JASPER WILLIAMS HIGH SCHOOL

ANNUAL EXAMINATION 2020

YEAR 12 CHEMISTRY

Time Allowed: 3 hours
(An extra 10 minutes is allowed for reading this paper.)

INSTRUCTIONS

1. Write your **Index Number** and **Year Level** on the front page of the **Answer Booklet**.
2. Write **all** your answers in the **Answer Booklet** provided.
3. If you use extra sheets of paper, be sure to show clearly the question number(s) being answered and secure each sheet in your **Answer Booklet** at the appropriate places. Ensure that your **Index Number** and **Year Level** are written on the extra sheets.
4. Answer **all** the questions with a blue **or** black ballpoint pen or ink pen. Do **not** use red ink. You may use a pencil **only** for drawing.
5. You may use a calculator, provided it is silent, battery-operated and non-programmable.
6. There are four strands in this paper. All the strands are **compulsory**.

Note:

- A Periodic Table of Elements is provided for your use during the examination. Both the **atomic number** and the **relative atomic mass** for each element are given.
- Final answers to calculations must be expressed to two decimal places.

SUMMARY OF QUESTIONS

	Strand	Multiple-choice questions	Short answer questions	Total marks	Suggested time
1	**General Chemistry** All the questions are compulsory	2	8	10	18 minutes
2	**Investigating matter** All the questions are compulsory	4	16	20	36 minutes
3	**Reactions** All the questions are compulsory	6	24	30	54 minutes
4	**Materials** All the questions are compulsory	5	20	25	45 minutes
5	**Consumer Chemistry** All the questions are compulsory	3	12	15	27 minutes
	TOTAL	**20**	**80**	**100**	**180 minutes**

INSTRUCTIONS

MULTIPLE-CHOICE QUESTIONS

The multiple-choice questions are **all compulsory**. Each question is worth **1 mark**.

1. **In your Answer Booklet, circle the letter of the best answer.**
   If you change your mind, put a line through your first circle and draw a circle around the letter of your next choice.

   For example:

12	A	B	C	D

2. **If you change your mind again and like your first answer better, put a line through your second circle and tick (✓) your first answer.**

   For example:

12	A	✓ B	C	D

3. **No mark will be given if you circle more than one letter as the answer for a question.**

STRAND 1 GENERAL CHEMISTRY [10 MARKS]

- This strand has **5 Questions**.
- **Circle** the letter of the **best** answer in the **Answer Booklet** for **Questions 1 and 2**.
- Write the answer for **Questions 3 – 5** in the space provided in the **Answer Booklet**.

1. Which of the following is a correct statement about systematic errors?

   A. They are consistent in magnitude.
   B. Their magnitude depends on the experimenter's skill.
   C. They arise due to incorrect judgment of a measurement.
   D. They occur as a result of a person's inability to perform the experiment correctly

2. The exponential base unit for the prefix mega is denoted by _____.

   A. 10^{-9}
   B. 10^{3}
   C. 10^{6}
   D. 10^{9}

3. In an experiment on precision and accuracy, three different groups obtained the mass of the same stone five times as shown in the table below.

Measurement	Group 1	Group 2	Group 3
1	16.50 g	15.45 g	14.90 g
2	14.45 g	15.50 g	14.90 g
3	14.00 g	15.55 g	14.85 g
4	17.00 g	15.50 g	14.90 g
5	14.50 g	15.50 g	14.85 g

Note: The actual mass of the stone was 15.50 g.

(i) Using the results of the experiment, determine the group whose results were of:

I - Low accuracy and high precision. **(1 mark)**

II - Low accuracy and low precision. **(1 mark)**

(ii) Identify the group that obtained the best results. **(1 mark)**

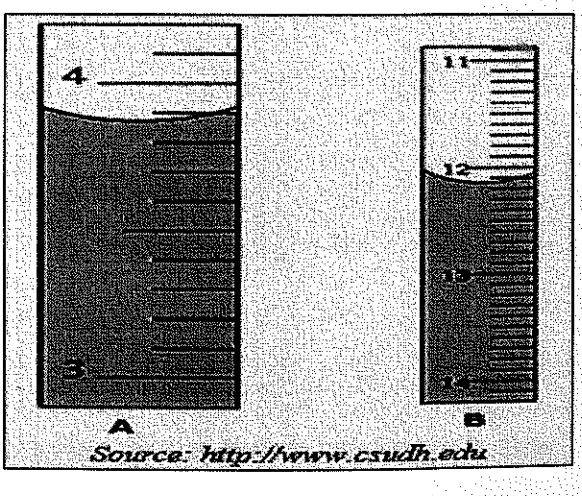
(iii) State a reason for your answer to part (ii) above. **(1 mark)**

4. Complete the following table.

Prefix	Symbol	Exponential base	Base units
Mega	**(ii)**	**(iii)**	1,000,000
(i)	k	10^3	**(iv)**

(2 marks)

5. Give the reading (in mL) from a graduated cylinder (**A**) and a burette (**B**) given below with their uncertainties.



(2 marks)

STRAND 2 INVESTIGATING MATTER [20 MARKS]

- This strand has **10 Questions**.
- **Circle** the letter of the **best** answer in the **Answer Booklet** for **Questions 1 – 4**.
- Write the answer for **Questions 5 – 11** in the space provided in the **Answer Booklet**.

1. Which of the following atoms has the greatest ability to attract the shared electrons in forming a covalent bond?

   A. Fluorine
   B. nitrogen
   C. sulphur
   D. silicon

2. An element has atoms with electron configuration as 2, 8. This element will

   A. form an ionic compound.
   B. form a weak acidic oxide.
   C. dissolve in acids to give hydrogen gas.
   D. not take part in any chemical reaction.

3. An example of a discrete molecular substance is

   A. carbon dioxide.
   B. silicon dioxide.
   C. sodium chloride.
   D. magnesium chloride.

4. A calcium ion, Ca^{2+} has the same number of electrons as

   A. Mg^{2+}
   B. Al^{3+}
   C. Ar
   D. K

5. Give appropriate explanations for the statements given below.

   (i) Carbon tetrachloride molecule is overall non-polar even though each C–Cl bond is polar. **(1 mark)**

   (ii) Graphite is used as a lubricant while diamond is used for cutting metals. **(1 mark)**

   (iii) Sodium chloride readily dissolves in water but not in cyclohexane. **(1 mark)**

   (iv) The melting point of magnesium oxide is 2 852 °C while carbon dioxide has a melting point of -57 °C. **(1 mark)**

6. Draw the Lewis Structure of the following molecules in the space provided in the Answer Book, and give the names of their shapes.

(i) Carbon tetrachloride (CCl_4) **(1 mark)**

(ii) Phosphorus trichloride (PCl_3) **(1 mark)**

7. Using the electron pair repulsion theory, explain why a methane molecule has a tetrahedral shape. **(1 mark)**

8. Nitrogen trichloride (NCl_3) is a polar molecule.

(i) Explain the statement above. **(1 mark)**

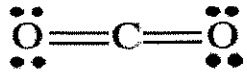
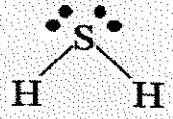
(ii) Draw the electron-dot diagram (Lewis structure) of the nitrogen trichloride molecule. **(1 mark)**

9. Complete the table by filling in the appropriate information for **(i) – (iii)** in the spaces provided in the **Answer Book**.

Molecule	Formula	Shape	Reason for Shape
Boron trichloride	**(i)**	Trigonal planar	Maximum repulsion from three bond pairs of electrons.
Tetrachloromethane	CCl_4	**(ii)**	The four bonded pairs having maximum repulsion
Nitrogen trichloride	NCl_3	Trigonal pyramid	**(iii)**

(2 marks)

10. Both, carbon dioxide (CO_2) and hydrogen sulphide (H_2S) have two atoms bonded to the central atom as shown in the structures below.

Carbon dioxide (CO_2)	Hydrogen sulphide (H_2S)
	

Explain why CO_2 has a linear shape while H_2S has a V-shape based on their structures shown above. **(2 marks)**

11. Study the table given below describing the different types of solids and answer the questions that follow:

Type of Solid	Type of particles present in the Solid	Attractive forces between particles	Electrical conductivity in solid state	Meting and boiling points
X	Molecules	I	Non-conductor	Low melting and boiling points
Y	Cations in a sea of delocalised electrons	Attraction between nucleus and delocalised electrons	II	High melting and boiling points
Covalent network solid	Atoms	Strong covalent bonds between atoms	Conductors and non-conductors	III

(i) Identify the type of solids represented by X and Y. **(1 mark)**

(ii) Write the appropriate information for items I, II and III. **(2 marks)**

STRAND 3 REACTIONS [30 MARKS]

- This strand has **13 Questions**.
- **Circle** the letter of the **best** answer in the **Answer Booklet** for **Questions 1 – 6**.
- Write the answer for **Questions 7 – 16** in the space provided in the **Answer Booklet**.

1. The _____ is the mass of one mole of any chemical compound. The word which best fits the blank space is

   A. mole
   B. molecule.
   C. molar Mass
   D. mass number

2. The Empirical Formula expresses

   A. Moles of reactants and products.
   B. Molecules of reactants and products.
   C. Whole number ratio of atoms or ions.
   D. Actual number of atoms in a compound.

3. The formula $C_1V_1 = C_2V_2$ is used to calculate

A. Titration
B. Dilution problem
C. Gravimetric analysis.
D. Quantitative analysis.

4. Precipitation reaction occurs when

A. ions are exchanged.
B. Atoms dissolve in a solvent.
C. Insoluble substance forms.
D. Cations and anions combine to form insoluble solid. .

5. A titrant is a liquid in a

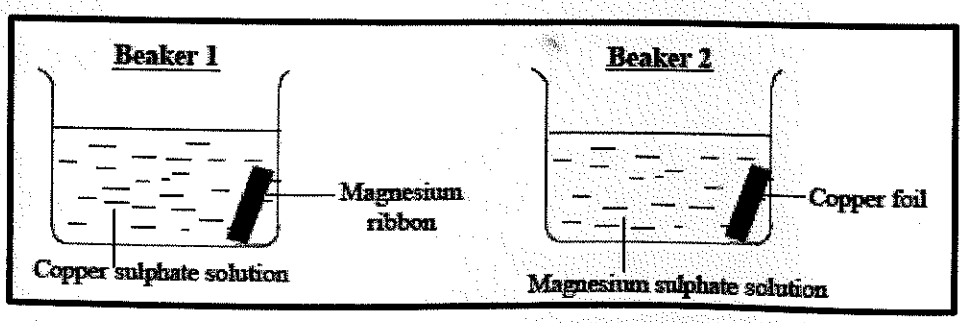
A. Pipette..
B. Burette.
C. Conical flask.
D. Volumetric flask.

6. The colour of Methly Orange indicator at end point is

A. Red.
B. Pink.
C. Orange.
D. Colourless.

7. Calculate the percentage water of crystallisation in hydrated Magnesium sulphate crystals ($MgSO_4.7H_2O$). **(1 mark)**

8. Study the diagrams given below to answer the questions that follow.



(i) State **two** observations that would be made in **Beaker 1**. **(1 mark)**

(ii) There was no change observed in **Beaker 2**. Explain this statement. **(1 mark)**

9. The equation below shows a proton transfer.

$$NH_4^+{}_{(aq)} + H_2O_{(l)} \rightleftharpoons H_3O^+{}_{(aq)} + NH_{3(aq)}$$

(i) Identify the proton that is transferred from the equation given above. **(1 mark)**

(ii) Which reactant has the proton been transferred from? **(1 mark)**

(iii) Identify the base and conjugate base in the equation above. **(1 mark)**

10. A group of students were studying the energy changes which accompany some chemical reactions. The summary of their observations is given in the table below.

	Reagent	**Initial temperature (°C)**	**Final temperature (°C)**	**Change in temperature (°C)**	**Inference**
1	5 pellets of sodium hydroxide + 10 mL water	27	32	-	Heat is given off
2	0.5 g of ammonium chloride + 10 mL water	27	23	4	Heat is absorbed
3	1 cm strip of magnesium ribbon + 10 mL of dilute hydrochloric acid	27	30	3	Heat is given off

(i) Name the **two** types of energy changes that the students observed. **(1 mark)**

(ii) What is the change in temperature when sodium hydroxide pellets are dissolved in water? **(1 mark)**

(iii) In terms of heat content of reactants and products, explain the change in temperature when sodium hydroxide pellets are dissolved in water. **(1 mark)**

(iv) In terms of energy changes, what conclusion can be drawn about the reaction between magnesium and dilute hydrochloric acid? **(1 mark)**

11. The conversion of natural gas to synthesis gas during the production of methanol is shown by the following equation:

$$CH_{4(g)} + H_2O_{(g)} \rightleftharpoons CO_{(g)} + 3H_{2(g)}; \quad \Delta H = +206\ kJmol^{-1}.$$

(i) What does the value $\Delta H = +206\ kJmol^{-1}$ indicate about the reaction? **(1 mark)**

(ii) What would you predict about the equilibrium amount (number of moles) of carbon monoxide, CO, if the system underwent an increase in pressure by decreasing the volume while the temperature remained constant? Give a reason. **(1 mark)**

(iii) Would the equilibrium amount (number of moles) of carbon monoxide alter, if the temperature was increased while the pressure remained constant? Give a reason. **(1 mark)**

(iv) How would the addition of a nickel catalyst affect the equilibrium amount (number of moles) if the pressure and temperature remained constant? Give a reason. **(1 mark)**

12. An organic compound is found to contain 37.5% Carbon, 12.5% Hydrogen and 50% Oxygen.

(i) Find the **empirical formula** for this compound. **(2 marks)**

(ii) The molecular mass for this compound is 64 g mol^{-1}. Determine its **molecular formula.** **(1 mark)**

13. A chemist was required to prepare 0.15 mol L^{-1} of glucose solution. What volume of this solution can be made if he has 50.0 mL of 0.20 mol L^{-1} glucose solution in his pharmacy? **(2 marks)**

14. When one drop of concentrated hydrochloric acid is added to 1 litre of distilled water the pH decreases from 7 to 3.

Write equation for the reaction of the acids mentioned above with water in the **Answer Book**.

$$HCl + H_2O \longrightarrow$$

(1 mark)

15. 20 mL of 0.05 mol L^{-1} sodium carbonate (Na_2CO_3) was titrated against a solution of hydrochloric acid (HCl). It was found that an average of 19.50 mL of the acid was required to react completely with 25 mL of the sodium carbonate solution.

The balanced equation for the reaction is:

$$Na_2CO_3 + HCl \longrightarrow 2NaCl + H_2O + CO_2$$

(i) How many moles of sodium carbonate was present in the 20 mL sample? **(1 mark)**

(ii) Find the number of moles of HCl that reacted with the sodium carbonate solution. **(1 mark)**

(iii) Calculate the concentration of the hydrochloric acid solution in **mol L^{-1}**. **(1 mark)**

16. Calculate the oxidation number of Chromium (**Cr**) in $Cr_2O_7^{2-}$ **(1 mark)**

STRAND 4 MATERIALS [25 MARKS]

- This strand has **10 Questions**.
- **Circle** the letter of the **best** answer in the **Answer Booklet** for **Questions 1 – 5**.
- Write the answer for **Questions 6 – 10** in the space provided in the **Answer Booklet**.

1. Which of the following is an amphoteric oxide?

A. SiO_2 B. MgO C. Na_2O D. $Al2O_3$

2. The solid that will dissolve in water is

A. iodine.
B. naphthalene.
C. sucrose.
D. phosphorous.

3. When a mixture of ethanol, acetic acid and concentrated sulphuric acid is warmed in a test tube,

A. a pleasant vapour is smelt.
B. a dense brown vapour is seen.
C. an orange brown solution is formed.
D. the mixture separates into three layers.

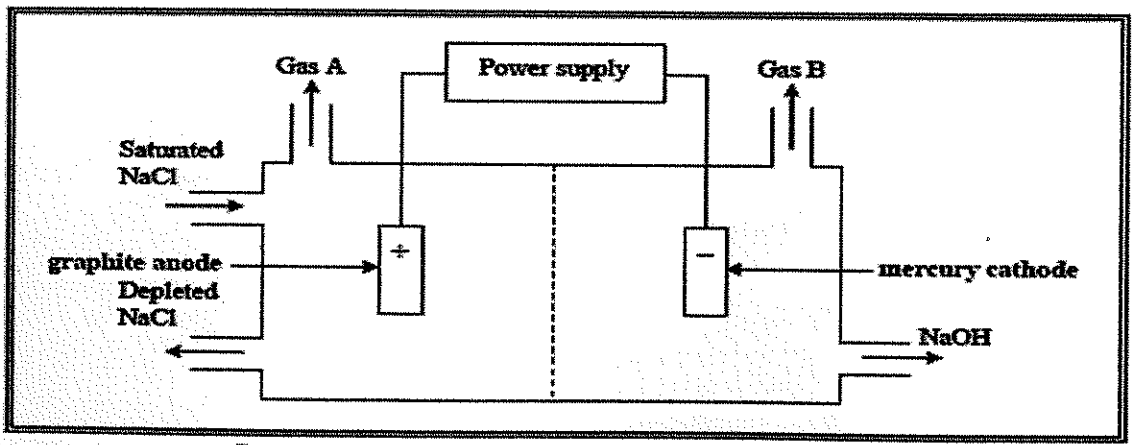
4. When a Propene is warmed with Bromine water in a test tube,

A. a pleasant vapour is smelt.
B. a dense brown vapour is seen.
C. a colourless solution is seen.
D. the mixture separates into three layers.

5. Which of the following has the highest boiling point?

A. Ethane.
B. Ethyne.
C. Ethanol.
D. Ethanoic acid.

6. Chlorine is obtained by the electrolysis of aqueous sodium chloride (brine).The diagram below shows the simple electrolytic cell in the industrial preparation of chlorine. Study the diagram carefully and answer the following questions.



Source: *www.smartlearner.mobi/science/chloroalkali.htm*

(i) At the graphite anode, oxidation of chloride ions to chlorine occurs here. Write the half-ion equation for the oxidation of chloride ions to chlorine.

(1 mark)

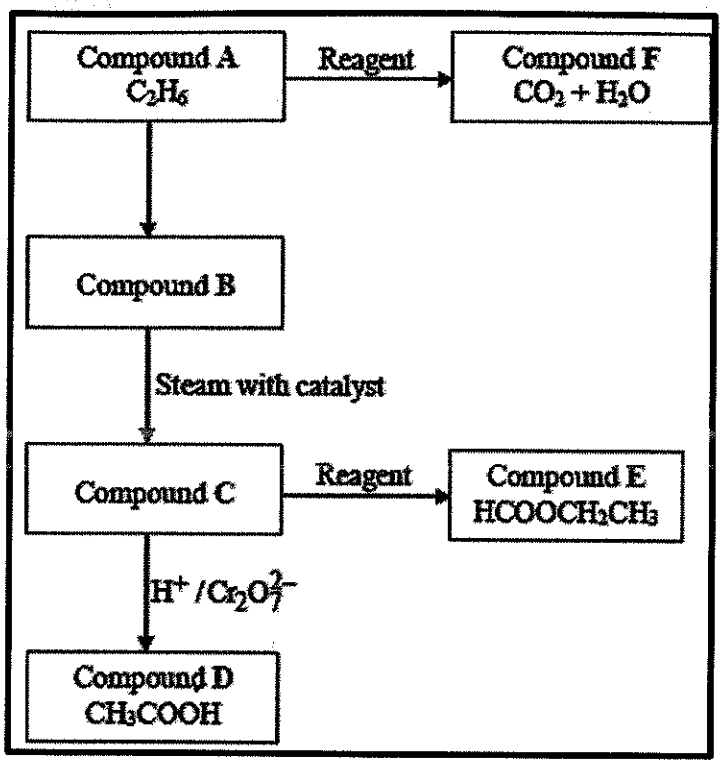
(ii) Identify the gas labelled B. **(1 mark)**

(iii) The chlorine from the anode and the sodium hydroxide from the cathode react to form sodium hypochlorite. This is then used as the third stage in the paper and pulp industry. Describe the usefulness of sodium hypochlorite in the third stage of paper and pulp industry.

(1 mark)

7. Draw the two **geometric isomers** of Butene. **(2 marks)**

8. Consider the following reaction sequence to answer the questions that follow.



(i) **Name** Compounds **B** and **C**. **(1 mark)**

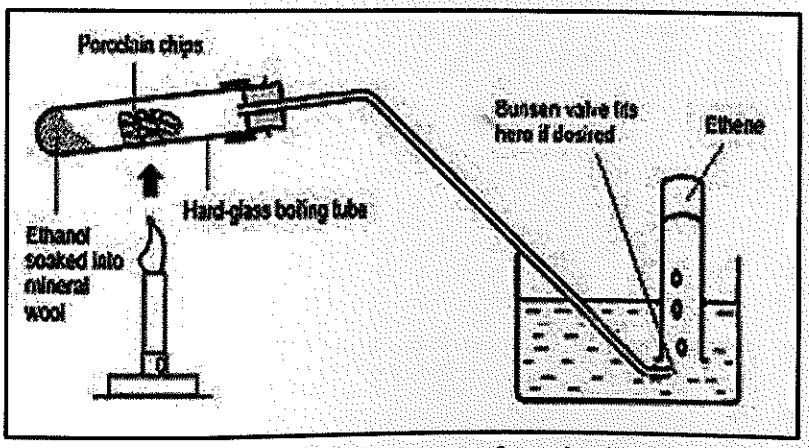
(ii) **Name** the reagent needed to convert:

I- Compound **A** to Compound **F** **(1 mark)**

II- Compound **C** to Compound **E** **(1 mark)**

(iii) Compound **B** decolourises bromine water when bubbled through it. Draw the **structural formula** of the product and give its **name**. **(2 marks)**

9. To prepare **ethene from ethanol by dehydration**, the apparatus was set up as shown below.



(i) What function does the **porcelain chip** perform in the preparation of ethene gas? **(1 mark)**

(ii) Write an equation for the **dehydration of ethanol**. **(1 mark)**

(iii) Write an equation for combustion of ethene with oxygen. **(1 mark)**

(iv) What observation is made when bromine water is shaken with the ethene gas? **(1 mark)**

(v) Write down the equation for the reaction of **bromine with ethene** and **name** the product. **(1 mark)**

10. The following steps were carried out in an experiment on oxidation of an alcohol

> **Step 1** – Add 5 drops of ethanol to 10 drops of dilute sulphuric acid in a test tube.
>
> **Step 2** – Add 2 drops of potassium dichromate solution to the same test tube and warm the mixture.

(i) Write the formula of the alcohol and beside it write the formula and the name of the organic product. **(2 marks)**

(ii) Write the formula and the name of the organic product formed on oxidation of methanol. **(1 mark)**

(iii) How does a breathalyser work? **(2 marks)**

STRAND 5 CONSUMER CHEMISTRY [15 MARKS]

- This strand has **9 Questions**.
- **Circle** the letter of the **best** answer in the **Answer Booklet** for **Questions 1 – 3**.
- Write the answer for **Questions 4 – 9** in the space provided in the **Answer Booklet**.

1. Fats are esters of fatty acids and

A. Glycerol.
B. Oils.
C. Triglycerides.
D. Alcohols.

2. Butter is made from

A. Animal fats.
B. Milk fat and water.
C. Vegetable oils.
D. Trans-fats.

3. Antibiotics are drugs that take away

A. Fever.
B. Physical pain.
C. Acid levels in stomach.
D. Diseases caused by bacteria.

4. Butter and margarine are common spreads used in most households in Fiji. Margarine is a product formed from polyunsaturated vegetable oil.

(i) Name the process that converts vegetable oil into margarine. **(1 mark)**

(ii) State **two** conditions that are required for the conversion of vegetable oils into margarine. **(1 mark)**

(iii) What does the term "polyunsaturated" mean? **(1 mark)**

(iv) State why the onset of rancidity is faster in butter than in margarine. **(1 mark)**

(v) Explain how you would test for unsaturation in vegetable oil. **(1 mark)**

5. Give the main component of dried rootstocks of kava. **(1 mark)**

6. Classify the following drugs as a depressant, stimulant or both.

(i) Heroin

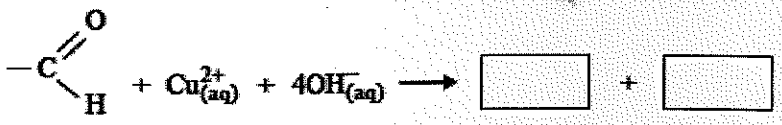
(ii) Marijuana **(2 marks)**

7. Match the terms in the list given below with the descriptions (i) to (iv) by writing the terms beside the correct numbers (i) to (iv) in the **Answer Book**.

rancidity	**globular protein**	**margarine**	**fibrous protein**
Benedict's Solution	**glycosidic bond**	**peptide bond**	

(i) Insoluble reddish brown precipitate with glucose test.
(ii) Present in muscle tissue, nails and hair.
(iii) Deterioration of fats and oils with time.
(iv) Chemical linkage between monosaccharides. **(2 marks)**

8. Complete the equation below in the **Answer Book** showing the reaction between glucose and Benedict's solution.



(1 mark)

9. Hydrogenation and refining of fats and oils are two important processes in the food industries. What is the purpose of the refining process? **(1 mark)**

THE END

PERIODIC TABLE OF THE ELEMENTS

Group	I	II										III	IV	V	VI	VII	VIII
Row 1	1 H 1																2 He 4
2	3 Li 7	4 Be 9										5 B 11	6 C 12	7 N 14	8 O 16	9 F 19	10 Ne 20
3	11 Na 23	12 Mg 24										13 Al 27	14 Si 28	15 P 31	16 S 32	17 Cl 35.5	18 Ar 40
4	19 K 39	20 Ca 40	21 Sc 45	22 Ti 48	23 V 51	24 Cr 52	25 Mn 55	26 Fe 56	27 Co 59	28 Ni 59	29 Cu 64	30 Zn 65	31 Ga 70	32 Ge 73	33 As 75	34 Se 79	35 Br 80	36 Kr 84
5	37 Rb 85	38 Sr 88	39 Y 89	40 Zr 91	41 Nb 93	42 Mo 96	43 Tc (98)	44 Ru 101	45 Rh 101	46 Pd 106	47 Ag 108	48 Cd 112	49 In 115	50 Sn 119	51 Sb 122	52 Te 128	53 I 127	54 Xe 131
6	55 Cs 133	56 Ba 137	57* La 139	72 Hf 178	73 Ta 181	74 W 184	75 Re 186	76 Os 190	77 Ir 192	78 Pt 195	79 Au 197	80 Hg 201	81 Tl 204	82 Pb 207	83 Bi 209	84 Po (209)	85 At (210)	86 Rn (222)
7	87 Fr (223)	88 Ra 226	89+ Ac 227	104 Ku 260														

58* Ce 140	59 Pr 141	60 Nd 144	61 Pm (145)	62 Sm 150	63 Eu 152	64 Gd 157	65 Tb 159	66 Dy 162	67 Ho 165	68 Er 167	69 Tm 169	70 Yb 173	71 Lu 175
90 Th 232	91 Pa 231	92 U 238	93 Np 237	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (252)	99 Es (254)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (260)

* Lanthanide Series

\+ Actinide Series

( ) mass number of most stable isotope.

Key :