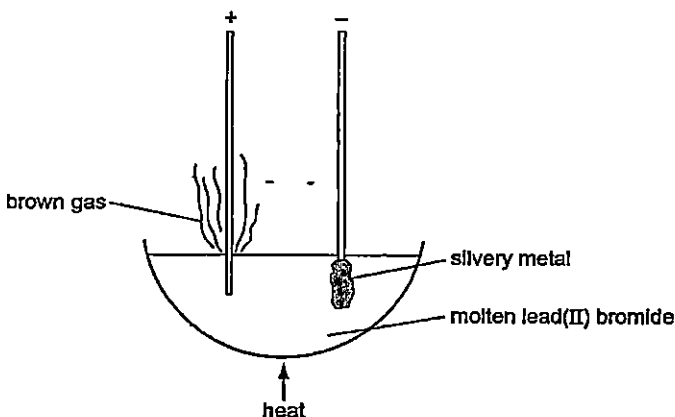
23 In the extraction of iron, carbon monoxide acts as

- A an oxidising agent
 B a reducing agent
 C a catalyst
 D an impurity to lower the melting point of the mixture to conserve energy

24. Magnesium can be obtained by heating magnesium oxide with which element?

- A calcium
 B hydrogen
 C carbon monoxide
 D carbon

25 The diagram shows the electrolysis of molten lead(II) bromide using inert electrodes



What happens during this electrolysis?

- A Atoms change to ions
- B Ions change to atoms.
- C Covalent bonds are broken
- D New compounds are formed

26 An alloy of copper and zinc is added to an excess of dilute hydrochloric acid. The resulting mixture is then filtered. Which observations are correct?

	filtrate	residue
A	colourless solution	none
B	colourless solution	red-brown
C	blue solution	gray
D	blue solution	none

27 Which pair of compounds could be used in the preparation of calcium sulfate?

- A calcium carbonate and sodium sulfate
- B calcium chloride and ammonium sulfate
- C calcium hydroxide and barium sulfate
- D calcium nitrate and lead(II) sulfate

28 The compounds $\text{CO}(\text{NH}_2)_2$ and NH_4NO_3 are used as fertilisers

The proportion of nitrogen by mass in $\text{CO}(\text{NH}_2)_2$ is 1 that in NH_4NO_3
 The proportion of nitrogen by mole in $\text{CO}(\text{NH}_2)_2$ is 2 that in NH_4NO_3

Which words correctly complete gaps 1 and 2?

	1	2
A	equal to	equal to
B	higher than	equal to
C	higher than	higher than
D	lower than	lower than

29 Titration of an acid against a base is a method often used in the preparation of salts
 Which properties of the acid, the base and the salt are required if this method is to be used?

	acid	base	salt
A	insoluble	insoluble	insoluble
B	soluble	insoluble	insoluble
C	soluble	soluble	insoluble
D	soluble	soluble	soluble

30 The oxide of an element X increases the rate of decomposition of hydrogen peroxide. At the end of the reaction the oxide of X is unchanged
 Which details are those of X?

	proton number	mass number
A	18	40
B	20	40
C	25	55
D	82	207

31 Scrap iron is often recycled. Which reason for recycling is not correct?

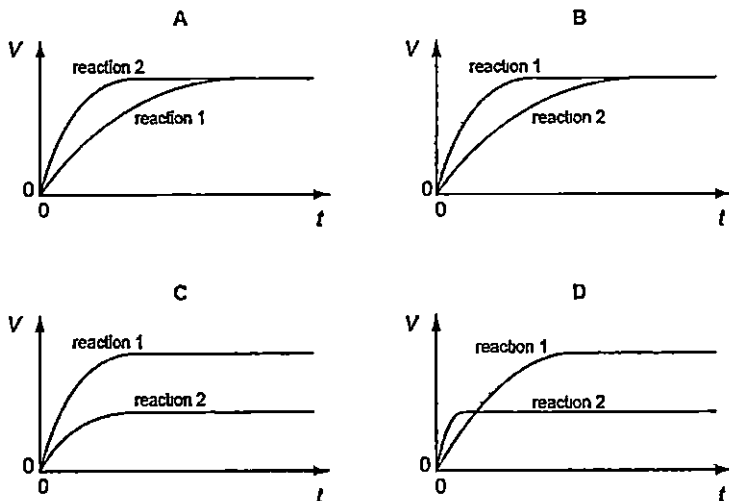
- A It reduces the need to collect the scrap iron
- B It reduces the amount of waste taken to landfill sites
- C It reduces the amount of pollution at the site of the ore extraction
- D It saves natural resources

32 A student performs two reactions.

reaction 1 10 g of magnesium ribbon with excess 2.0 mol / dm^3 dilute hydrochloric acid

reaction 2 5 g of magnesium powder with excess 3.0 mol / dm^3 dilute hydrochloric acid

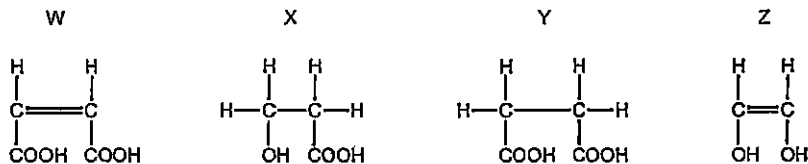
In both experiments, the volume of hydrogen produced, V , is measured against time, t , and the results plotted graphically. Which set of graphs is correct?



33 Which information is correct regarding the formation of ethanol by the process of fermentation?

	substances fermented	gas evolved during fermentation
A	carbohydrates	carbon dioxide
B	carbohydrates	carbon monoxide
C	hydrocarbons	carbon dioxide
D	hydrocarbons	carbon monoxide

34 What are the reactions of compounds W, X, Y and Z?



	decolourises aqueous bromine	has a pH of less than 7	reacts with a carboxylic acid to form an ester
A	X and Y	W, X and Y	W, X, Y and Z
B	X and Y	X and Z	X and Z
C	W and Z	W, X and Y	X and Z
D	W and Z	X and Z	W, X and Y

35 Compound X has the molecular formula $\text{C}_2\text{H}_6\text{O}$

X can be made by a fermentation process.

X can be oxidised to Y

X can react with Y to form Z and water

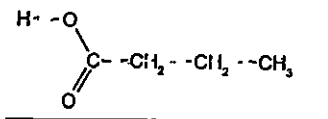
To which homologous series do X, Y and Z belong?

	X	Y	Z
A	alcohols	carboxylic acids	esters
B	alcohols	esters	carboxylic acids
C	carboxylic acids	alcohols	esters
D	carboxylic acids	esters	alcohols

- 36 Useful fractions are obtained by the fractional distillation of petroleum. Which fraction is matched by its use?

	fraction	use
A	bitumen	fuel in cars
B	lubricating oils	for making waxes and polishes
C	paraffin (kerosene)	for making roads
D	petrol (gasoline)	aircraft fuel

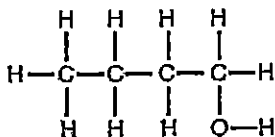
- 37 Which statement, about the compound shown below, is correct?



- A It does not react with ammonia
 B It does not react with magnesium
 C It is formed by oxidation of butanol
 D It is propanoic acid.
- 38 Compounds X and Y are both alkanes. Compound X has a higher boiling point than compound Y. What could be the formulae of compounds X and Y?

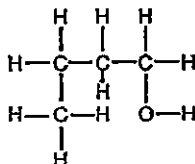
	compound X	compound Y
A	C_8H_{18}	C_9H_{18}
B	C_8H_{18}	C_9H_{20}
C	C_8H_{18}	C_8H_{16}
D	C_8H_{20}	C_8H_{18}

39 Compound Q has the structure shown.

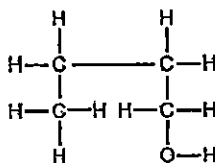


Which structure is an isomer of Q?

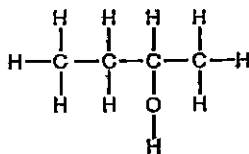
A



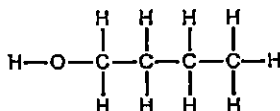
B



C

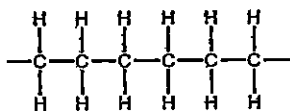


D

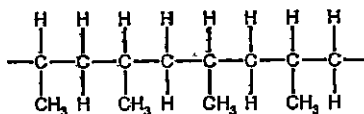


40 What is the partial structure of the polymer formed by the polymerisation of propene, $\text{CH}_3\text{CH}=\text{CH}_2$?

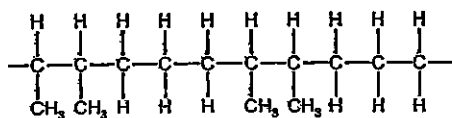
A



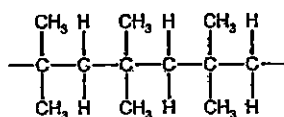
B



C



D



1. The diagram 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							-	-															

(a) Answer each of the following questions using only those elements shown in the diagram. Each element may be used once, more than once or not at all.

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) has a chloride of type XCl_2 , whose aqueous solution forms a white precipitate with aqueous sodium hydroxide but insoluble in excess of NaOH .

..... [1]

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

..... [1]

(ii) Arsenic(III) oxide is slightly soluble in water. Arsenous acid, H_3AsO_3 , a weak acid is formed.
When 100 cm^3 of 0.05 mol/dm^3 of both arsenous acid and hydrochloric acid is added separately to excess magnesium, will arsenous acid produce more, less or the same volume of hydrogen compared to hydrochloric acid?

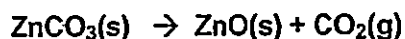
..... [1]

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

(iii) State the chemical formula of the salt formed from the reaction between arsenous acid and magnesium. [1]

..... [1]

2. Zinc carbonate thermally decomposes to form zinc oxide and carbon dioxide.



In an experiment, a sample of a certain mass of zinc carbonate is heated in a test-tube using a bunsen burner.

The total volume of carbon dioxide formed is measured every 10 seconds. The results are plotted on the graph below.



- (a) Suggest why the volume of carbon dioxide does not increase very much when the zinc carbonate is first heated.

.....

 [1]

- (b) Using the same flame intensity and the same particle size of lead (II) carbonate and calcium carbonate, two separate but same experiments were carried out.

Experiment (i) the same mass of lead (II) carbonate is heated.

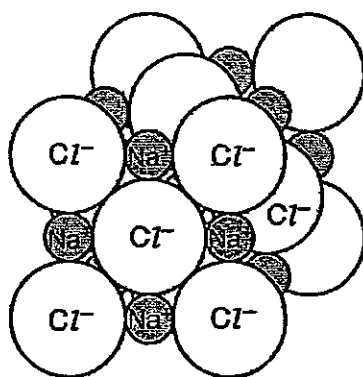
Experiment (ii) the same number of moles of calcium carbonate is heated.

On the axes above, draw the graphs you would expect from the results of these experiments and label :-

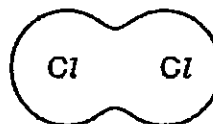
Graph (i) for experiment (i) when same mass of lead carbonate is heated, [1]

Graph (ii) for experiment (ii) when same number of moles of calcium carbonate is heated. [1]

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



sodium chloride



chlorine

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

(i) Explain, in terms of structure and bonding, the low melting point of chlorine

.....

[1]

(ii) Explain why hydrogen chloride can conduct electricity in the aqueous state.

.....

[1]

- (b) State the two electrode half equations when concentrated aqueous sodium chloride is electrolyzed.

Anode reaction

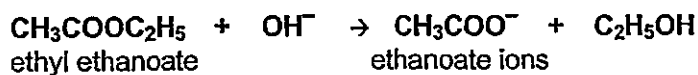
Cathode reaction[2]

- (c) Chlorine gas reacts with ammonia gas, NH_3 , to form hydrogen chloride and nitrogen gas.

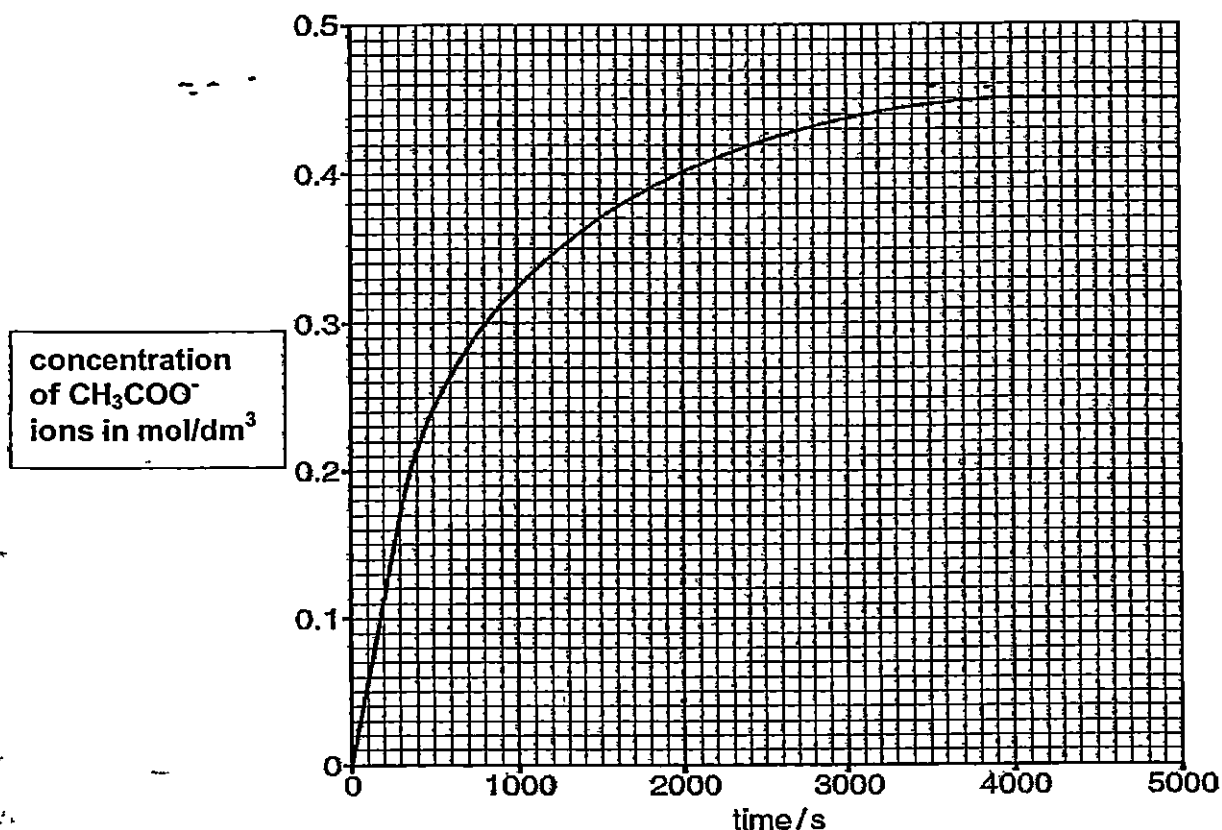
Construct a balanced chemical equation with state symbols for this reaction.

..... [2]

4. The ester, ethyl ethanoate, reacts with hydroxide ions to form ethanoate ions and ethanol, as shown in the equation below.



- (a) The graph shows how the concentration of ethanoate ions, CH_3COO^- , changes as the reaction proceeds.



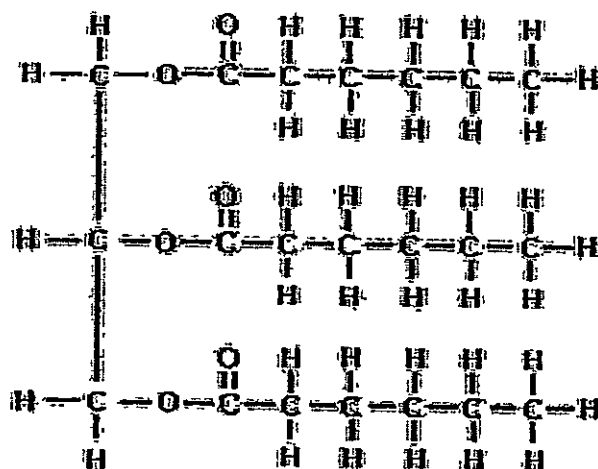
- (i) Use the information in the graph to deduce the mass of ethanoate ions in 200 cm^3 of the solution when the reaction is complete.

mass =g [1]

- (ii) Use the information in the graph to calculate the average rate of reaction, in $\text{mol/dm}^3/\text{s}$, during the first 300 seconds.

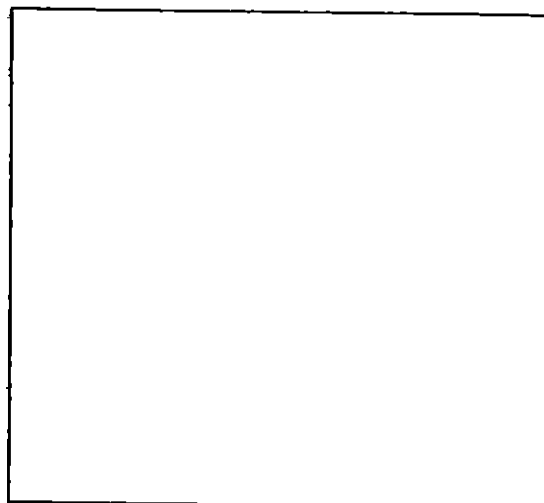
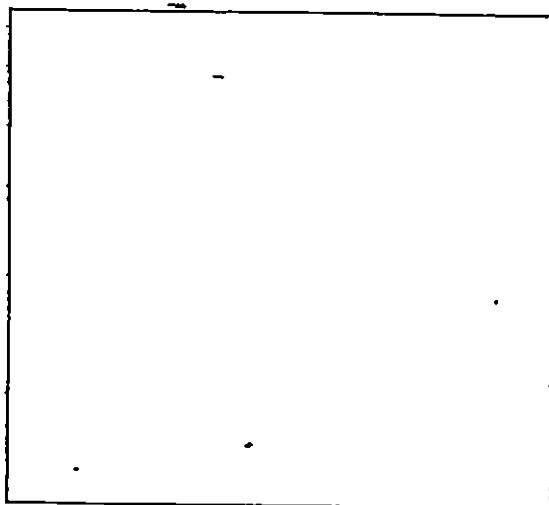
average rate of reaction mol / dm³ / s [1]

- (b) Below is a molecule of fats found in our bodies and foods are in the form of '*triglyceride*' molecule, which is a saturated fat.



Triglyceride-Saturated

Use the example given and draw the display diagram of two products when hydroxide ion, OH⁻, reacts with this molecule.



[2]

5. Analysis of a yellow compound X, which consists of two ions, shows it has the following composition.

Element	Percentage by mass
---------	--------------------

hydrogen	3.40
nitrogen	12.0
oxygen	41.0
vanadium	43.6

- (a) Show that X has the formula $\text{H}_4\text{NO}_3\text{V}$.

[1]

- (b) Suggest one physical property of *compound X* caused only by the presence of vanadium in the compound.

[1]

- (c) Aqueous sodium hydroxide is added to solid X and the mixture is warmed.
A colourless gas that turns moist red litmus blue is evolved.
Deduce the formula of each of the two ions present in X.

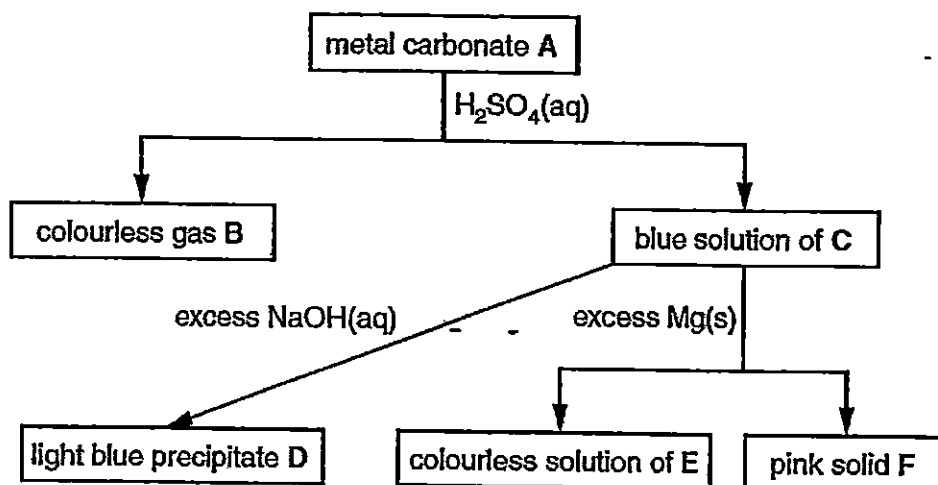
positive ion negative ion [2]

- (d) An acidified aqueous solution of X reacts with aqueous potassium iodide to form iodine.
State what you can deduce about the *chemical nature* of X.

[1]

6. The flow chart shows some reactions of the compounds of a metal.

18



Identify, by name, each of the substances.

A

B

C

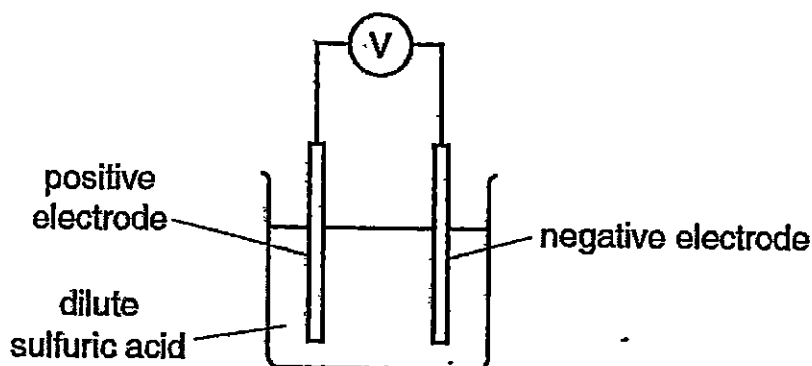
D

E

F

[6]

7. The diagram shows a simple electrochemical cell.



The voltages produced by different combinations of metal electrodes are shown in the table.

Positive electrode	Negative electrode	Voltage / V

silver	R	+0.10
Copper	S	+0.48
Copper	T	+2.70
Copper	U	+0.78
Silver	copper	+0.46

- (a) Use the information in the table to deduce the order of reactivity of the metals silver, copper, R, S, T, U

most reactive



.....

least reactive

[1]

- (b) State two metals from the table that will produce the *highest voltage* when used in the electrochemical cell as shown in the diagram.

Anode and Cathode..... [1]

- (c) (i) **Briefly state** a method, to extract aluminium and zinc from its ore, such as aluminium oxide and zinc oxide respectively.

Aluminium [1]

Zinc [1]

- (ii) When solid copper (II) nitrate is heated, it decomposed to copper (II) oxide, nitrogen dioxide and oxygen.

Write a chemical equation to represent the thermal decomposition of copper(II) nitrate.

..... [1]

- (d) Draw the cross and dot diagram of ammonium fluoride in the space below.

[2]

8. (a) (i) Explain why attaching iron with magnesium prevents iron from rusting.

.....

 [1]

- (ii) If copper is attached to iron, will iron rust slower, or faster or no difference? Explain your answer.

.....

 [2]

- (b) Other than cost, state one benefit of recycling of iron.

.....

 [1]

- (c) In the manufacture of iron in the blast furnace explain the presence of nitrogen in the waste gases.

.....
 [1]

9. A student titrates 20.0 cm^3 of a metal hydroxide, $M(\text{OH})_2$, of concentration 0.060 mol / dm^3 with a strong acid of concentration 0.050 mol / dm^3 . It requires 24.0 cm^3 of acid to neutralise the metal hydroxide.

(a) Calculate the number of moles of acid in 24.0 cm^3 of the acid.

..... moles [1]

(b) Calculate the number of moles of OH^- ions in 20.0 cm^3 of the metal hydroxide.

..... moles [1]

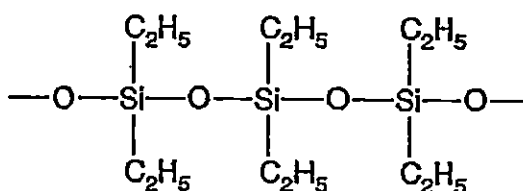
(c) Deduce whether the acid used is more likely to be hydrochloric acid or sulfuric acid.

..... [1]

(d) Explain why barium sulfate should not be prepared by adding sulfuric acid to barium oxide?

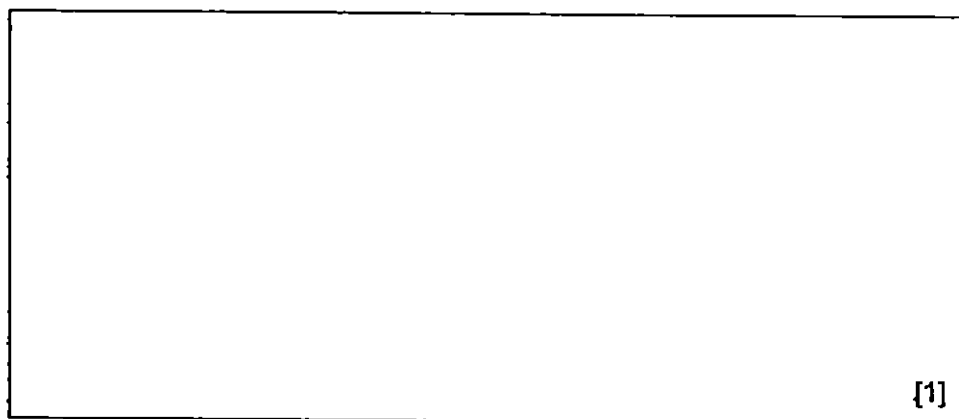
.....
.....
.....
..... [1]

10. Silicone fluids are polymers. Part of the structure of a silicone fluid is shown below.

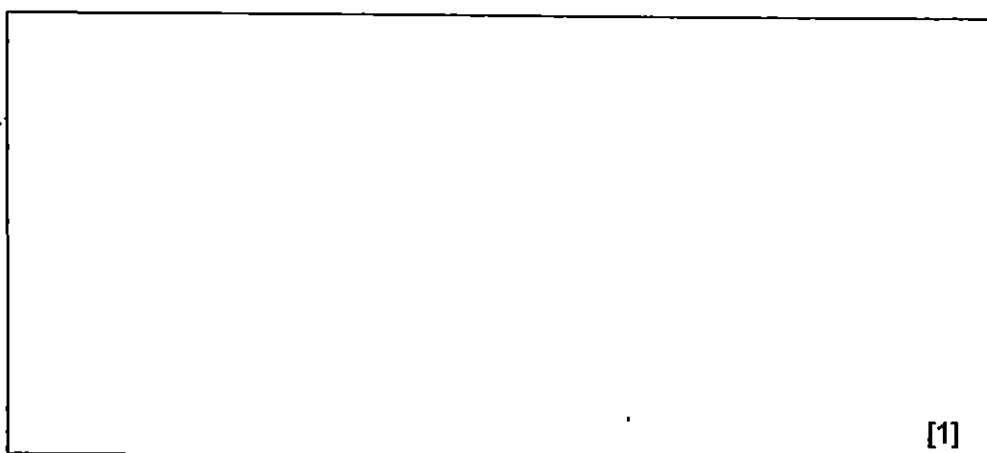


The monomer used in making this silicone fluid is a saturated compound. Deduce the structure of this monomer.

- (a) Draw the structure of the repeating unit of this polymer



- (b) If this is a condensation polymer, draw the monomer of this polymer.



SECTION.B (30 marks)

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.

11. The table below shows some properties of the Group 0 elements (noble gases).

element	density of liquid element in g/cm ³	boiling point /°C
helium	0.15	-269
neon	1.20	-246
argon	1.40	-186
krypton		-152
xenon	3.52	

- (a) Describe the changes in density and boiling point of the elements in group 0 from helium to xenon.

..... [2]

- (b) Explain why noble gases are inert and not reactive.

..... [1]

- (c) Several compounds of the noble gases have been produced in recent years, e.g. fluorides of xenon.

- (i) Complete the equation for the reaction of xenon(IV) fluoride with water.

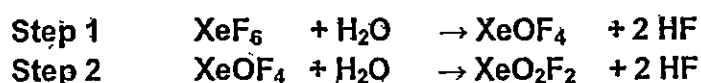


- (ii) Predict the pH of the solution after this reaction?

..... [1]

- (d) Xenon(VI) fluoride, XeF₆, with a m.p. of 49°C and b.p. of 76°C reacts with water to form a mixture which contains xenon, xenon(VI) oxide, XeO₃, and hydrogen fluoride, HF and oxygen gas in step 3.

Xenon hexafluoride, XeF₆, hydrolyses to XeO₃, stepwise in 3 steps, of which only two steps are shown below.



- (i) Determine the oxidation number of the xenon in compound, XeO₂F₂, formed in step 2.

..... [1]

- (ii) Using the information from reactions in step 1 and step 2, predict the balanced chemical equation for the reaction in step 3 when XeO_2F_2 hydrolyses further with water.

..... [1]

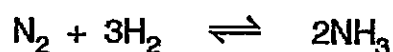
- (iii) Neon is also a noble gas, state one commercial use of neon.

..... [1]

- (iv) Is xenon (VI) fluoride a covalent or ionic compound? Give a reason for your answer from the information given above

..... [2]

12. Ammonia is manufactured by the Haber process



- (a) State what does the symbol $\rightleftharpoons$ means

..... [1]

The table below shows how the percentage yield of ammonia varies with both temperature and pressure.

pressure / atmospheres	% yield at 200°C	% yield at 300°C	% yield at 400°C	% yield at 500°C
30	68	32	11	4
100	81	51	25	10
200	86	63	36	18
300	88	69	40	24

- (b) (i) Using the information above, describe how, the percentage yield of ammonia changes with temperature and pressure.

..... [1]

- (ii) Explain how using a catalyst in the Haber process has an economic advantage.

..... [1]

Farmers use chemicals to improve crop yield. Ammonium phosphate, $(\text{NH}_4)_3\text{PO}_4$, is used as a fertiliser and calcium hydroxide, $\text{Ca}(\text{OH})_2$, is used to reduce the acidity of soils.

The relative formula mass of ammonium phosphate is 149.

- (c) Calculate the percentage by mass of nitrogen in ammonium phosphate.

percentage = % [1]

- (d) A farmer adds ammonium phosphate to a field.
He then adds calcium hydroxide to the field because the soil is very acidic.

- (i) Calcium hydroxide neutralises acid in soil.
Give an ionic equation for this reaction.

.....[1]

- (ii) Adding calcium hydroxide together with ammonium phosphate reduces the effectiveness of ammonium phosphate as a fertiliser. Explain.

.....
.....
.....
..... [1]

- (e) (i) State one man made source of oxides of nitrogen.

..... [1]

- (ii) Use chemical equation/s, to show how the production of oxides of nitrogen can be reduced in cars.

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

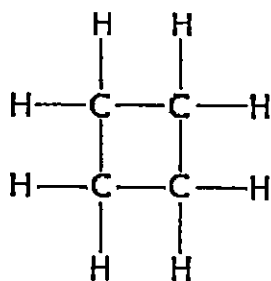
- (f) State one natural source of methane.

..... [1]

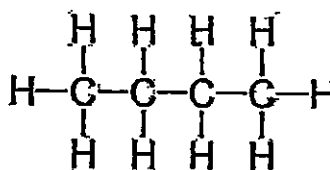
EITHER

13. The alkanes are a homologous series of hydrocarbons.

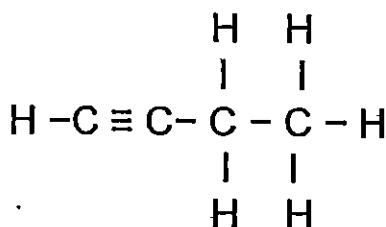
(a) Jezicar and Authoree had a discourse on the molecules below.



Molecule A



Molecule B



Molecule C

Jezicar says that both molecule A and B are in the alkane homologous series, But Authoree believes that molecule A and B are in a different homologous series because they both do not share the same general formula.

From the information above,

(i) suggest a reason, why Jezicar may be right.

.....

 [1]

(ii) State the condition/s for the chemical reaction between an alkane and chlorine

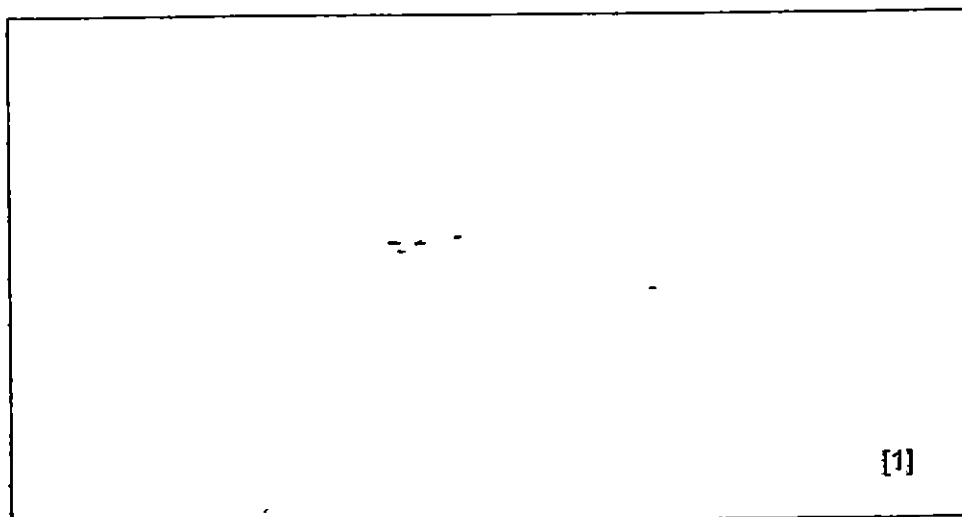
condition/s [1]

(iii) In terms of bond making and bond breaking state whether the chemical reaction between an alkane and chlorine is an exothermic or endothermic reaction?

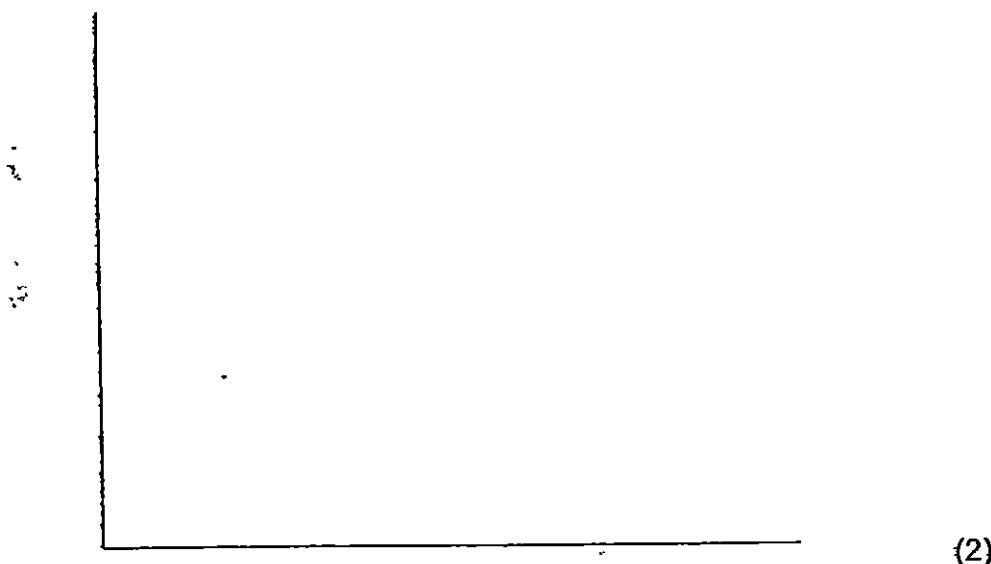
.....

 [1]

- (iv) Molecule C behaves just like an unsaturated hydrocarbon. Draw the display diagram of the product formed when excess bromine is completely reacted with molecule C.



- (v) Draw a energy profile diagram for the reaction between molecule A and chlorine. Label the activation energy, enthalpy change and also label the axes.



- (b) One mole of undecane, $C_{11}H_{24}$, is cracked to form a mixture containing one mole of ethene, one mole of propene and one mole of another substance.

State the formula of the other substance.

.....[1]

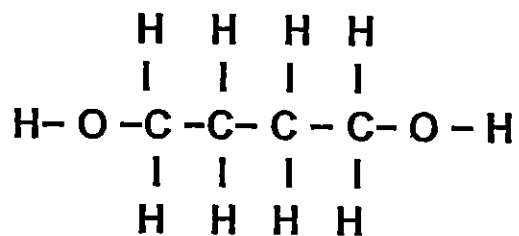
- (c) Butanoic acid, C_3H_7COOH , reacts with sodium to form a salt and a gas.
State the name and formula of the salt.

Name

formula

[2]

- (d) If Butan 1,4 diol , $\text{HOCC}_2\text{H}_4\text{COH}$, display diagram shown below

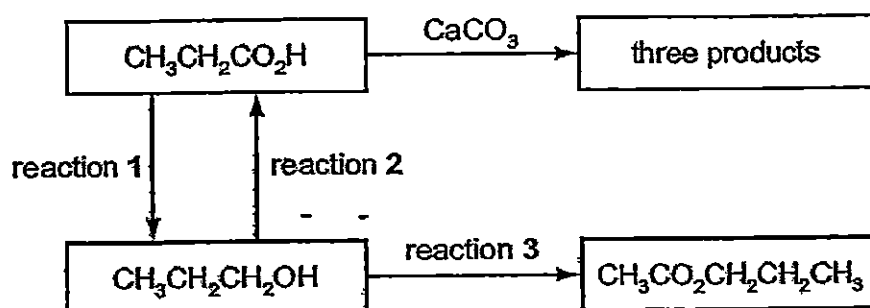


is reacted completely with excess acidified potassium manganate (VII), State the display diagram of the product form in the box below.

[1]

OR

14. A series of reactions based on propanoic acid is shown.



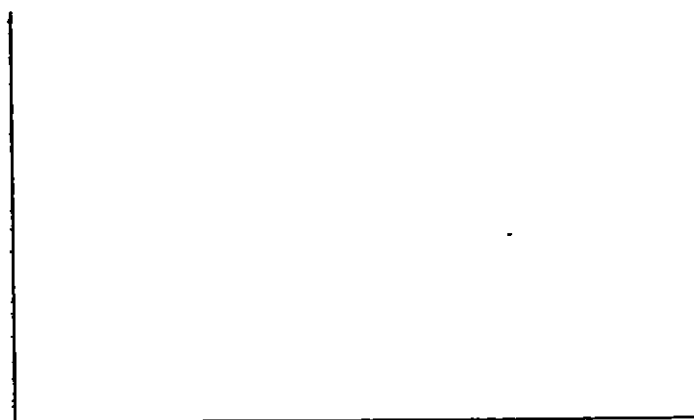
- (a) (i) When propanoic acid reacts with calcium carbonate, there is effervescence and the solution feels warm. Write a balanced chemical equation for the reaction between propanoic acid and calcium carbonate.

..... [1]

- (ii) State the name of the salt formed in reaction between $\text{CH}_3\text{CH}_2\text{COOH}$ and calcium carbonate,

..... [1]

- (iii) Draw a labelled energy profile diagram for the reaction between $\text{CH}_3\text{CH}_2\text{COOH}$ and calcium carbonate.



[2]

- (b) (i) Name the type of reaction for the conversion of $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$ to $\text{CH}_3\text{CH}_2\text{COOH}$ in reaction 2?

..... [1]

- (ii) Suggest the name of type of reaction for the conversion of $\text{CH}_3\text{CH}_2\text{COOH}$ to $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$ in reaction 1.

..... [1]

- (c) Suggest a suitable reagent and experimental conditions for reaction 3.

..... [2]

30

- (d) State the name of an alkene and the experimental conditions to convert this alkene to $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$.

Name of alkene

Conditions [2]

END