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Bukit Batok Secondary School
GCE O Level Preliminary Examination
Sec 4 Express

CHEMISTRY
Paper 1 Multiple Choice

5073/01
19 August 2016
0930hr to 1030hr
1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

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

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

There are forty questions on this paper. Answer all questions. For each question there are four possible answers A, B, C and D.

Choose the one you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

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

Any rough working should be done in this booklet.

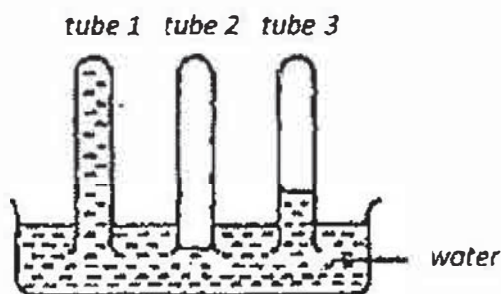
A copy of the Periodic Table is printed at the end of the question paper.

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

1. Which of the following is a compound?

- A. fluorine
- B. lithium
- C. petroleum
- D. sugar

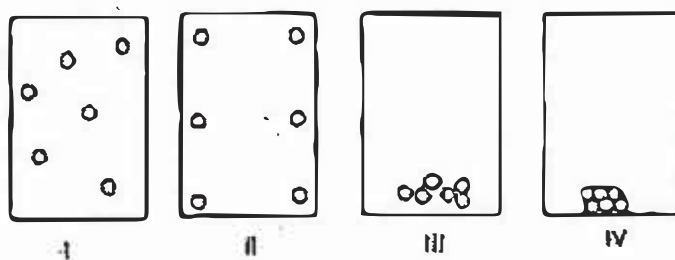
2. Three dry test tubes were filled with different gases and placed in a trough of water. The diagram shows what happens after some time.



Which gases could the tubes have contained?

- | | Tube 1 | Tube 2 | Tube 3 |
|----|----------------|----------------|----------------|
| A. | ammonia | carbon dioxide | hydrogen |
| B. | ammonia | hydrogen | carbon dioxide |
| C. | carbon dioxide | ammonia | hydrogen |
| D. | carbon dioxide | hydrogen | ammonia |

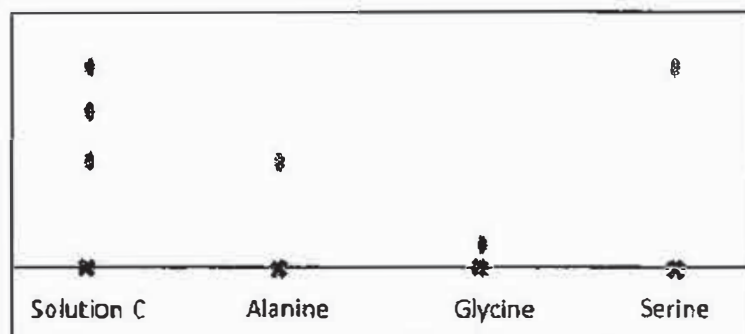
3. Substance X has a melting point of $-95\text{ }^{\circ}\text{C}$ and a boiling point of $56\text{ }^{\circ}\text{C}$. A metal tank contains substance X at $60\text{ }^{\circ}\text{C}$. The tank is cooled to $0\text{ }^{\circ}\text{C}$. Four arrangements of particles in the tank are shown below.



Which diagrams best show the arrangements of particles of X in the tank at $60\text{ }^{\circ}\text{C}$ and at $0\text{ }^{\circ}\text{C}$?

- | | at $60\text{ }^{\circ}\text{C}$ | at $0\text{ }^{\circ}\text{C}$ |
|----|---|--|
| A. | I | III |
| B. | I | IV |
| C. | II | III |
| D. | III | IV |

4. A protein undergoes hydrolysis to form solution C. Chromatography was carried out on solution C, glycine, serine and alanine.



Which of the following about solution C can be deduced from the chromatogram?

- A. Solution C contains alanine only.
 B. Solution C contains glycine and serine.
 C. Solution C does not contain serine.
 D. Solution C does not contain glycine.
5. From which mixture can the underlined substance be obtained by adding water, stirring and filtering?
- A. ethanoic acid and water
 B. copper (II) sulfate and sodium chloride
 C. silver nitrate and calcium chloride
 D. zinc carbonate and sodium chloride
6. Which of the following ions contains the largest number of electrons?
- A. O^{2-}
 B. Cl^-
 C. Na^+
 D. Al^{3+}
7. The electronic structures of atoms P, Q and R are given below.

P: 2.1 Q: 2.8.6 R: 2.7

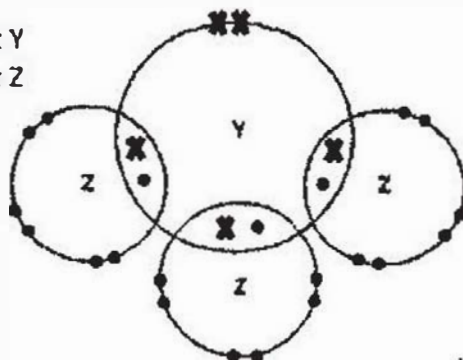
Which are the formulae of the compounds formed between

- (i) P and Q
 (ii) Q and R?

	P and Q	Q and R
A.	P_2Q	QR
B.	P_2Q	QR_2
C.	PQ	QR
D.	PQ_2	Q_2R

8. A compound X contains oxygen and one other element. Which one of the following properties of X indicates most clearly whether the bonds in X are ionic or covalent?
- X has a high melting point.
 - X is almost insoluble in water.
 - X is a hard solid at room temperature.
 - X conducts electricity only when molten or in aqueous solution.
9. The formula of thallium carbonate is Tl_2CO_3 and that of sodium chlorite is $NaClO_2$. What is the formula of thallium chlorite?
- Tl_2ClO_2
 - $TlClO_2$
 - $Tl(ClO_2)_2$
 - $Tl_2(ClO_2)_3$
10. The diagram shows the arrangement of electrons in the outer shells of the atoms in the compound YZ_3 .

x : electron of element Y
 ● : electron of element Z

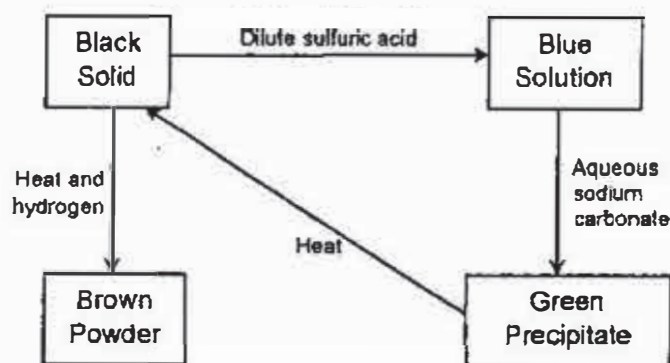


Which pair of elements could be Y and Z?

- | | Y | Z |
|----|------------|----------|
| A. | calcium | fluorine |
| B. | aluminium | nitrogen |
| C. | phosphorus | chlorine |
| D. | sulfur | chlorine |
11. The elements, sodium and chlorine, in the third period of the Periodic Table show a gradual change in properties. Which of the following changes is correct?
- Their melting points increase.
 - Their ability to gain electrons increase.
 - Their oxides change from acidic to basic.
 - Their chlorides change from covalent to ionic.

12. 25.0 cm^3 sodium hydroxide solution in a conical flask was titrated with 0.1 mol/dm^3 hydrochloric acid in a burette. Which of the steps would cause the calculated concentration of sodium hydroxide to be lower than its true value?
- A. There are air bubbles in the burette.
 - B. Record the final reading of burette before the indicator changes its colour.
 - C. Rinse the burette with distilled water but not with 0.1 mol/dm^3 hydrochloric acid.
 - D. Wash the conical flask with distilled water before sodium hydroxide solution is pipetted into the flask.
13. On complete combustion, a certain mass of hydrocarbon gave 11.0 g of carbon dioxide and 9.0 g of water. What could the hydrocarbon be?
- A. CH_4
 - B. C_2H_2
 - C. C_2H_4
 - D. C_2H_6
14. Which one of the following gases at room temperature and pressure does not occupy 12 dm^3 ?
- A. 6 g of helium
 - B. 16 g of oxygen
 - C. 14 g nitrogen
 - D. 9 g of steam
15. A compound Y gave a gas when heated with an excess of aqueous sodium hydroxide. When no more gas was evolved, the resulting alkaline solution was heated with aluminium powder and the same gas was given off.
- Which of the following was compound Y?
- A. ammonium chloride
 - B. sodium nitrate
 - C. ammonium nitrate
 - D. nitric acid
16. Which of the following methods can be used to distinguish between solid sodium carbonate and solid calcium carbonate?
- A. Add acidified barium nitrate to the solid.
 - B. Add acidified aqueous silver nitrate to the solid.
 - C. Heat the solid and test the gaseous product with limewater.
 - D. Add dilute acid to the solid and test the gaseous product with limewater.

17. The reaction scheme below shows the reactions involving a metal and three of its compounds.



What is the metal?

- A. copper
 - B. iron
 - C. lead
 - D. zinc
18. Which of the following is **not true** of acids?
- A. They turn litmus from blue to red.
 - B. Their aqueous solutions conduct electricity.
 - C. They are generally formed by the action of water on the oxides of metals.
 - D. They neutralize bases to yield salt and water only.
19. An element forms a hydroxide which dissolves in both acids and alkalis. What is this element likely to be?
- A. calcium
 - B. iron
 - C. sodium
 - D. zinc
20. Which substance is **not used** to prepare magnesium sulfate by reaction of dilute sulfuric acid?
- A. magnesium carbonate
 - B. magnesium chloride
 - C. magnesium hydroxide
 - D. magnesium oxide
21. Which element is always present with iron in mild steel?
- A. aluminium
 - B. carbon
 - C. copper
 - D. tin

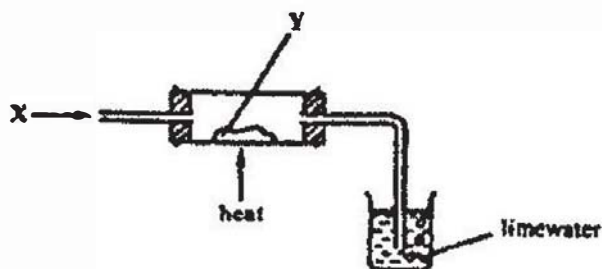
22. Hydrogen is produced by reaction of a metal A and a dilute acid. When the same gas was passed over an oxide of metal B, it reduced the metallic oxide to its metal in the presence of heat.

Which of the following substances would give these results?

	Metal A	Acid	Oxide of Metal B
1.	zinc	sulfuric acid	calcium oxide
2.	calcium	hydrochloric acid	lead (II) oxide
3.	iron	sulfuric acid	copper (II) oxide
4.	copper	hydrochloric acid	zinc oxide

- A. 1, 2 and 3 are correct
 B. 1 and 3 are correct
 C. 2 and 3 are correct
 D. 1 and 4 are correct

23. A gas X was passed over a hot solid Y using the apparatus in the diagram below.



What are gas X and solid Y?

	X	Y
A.	carbon dioxide	carbon
B.	carbon monoxide	copper
C.	carbon dioxide	copper (II) oxide
D.	carbon monoxide	copper (II) oxide

24. Which of the following is an example of a redox reaction?

- A. $2\text{Br}_{(\text{aq})}^- \rightarrow \text{Br}_{2(\text{g})} + 2\text{e}^-$
 B. $\text{Na}^+_{(\text{aq})} + \text{e}^- \rightarrow \text{Na}_{(\text{s})}$
 C. $\text{CuO}_{(\text{s})} + \text{H}_2_{(\text{g})} \rightarrow \text{Cu}_{(\text{s})} + \text{H}_2\text{O}_{(\text{g})}$
 D. $\text{CuCO}_{3(\text{s})} + \text{H}_2\text{SO}_{4(\text{aq})} \rightarrow \text{CuSO}_{4(\text{aq})} + \text{H}_2\text{O}_{(\text{l})} + \text{CO}_{2(\text{g})}$

25. In which of the following substances does nitrogen exhibit its highest oxidation state?

- A. N_2
 B. NO_2
 C. N_2H_4
 D. HNO_3

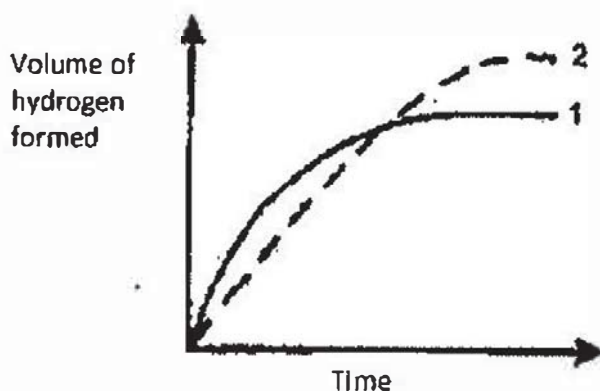
26. Which one of the following substances is present in the exhaust fumes and could contribute to the formation of acid rain?

- A. carbon
- B. lead (II) oxide
- C. nitrogen
- D. nitrogen dioxide

27. A solution can be decomposed using a powdered catalyst. What would be the effect on the rate of the decomposition and the volume of gas produced if an equal volume of water was added to the solution before the reaction began?

	Rate	Final volume of gas
A.	decreased	increased
B.	unchanged	decreased
C.	increased	increased
D.	decreased	unchanged

28. In the graph below, curve 1 was obtained by the reaction between 50 cm³ of 1 mol/dm³ sulfuric acid and excess zinc granules.



Which of the following changes would produce curve 2?

- A. Increase temperature by 10 °C.
- B. Adding the same amount of zinc powder instead of zinc granules.
- C. Using 100 cm³ of 1 mol/dm³ sulfuric acid instead 50 cm³ of 1 mol/dm³ sulfuric acid.
- D. Using 100 cm³ of 0.75 mol/dm³ sulfuric acid instead of 50 cm³ of 1 mol/dm³ sulfuric acid.

29. The energy required to break the following bonds are given in the table below.

Bond	Energy required to break bond / kJ/mol
F – F	158
H – H	436
H – F	556

Which of the following can be deduced from the information provided above?

- A. The bonds in fluorine molecule is the strongest.
 B. Hydrogen gas is more reactive than fluorine gas.
 C. Hydrogen fluoride molecules are the least stable.
 D. The energy produced when forming 1 mole of hydrogen fluoride from its elements is 259 kJ.
30. It was found that the heat required to evaporate 7.4 g of ethoxyethane (C₂H₅)₂O was 2.6 kJ while that required to evaporate 4.6 g of ethanol was 3.9 kJ. From this evidence, which of the following would be the **most** correct conclusion?
- A. The more carbon atoms there are in a molecule, the more difficult it is to evaporate the substance.
 B. The molecules of ethoxyethane are held together more strongly than those of ethanol.
 C. The molecules of ethanol are bound together more strongly than those of ethoxyethane.
 D. The atoms in ethoxyethane molecules are more difficult to break apart than those in ethanol molecules.
31. During an electrolysis, 5.00 moles of electrons are passed through a molten aluminium salt, what is the maximum mass of aluminium formed at the cathode?
- A. 16.2 g
 B. 27.0 g
 C. 45.0 g
 D. 135.0 g
32. The copper heat-reflecting shields of some space rockets are gold plated using electroplating. Which electrodes and electrolytes will be used to gold-plate the heat shields?

	Negative electrode	Positive electrode	Electrolytes
A.	carbon	heat shield	gold compound
B.	heat shield	carbon	copper compound
C.	heat shield	gold	gold compound
D.	gold	heat shield	copper compound

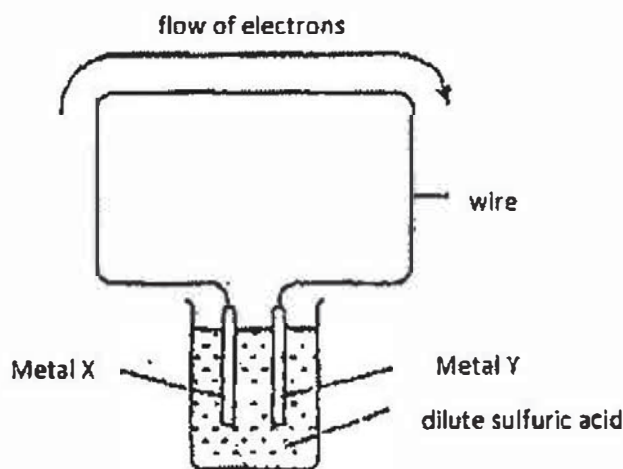
33. The following three solutions undergone electrolysis using inert electrodes.

- Solution I concentrated sodium chloride
 Solution II dilute potassium sulfate
 Solution III silver nitrate

Which of the solution(s) produce oxygen gas at the anode?

- A. I only
 B. I and II only
 C. II and III only
 D. I, II and III

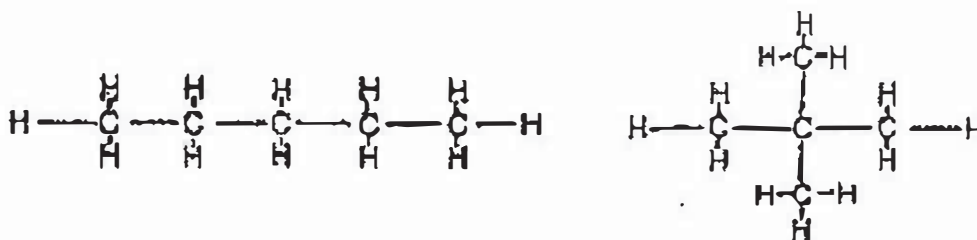
34. The diagram below shows a simple cell.



For which pair of metals would electrons flow as shown in the diagram?

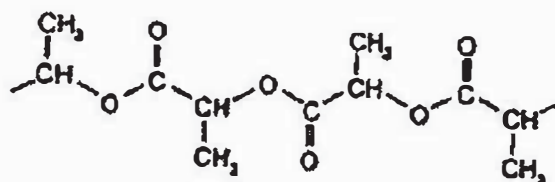
- | | X | Y |
|----|------|-----------|
| A. | iron | zinc |
| B. | zinc | copper |
| C. | lead | magnesium |
| D. | zinc | magnesium |

35. Which property is similar for the two organic compounds shown below?

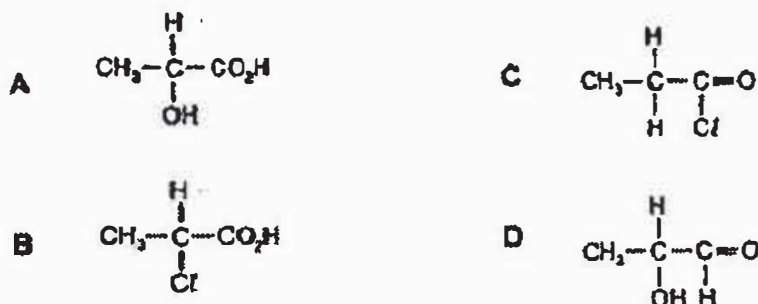


- A. melting point
 B. structural formula
 C. solubility in methylbenzene
 D. composition by mass

36. Ethanol is used in some after-shave lotions and deodorants. Which pair of properties makes it suitable for these uses?
- It is flammable and vaporises easily.
 - It is flammable and mixes easily with water.
 - It is a good solvent and vaporises easily.
 - It is colourless and has a low freezing point.
37. What happens when one mole of ethane is mixed in the dark at room temperature with six moles of chlorine gas?
- There is no reaction.
 - Only C_2Cl_6 are formed.
 - C_2Cl_6 and HCl are formed.
 - CH_3CH_2Cl and HCl are formed.
38. One form of biodegradable polymer used for 'plastic' bags has the following structure.



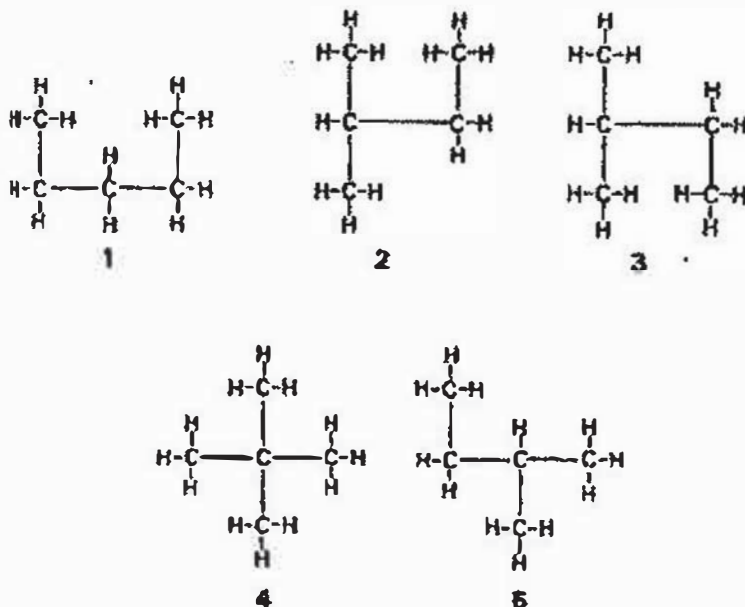
What could be the monomer for this polymer?



39. Which process is used to convert substance R to S?

	R	Process	S
A.	ester	addition polymerisation	terylene
B.	ethanol	neutralisation	ethanoic acid
C.	amino acids	condensation polymerisation	protein
D.	fats	condensation polymerisation	fatty acids and glycerol

40. Five structural formulas are shown below.



How many isomers are there?

- A. 2
- B. 3
- C. 4
- D. 5

- End of Paper 1 -

Name: Index no: Class:



Bukit Batok Secondary School
GCE O Level Preliminary Examination
Sec 4 Express

CHEMISTRY
Paper 2

5073/02
11 August 2016
1115hr to 1300hr
1 hour 45 minutes

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

READ THESE INSTRUCTIONS FIRST

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

Write in dark blue or black pen

You may use an HB pencil for any diagrams or graphs.

Do not use staples, paper clips, 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 of 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 given at the end of the paper.

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

For Examiner's Use	
Section A	
Section B	
Total	

Section A [50 marks]

Answer all questions in this section in the spaces provided.

A1. A diagram of the Periodic Table is shown below.

				N			P	
Q	M							R

Using the letters shown in the Periodic Table,

a. identify the element that forms giant covalent structures.

..... [1]

b. identify the element that does not form compounds.

..... [1]

c. identify the most reactive non-metal.

..... [1]

d. identify the elements that have the same number of shells.

..... [1]

e. Write the formula for the nitride of M.

..... [1]

[Total : 5 marks]

A2. Element X is an alkali metal while element Y is a halogen which is yellow-green in colour.

- a. When a small piece of X is placed in some aqueous copper (II) sulfate solution, it darts about and dissolves.

Describe two other changes that can be seen.

.....
 [2]

- b. When an excess of aqueous Y is added to aqueous potassium iodide, a brown solution and a black solid are obtained.

- (i) Name the brown solution and the black solid.

Brown solution

Black solid [2]

- (ii) Explain the formation of the black solid other than the reddish brown solution.

.....
 [1]

[Total : 5 marks]

A3. Human activities in recent centuries have released additional amounts of heat absorbing gases to the atmosphere.

Carbon dioxide is a greenhouse gas which has a greenhouse factor of 1. Other gases are given a greenhouse factor that compares their effect with carbon dioxide. The greenhouse effect increases as the factor value increases. The table gives some information of five main greenhouse gases.

Greenhouse gas	Greenhouse factor	Contribution to greenhouse effect / %	Current rate of increase in the air / %
CO ₂	1	50	0.4
CH ₄	30	18	1.0
N ₂ O	160	6	0.3
O ₃	2000	12	1.5
CFCs	10000	14	2.0

- a. Name the greenhouse gas that is only produced by human activities.

..... [1]

- b. If equal volumes of each gas at room temperature were filled in separate gas jars and exposed to sunlight, which gas jar will show the highest rise in temperature?

..... [1]

- c. Explain why living organisms cannot survive on Earth without the presence of greenhouse gases in the atmosphere.

.....
 [1]

- d. Explain why although carbon dioxide has the lowest greenhouse factor among the gases listed, its contribution towards global warming is the most significant.

.....
 [1]

- e. List a possible consequence of an increase in global warming.

.....
 [1]

[Total : 5 marks]

- A4. X, Y and Z are three different metals. The results of two experiments carried out using the metals or their oxides are recorded below.

Experiment	X	Y	Z
Adding the metal to water	Effervescence	No observable change	No observable change
Heating the metal oxide	No observable change	Metal produced	No observable change

- a. Based on the above information, arrange the three metals in order of increasing reactivity, starting from least reactive metal.

..... [1]

- b. An oxide of Y has the formula YO. When 1.08 g of this oxide is heated strongly, it decomposed completely to give 60.0 cm³ of oxygen, measured at r.t.p.

- (i) Write a balanced chemical equation for the decomposition of oxide of Y.

..... [1]

- (ii) Calculate the relative atomic mass of Y.

[3]

[Total : 5 marks]

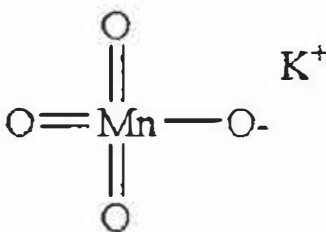
A5. Hydrogen peroxide (H_2O_2) can behave as an oxidising agent and a reducing agent.

- a. Complete the table below to show the role of hydrogen peroxide as an oxidising or a reducing agent.

	Reaction of H_2O_2 with acidified KMnO_4	Reaction of H_2O_2 with FeSO_4 solution
Observation	Purple solution decolourised	Light green solution turned yellow
Role of H_2O_2		

[2]

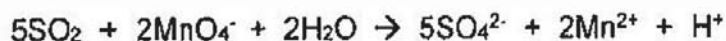
- b. Potassium manganate (VII), KMnO_4 , has the following structure.



What is the total number of electrons surrounding the manganese atom?

..... [1]

- c. Sulfur dioxide, an air pollutant is detected by bubbling the polluted air through an aqueous solution of potassium manganate (VII). A change in colour from purple to colourless confirms its presence. The ionic equation is shown below.



State two characteristics from this reaction which shows that manganese is a transition metal.

.....

 [2]

[Total : 5 marks]

A6. Le Chatelier's principle predicts that the highest yield of ammonia in the Haber process should occur at a high pressure and at a low temperature. In practice, however, these conditions are not used.

The table below shows the percentage yield of ammonia at different temperatures and pressures.

Temperature / °C	percentage yield of ammonia at equilibrium		
	200 atm	300 atm	400 atm
350	24	40	48
450	20	23	30
550	10	12	15

a. Construct a balanced chemical equation for the reaction in Haber process.

..... [1]

b. By referring to the table, state how the increase of pressure affects the percentage yield of ammonia at equilibrium.

..... [1]

c. (i) Explain how the increase in temperature causes the percentage yield of ammonia to decrease at equilibrium.

..... [1]

(ii) From this observation, deduce whether this the formation of ammonia is exothermic or endothermic.

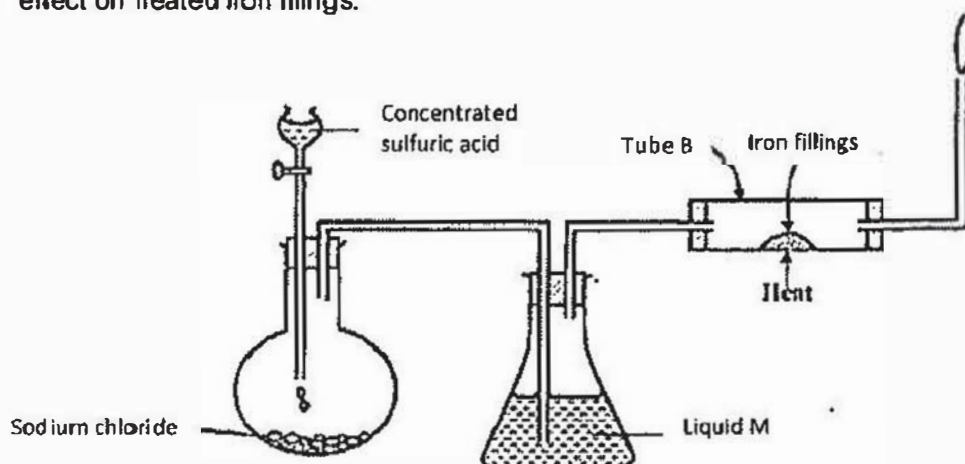
..... [1]

d. Suggest why Le Chatelier's principle is not applied to Haber process in practice.

..... [2]

[Total : 6 marks]

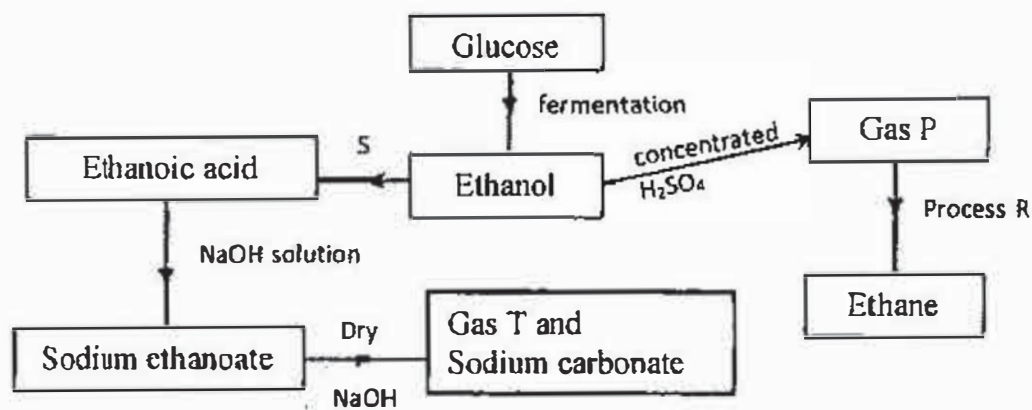
A7. The set-up below was used to prepare dry hydrogen chloride gas, and investigate its effect on heated iron filings.



- a. Name liquid M.
 [1]
- b. (i) What will be observed in tube B.
 [1]
- (ii) Write an equation for the reaction that occurs in tube B.
 [1]
- (iii) Why is the gas from tube B burnt?
 [1]
- c. Explain the following observations with help of equation(s):
- (i) a white precipitate is formed when hydrogen chloride gas is passed through aqueous silver nitrate.
 [1]
- (ii) hydrogen chloride gas fumes in ammonia gas.
 [1]

[Total : 6 marks]

A8. Study the flow chart below and answer the questions that follow.



a. State any two conditions necessary for fermentation of glucose to take place.

.....
 [1]

b. State one reagent that can be used to carry out process S.

..... [1]

c. Both gases P and T are hydrocarbons. Identify the gases:

P:

T: [2]

d. How is sodium hydroxide kept dry during the reaction?

..... [1]

e. State another use of ethanol other than as an alcoholic drink.

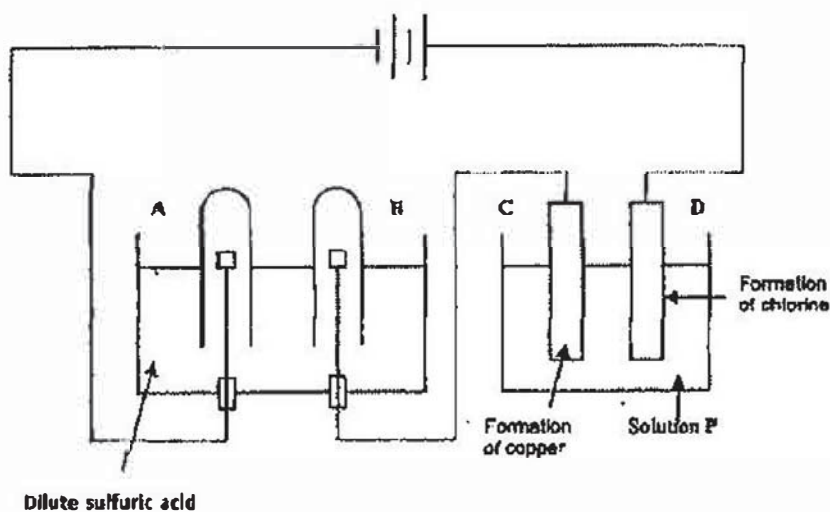
..... [1]

f. Another alcohol is butanol. Draw the structure of butan-2-ol.

[1]

[Total : 7 marks]

A9. The diagram below shows an experiment in which an electric current is being passed through dilute sulfuric acid and solution P.



a. After electrolysis for 30 minutes at a constant current, 200 cm³ of gas is collected in the test-tube at electrode A.

(i) Predict the volume of gas at electrode B.

..... [1]

(ii) Why would steel not be a suitable material for electrode B?

..... [1]

b. (i) Identify solution P.

..... [1]

(ii) Write half equations for both electrodes C and D.

..... [2]

(iii) A few drops of Universal indicator solution was added to the electrolyte close to electrode D. Universal indicator turned blue then decolourised. Explain this observation.

..... [1]

[Total : 6 marks]

- End of Section A -

Section B [30 marks]

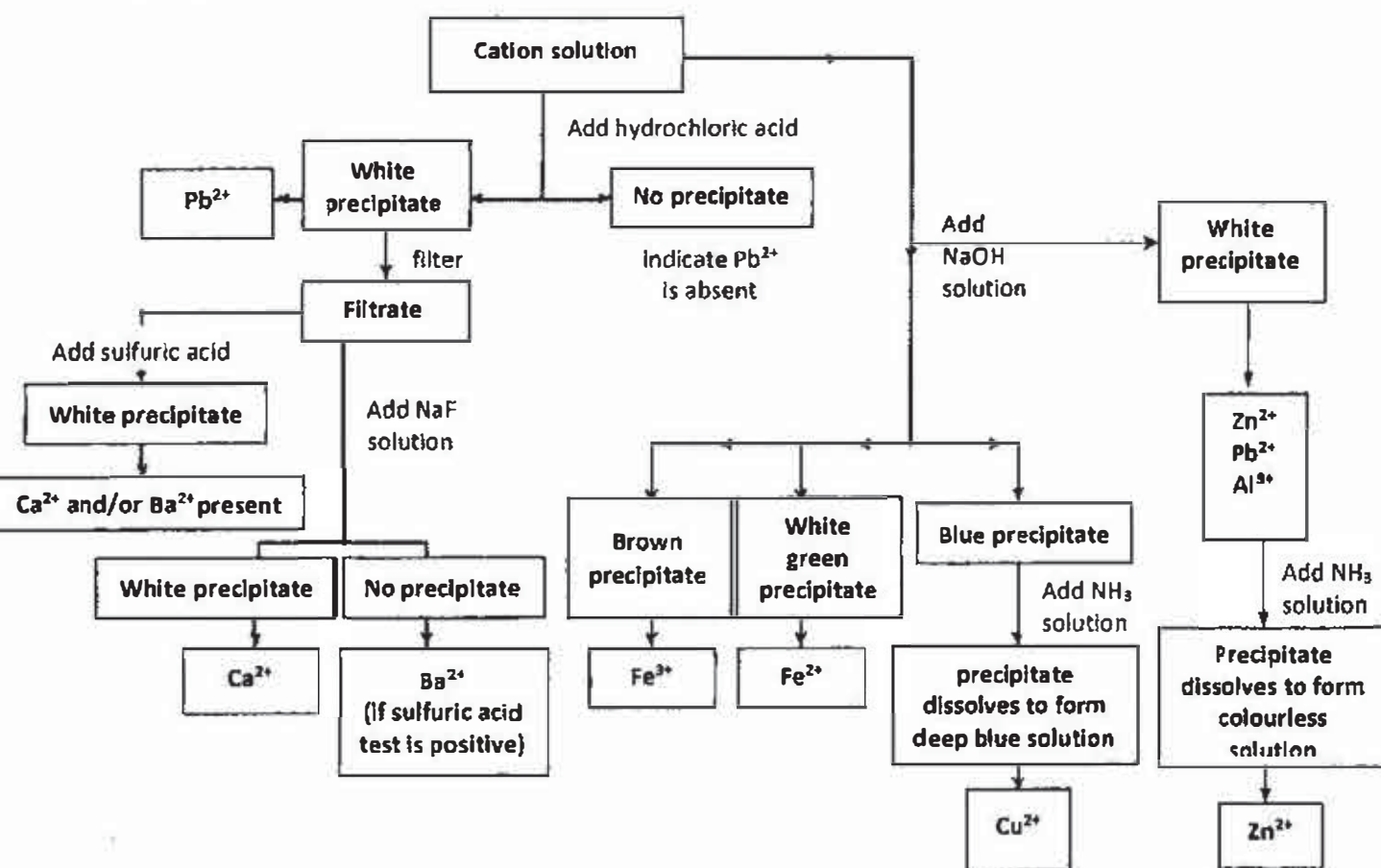
Answer all three questions from this section.

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

B10.

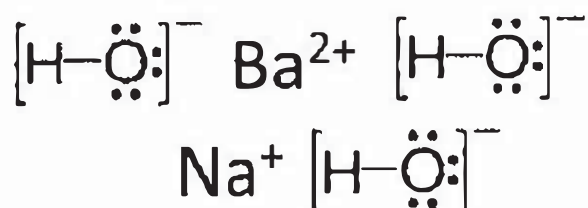
A precipitation reaction refers to the formation of an insoluble salt when two solutions containing soluble salts are combined. The insoluble salt that is produced is known as the precipitate, hence the reaction's name.

Precipitation reactions are used to determine the presence of various ions in solution. The following flow chart shows how different cations can be identified through the formation of precipitates.



<http://community.boredofstudies.org/>

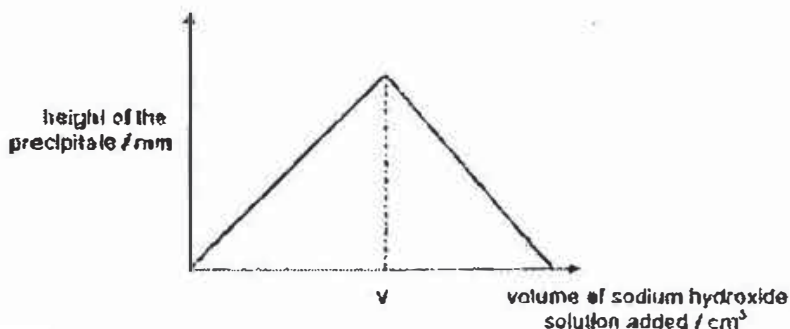
Barium hydroxide and sodium hydroxide are alkali solutions which can be used in precipitation reactions. They have the following structures.



A student performed a series of experiment involving precipitation reaction.

Experiment 1

0.5 cm³ of sodium hydroxide was added to a test tube containing an unknown salt solution. The height of the precipitate formed in the test tube was plotted against the volume of sodium hydroxide added.



Experiment 2

A study of a precipitation reaction between barium hydroxide and dilute sulfuric acid was conducted.

The reaction tubes containing different volumes of barium hydroxide, a strong base, and dilute sulfuric acid is as stated in the table. Precipitation occurs in all the reaction tubes and after 20 minutes, the height of the precipitate in each tube is measured and recorded in the table below.

Reaction tube	1	2	3	4	5	6
Volume of 0.50 mol/dm ³ of barium hydroxide used / cm ³	5.0	5.0	5.0	5.0	5.0	5.0
Volume of 1.0 mol/dm ³ of dilute sulfuric acid used / cm ³	1.0	1.5	2.0	2.5	3.0	3.5
Height of precipitate / cm	2.5	3.0	3.5	4.0	4.0	

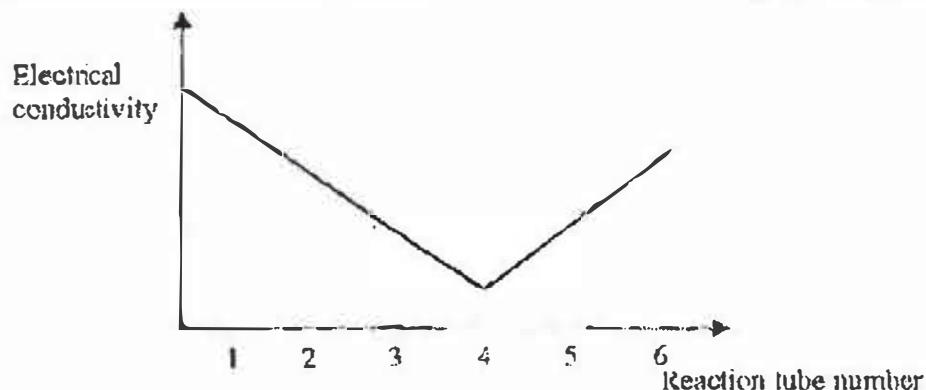
Table 1

To each tube, two drops of an indicator are added. The colour change of this indicator is shown as follows:

pH	Colour
< 8.2	colourless
8.2 to 13.0	pink
> 13.0	colourless

Table 2

The electrical conductivity of each reaction tube is recorded. The graph is seen below.



a. Draw a dot-and-cross diagram to show the bonding in a hydroxide ion.

[2]

b. (i) State the formula of a possible cation in the unknown salt solution in **Experiment 1**.

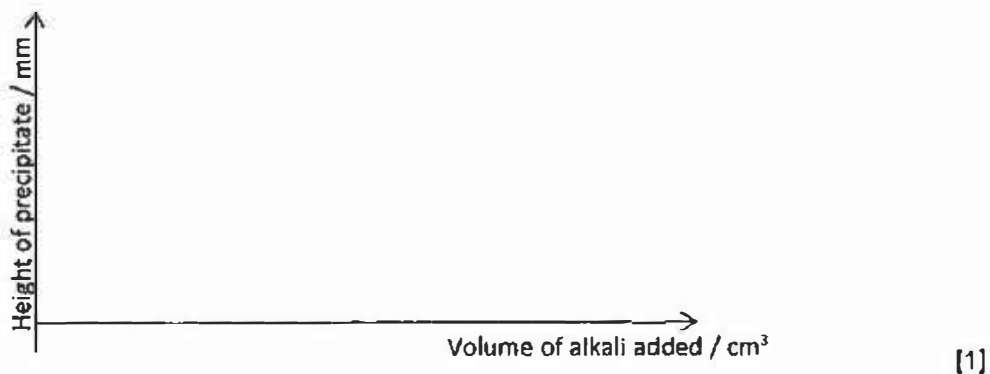
..... [1]

(ii) Some cations produced white precipitate when sodium hydroxide is added to their solutions. Describe how these cations can be distinguished from one another.

.....

 [2]

- (iii) The student added sodium hydroxide into copper (II) sulfate solution. Complete the diagram to show the variation of the height of the precipitate as the alkali was gradually added.



- c. (i) Give the name of the precipitate and the **other** product formed when barium hydroxide is added to dilute sulfuric acid in **Experiment 2**.
 [1]

- (ii) What is the colour formed in Reaction tube 1 and 5 when the indicator is added?
 Reaction tube 1
 Reaction tube 5 [1]

- (iii) Predict the height of the precipitate in the reaction tube 6 in centimetres (cm). Explain your answer.

 [1]

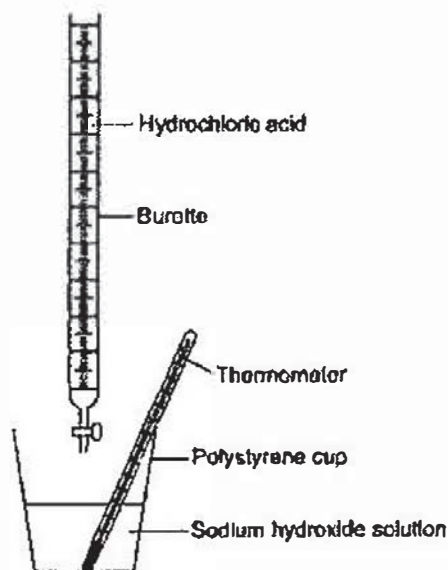
- (iv) Using the conductivity graph given, explain fully the shape of the graph.

 [3]

[Total : 12 marks]

B11.

A student investigates the energy released when hydrochloric acid completely neutralises sodium hydroxide solution. The student uses the apparatus shown in the diagram below.



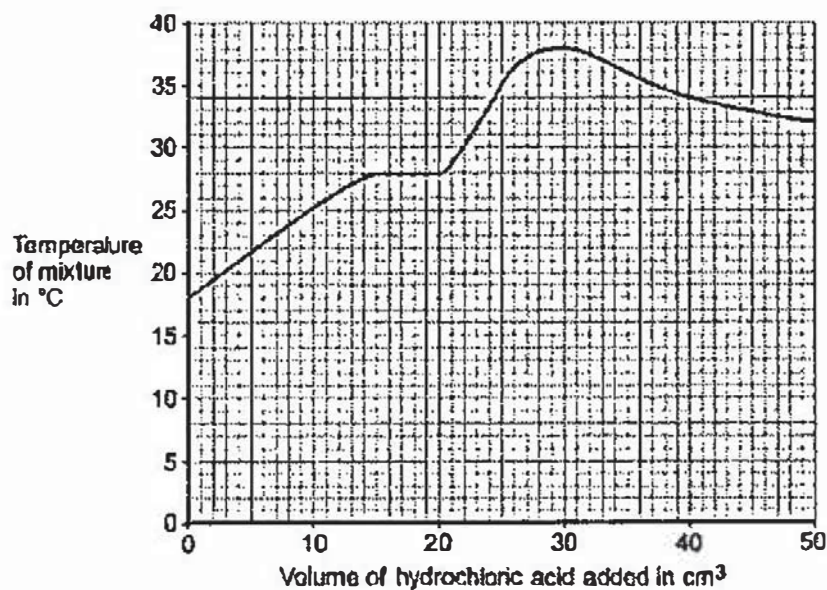
The student:

- measures 25 cm^3 sodium hydroxide solution into a polystyrene cup
- fills a burette with hydrochloric acid
- measures the temperature of the sodium hydroxide solution
- adds 5 cm^3 hydrochloric acid to the sodium hydroxide solution in the polystyrene cup
- stirs the mixture and measures the highest temperature of the mixture
- continues to add 5 cm^3 portions of hydrochloric acid, stirring and measuring the highest temperature of the mixture after each addition.

The student has plotted a graph of the results.

The graph line has been incorrectly drawn by including an anomalous result.

The graph is shown below.



- a. (i) Suggest a cause for the anomalous result when 20 cm³ of hydrochloric acid is added.

.....
 [1]

- (ii) Suggest the true value of the temperature of the anomalous point.

Temperature = °C [1]

- (iii) What was the total volume of the mixture when the maximum temperature was reached?

Total volume of the mixture = cm³ [1]

- (iv) Calculate the overall temperature increase in this experiment.

[1]

- (v) Use your answers to (a)(iii) and (a)(iv) and the equation to calculate the energy released in the reaction. Assume the volume in cm³ is equivalent to the mass of solution in grams.

Equation: $Q = mc\Delta T$

where: Q = energy released; m = mass of solution (g); c = 4.2 (J per g per °C);
 ΔT = change in temperature (°C)

[2]

- b. The student did the experiment again, starting with 50 cm³ of sodium hydroxide solution instead of 25 cm³.

Explain why this would make no difference to the overall temperature increase.

.....

 [2]

[Total : 8 marks]

B12 Either

a. Polyethene is formed from addition polymerisation of many monomers of ethene.

(i) Draw the structural formula of polyethene.

[1]

(ii) Determine the number of $\text{H}_2\text{C}=\text{CH}_2$ monomeric units, n , in one molecule of polyethene with molar mass of 40 000 g. Hence, how many carbon atoms are present in one molecule of polyethene.

$n = \dots\dots\dots$

number of carbon atoms in polymer = $\dots\dots\dots$ [3]

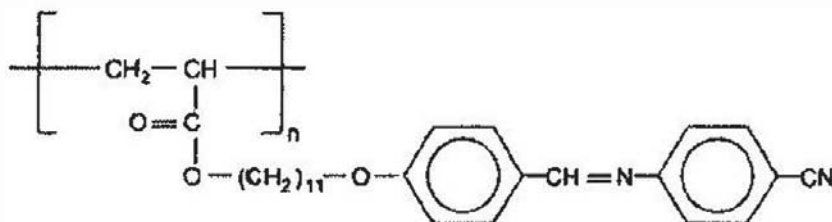
(iii) 'Out of sight, out of mind'.

Do you agree with this statement when it comes to the disposal of plastic waste?

.....

 [2]

b. The structure of a liquid crystal polymer is shown below.



(i) Explain why the above polymer is produced through addition polymerisation and not condensation polymerisation.

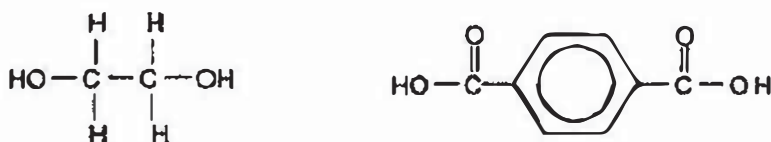
.....
 [1]

(ii) Describe a chemical test to distinguish the monomer of the liquid crystal from an organic compound with chemical formula C_4H_{10} .

.....

 [2]

c. Dacron is an example of a polymer that is formed by condensation polymerisation. Below is the structural formula of the two monomers that are used to prepare Dacron.



Draw the full structural formula of the repeating unit in Dacron.

[1]

[Total : 10 marks]

(ii) A water molecule has very slight charges ($\delta+$ and $\delta-$), as shown below.



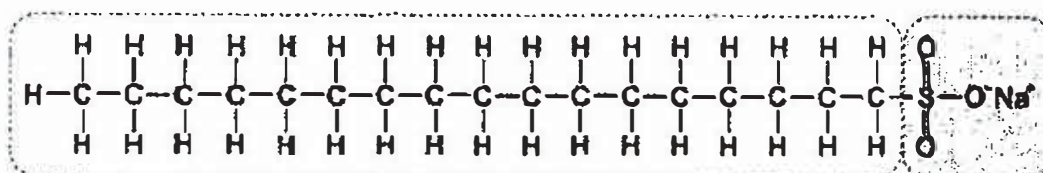
Would the head or tail of the soap particle be able to dissolve in water?
Explain your answer.

.....

.....

..... [2]

c. The diagram represents a soapless detergent particle.



(i) The hydrocarbon chain of this detergent comes from an alcohol.
Give the chemical formula of the alcohol used.

..... [1]

(ii) Suggest a problem that will arise with the use of this soapless detergent.

..... [1]

[Total : 10 marks]

- End of Paper 2 -

The Periodic Table of the Elements

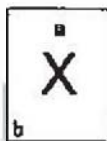
Group																		
I	II											III	IV	V	VI	VII	0	
		1 H Hydrogen 1																4 He Helium 2
7 Li Lithium 3	9 Be Beryllium 4											11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10	
23 Na Sodium 11	24 Mg Magnesium 12											27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulfur 16	35.5 Cl Chlorine 17	40 Ar Argon 18	
39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	64 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36	
85 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	98 Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54	
133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57	178 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	Po Polonium 84	At Astatine 85	Rn Radon 86	
Fr Francium 87	226 Ra Radium 88	227 Ac actinium 89																

*58-71 Lanthanoid series

†90-103 Actinoid series

140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	Pm Promethium 61	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	159 Tb Terbium 65	162 Dy Dysprosium 66	165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	173 Yb Ytterbium 70	175 Lu Lutetium 71
232 Th Thorium 90	Pa Protactinium 91	238 U Uranium 92	Np Neptunium 93	Pu Plutonium 94	Am Americium 95	Cm Curium 96	Bk Berkelium 97	Cf Californium 98	Es Einsteinium 99	Fm Fermium 100	Md Mendelevium 101	No Nobelium 102	Lr Lawrencium 103

Key



a = relative atomic mass
 X = atomic symbol
 b = proton (atomic) number

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

PRELIMINARY EXAMINATIONS – ANSWERS

Paper 1 : Multiple Choice Questions

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

13	$C_xH_y \rightarrow CO_2 + H_2O$ $11.0g \quad 9.0g$ <p>no of moles of $CO_2 = 11 \div [12+2(16)] = 0.250\text{mol}$ no of moles of $H_2O = 9 \div [2(1) + 16] = 0.500\text{mol}$</p> <p>0.250mol of CO_2 and 0.500mol of H_2O are produced 1mol of CO_2 and 2mol of H_2O are produced $C_xH_y \rightarrow CO_2 + 2H_2O$ To balance the equation, $C_xH_y = CH_4$ $CH_4 \rightarrow CO_2 + 2H_2O$</p>																
14	<p>(A) no of moles of He = $6 \div 4 = 1.50\text{mol}$ volume of He = $1.50\text{mol} \times 24\text{dm}^3 = 36\text{dm}^3$</p> <p>(B) no of moles of $O_2 = 16 \div 2(16) = 0.50\text{mol}$ volume of $O_2 = 0.50\text{mol} \times 24\text{dm}^3 = 12\text{dm}^3$</p> <p>(C) no of moles of $N_2 = 14 \div 2(14) = 0.50\text{mol}$ volume of $N_2 = 0.50\text{mol} \times 24\text{dm}^3 = 12\text{dm}^3$</p> <p>(D) no of moles of steam (H_2O) = $9 \div [2(1)+16] = 0.50\text{mol}$ volume of $H_2O = 0.50\text{mol} \times 24\text{dm}^3 = 12\text{dm}^3$</p>																
25	<p>(A) N_2 (B) NO_2 (C) N_2H_4 (D) HNO_3</p> <table style="margin-left: 40px;"> <tr> <td>0</td> <td>+4 -2</td> <td>-2 +1</td> <td>+1 +5 -2</td> </tr> <tr> <td></td> <td>-2</td> <td>-2 +1</td> <td>-2</td> </tr> <tr> <td></td> <td></td> <td>+1</td> <td>-2</td> </tr> <tr> <td></td> <td></td> <td>+1</td> <td></td> </tr> </table>	0	+4 -2	-2 +1	+1 +5 -2		-2	-2 +1	-2			+1	-2			+1	
0	+4 -2	-2 +1	+1 +5 -2														
	-2	-2 +1	-2														
		+1	-2														
		+1															
29	$F_2 + H_2 \rightarrow 2HF$ $\Delta H_{\text{break}} = (+158\text{kJ}) + (+436\text{kJ}) = +594\text{kJ}$ $\Delta H_{\text{form}} = 2(-556\text{kJ}) = -1112\text{kJ}$ $\Delta H_{\text{overall}} = (+594\text{kJ}) + (-1112\text{kJ}) = -518\text{kJ}$ <p>To form 2moles of HF, 518kJ of energy is released To form 1mole of HF, $518 \div 2 = 259\text{kJ}$ of energy is released.</p>																
31	$Al^{3+} + 3e^- \rightarrow Al$ <p>5mol mass?</p> <p>3mol of electrons produced 1mol of Al 5mol of electrons produced $5 \div 3 = 1.67\text{mol}$ of Al</p> <p>Mass of Al = $1.67\text{mol} \times 27 = 44.9\text{g} \approx 45.0\text{g}$</p>																

Paper 2 Section A

- 1a. N 1m
 1b. R 1m
 1c. P 1m
 1d. Q, M, R or N, P 1m
 1e. M_3N_2 (not nitrate) 1m

2a. Blue precipitate formed. 1m
 Effervescence. 1m
No displacement as reaction of alkali metal is too fast

2bi. Brown solution – Iodine solution
 Black solid – Iodine crystals

2bii. **Excess** iodine produced which cannot be dissolved in potassium chloride solution formed. (solid I_2 will dissolve unless in excess) 1m

3a. Chlorofluorocarbon (NAME!!!) 1m
 3b. Chlorofluorocarbon / CFCs 1m

3c. Greenhouse gases trapped heat to keep Earth warm. Without them, Earth will be too cold for survival. 1m

3d. There is highest volume of carbon dioxide in the atmosphere compared to the other gases listed. 1m
 OR
 It contributes the highest percentage to greenhouse effect.

3e. Ice caps melts, rise in sea level causes flooding to low lying lands. any 1m
 Increase in temperature causes low crops yield.
 Increase in temperature causes erratic weather changes.

4a. $Y < Z < X$ 1m
 4bi. $2YO \rightarrow 2Y + O_2$ 1m

4bii. $2YO \rightarrow 2Y + O_2$
 $1.08g \quad 60.0cm^3$

no of moles of $O_2 = 60.0cm^3 + 24000cm^3 = 0.00250mol$ 1m

1mol of O_2 is produced by 2mol of YO

0.00250mol of O_2 is produced by 0.00500mol of YO

Mr of YO = $1.08g \div 0.00500mol = 216$ 1m

Atomic Mass of Y = $216 - 16 = \underline{200}$ 1m

5a.		Reaction of H_2O_2 with acidified $KMnO_4$	Reaction of H_2O_2 with $FeSO_4$ solution	each 1m total 2m
	Role of H_2O_2	Reducing Agent	Oxidising Agent	

5b. 14 1m

5c.	Manganese <u>formed</u> coloured compounds. Manganese has varied oxidation states.	1m 1m
6a.	$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$	eqn 1m no need symbols
6b.	At same temperature, yield increases as pressure increases.	1m
6ci.	As temperature increases, ammonia molecules formed gained heat energy to break the N-H bonds thus causing the equilibrium to move to the left, resulting in lower yield / decomposed to N_2 and H_2 .	1m
6cii.	Exothermic	1m
6d.	High pressure is not applied as it will make the reaction dangerous and maintenance of machinery costly.	1m
	Low temperature is not used as it will make the reaction too slow.	1m
7a.	<u>Concentrated</u> sulfuric acid (as drying agent)	1m
7bi.	Green solid formed ($FeCl_2$) / white solid formed	1m
7bii.	$2HCl + Fe \rightarrow FeCl_2 + H_2$	1m
7biii.	<u>Hydrogen</u> gas is produced and it is <u>flammable</u> .	1m
7ci.	Silver chloride, an insoluble solid is formed. $Ag^+_{(aq)} + Cl^-_{(aq)} \rightarrow AgCl_{(s)}$	both 1m
7cii.	Ammonium chloride is formed. $HCl + NH_3 \rightarrow NH_4Cl$	both 1m
8a.	Use of yeast Temperature at $37^\circ C$ Airtight condition Stop production when ethanol reaches 15%	Any 2 1m
8b.	Acidified potassium manganate (VII)	1m
8c.	P : ethene T : methane	1m 1m
8d.	Use of calcium oxide	1m
8e.	As a solvent As an antiseptic React with carboxylic acids to form esters	any 1m



9ai. 100cm³ 1m

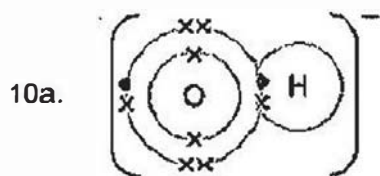
9aii. Oxygen is produced at electrode B which can oxidise iron in steel.
OR 1m
Iron in steel can react with sulfuric acid.

9bi. Concentrated copper (II) chloride

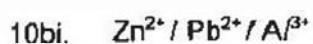
9bii. Electrode C : $\text{Cu}^{2+}_{(aq)} + 2\text{e}^- \rightarrow \text{Cu}_{(s)}$ 1m
Electrode D : $2\text{Cl}^-_{(aq)} \rightarrow \text{Cl}_{2(g)} + 2\text{e}^-$ 1m

9biii. Presence of hydroxide (OH⁻) ions turned Universal indicator blue and presence of chlorine gas (Cl₂) bleached the indicator. both 1m

Paper 2 Section B



share
1m
other e-
bracket,
charge
1m



any 1m

10bii. Add excess aqueous ammonia to the respective cation solutions / white precipitate formed.
The one that dissolved contain Zn^{2+} ion.

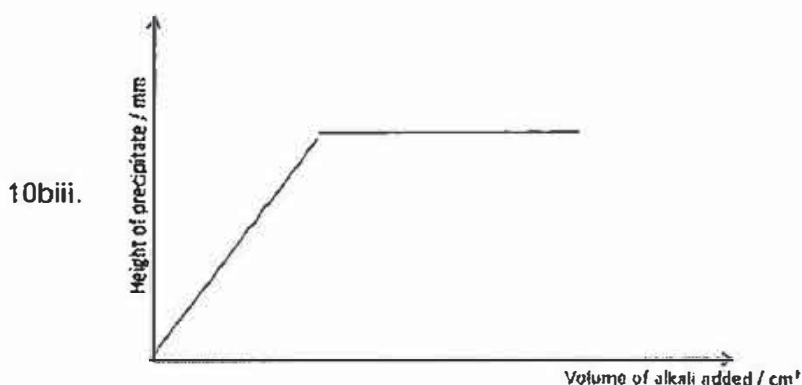
1m

Add hydrochloric acid to the respective cation solution.
The one that formed white precipitate contain Pb^{2+} ion.

1m

The white precipitate which does not dissolve in excess aqueous ammonia and the cation solution which does not form white precipitate when hydrochloric acid is added contains Al^{3+} ion.

+1m



1m

10ci. Barium sulfate, water

both 1m

10cii. Tube 1 – colourless / pink
Tube 5 - colourless

both 1m

10ciii. 4.0cm
Barium hydroxide (alkali) is used up, sulfuric acid is in excess.
Reaction stops.

both 1m

10civ. Electrical conductivity decreases from tube 1 to 4 because as more sulfuric acid is used, more ions are removed to from the precipitate. 1m

There is still some conductivity at the maximum production of precipitate (tube 4) because of water, a weak electrolyte, is present. 1m

Conductivity increases again from tube 5 to 6 as excess acid is added will contribute to more ions present for conductivity. 1m

11ai.
 • added less than 20cm³ of acid
 • read/record a lower temperature
 • failure to stir
 • heat loss
 any 1m

11aii. 32 -33°C 1m

11aiii. Total volume = 25cm³ (alkali) + 30cm³ (acid) = 55cm³ 1m

11aiv. Overall temperature increase = 38°C - 18°C = 20°C 1m

11av. $Q = mc\Delta T$ values
 $= 55 \times 4.2 \times 20 = \underline{4620J} / \underline{4.62kJ}$ (ecf if aiii, aiv is wrong) 1m
 ans 1m

11b. $H^+_{(aq)} + OH^-_{(aq)} \rightarrow H_2O_{(l)}$ optional
 There is twice volume of alkali, twice as much energy is released when more O-H bonds (in water molecules) are formed. 1m

But since there is also twice as much water that is produced, energy is absorbed by the water as the water is being heated. 1m

B12 Either

ai.  1m

aii. Mr of ethene monomer C₂H₄ = 2(12) + 4(1) = 28 1m
 no of monomers in the polymer, $n = 40\ 000 \div 28 = \underline{1429}$ or 1430 1m

Each monomer has 2 carbon atoms
 Number of carbon atoms in polymer = 1428.6 x 2 = 2857 1m

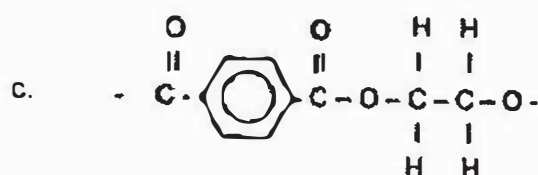
a.iii. Plastic waste are not able to decompose because they are non-biodegradable. *They cannot be broken down by bacteria.* 1m

They remain buried in landfills for a long period of time, hence more land is needed as landfill instead of land being used for more constructive purposes eg to grow crops for the population. 1m

bi. There is no amide or ester linkage in the polymer structure. 1m

bii. With the liquid crystal monomer, reddish brown aqueous bromine decolourised. 1m

With $C_{4}H_{10}$, reddish brown aqueous bromine remains. 1m



B12 Or

ai. 1m

aii. Saturated fatty acid has C - C bond only whereas polyunsaturated fatty acid contains C = C 1m

Polyunsaturated fatty acid contains many C = C bonds in its molecule. 1m

a.iii. Add aqueous bromine to saturated fatty acid, aqueous bromine remains brown. 1m

Add aqueous bromine to polyunsaturated fatty acid, brown aqueous bromine remains decolourised. 1m

bi. React fatty acid with an alkali eg sodium hydroxide. 1m

bii. The head. The head has a negative charge on COO^- which can be attracted to the hydrogen atoms which are the positively charge end of water molecule. -ve 1m +ve of H₂O 1m

ci. $C_{17}H_{35}OH$ 1m

cii. The long chain molecule takes a longer time to break down which can cause foaming when they are discharged into river and stream. 1m