**JOINT EXAMINATION**

**MID TERM 2 EXAM, 2021**

**CHEMISTRY FORM 4**

**TIME:2 HRS**

**NAME……………………………………………………….ADM NO……… …DATE……......**

**Instructions to candidates**

1. This paper consists of two sections A and B with 50 marks each.
2. Answer all the questions from both sections in the spaces provided.

**SECTION A (50MKS)**

1. (a) Give two reasons why most laboratory apparatus are made of glass. (1 mark)

(b) The diagrams below are some common laboratory apparatus. Name each apparatus and state its use. (2mks)

  (i) (ii)



2. Two immiscible liquids P and U were found to have densities 1.65g/cm3 and 0.52g/cm3 respectively. Using the most suitable set of apparatus, describe how one can separate them. (2 marks)

3. When hydrogen chloride gas dissolves in pure ethanoic acid the following equilibrium is established.

  CH3COOH(l) + HCl(g) CH3COOH+2(aq) + Cl–(aq)

­(a) (i) Identify the acid in the forward reaction. (1 mark)

(ii) Identify its conjugate base. (1 mark)

4. Metals J, K, L and M and their respective oxides were reacted. Metal M reduced the oxides of K and L. Metal L reduced the oxide of K and metal J reduced the oxide of M.

  a) Arrange the metals in order of reactivity starting with the least reactive. (2 marks)

b) Which of the above metals can be used as a sacrificial metal in electroplating of metal M. (1 mark)

5. (a) State two observations made when a small piece of potassium metal is put in a trough full of water (2 marks)

(b) Write a chemical equation for the reaction. (1 mark)

6. The atomic number of element Q is 15 and that of R is 9.

(a) Write the electronic arrangement of element Q and R (1 mark)

(b)Using dots (•) and crosses (x) to represent electrons, draw a diagram to show bonding in the compound formed. (2 marks)

(c) Give the chemical family to which element R belongs. (1 mark)

7. Study the table below and answer the questions that follow.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Substance | | **A** | **B** | **C** | **D** | **E** | **F** |
| Melting point (°C) | | 801 | 113 or 119 | -39 | 5 | -101 | 1356 |
| Boiling point (°C) | | 1410 | 445 | 457 | 54 | -36 | 2860 |
| Electrical conductivity | solid | poor | poor | good | poor | poor | Poor |
| liquid | good | poor | good | poor | poor | Poor |

Identify with reasons the substances that have

(i) a metallic structure (1 mark)

(ii) a molecular structure (1 mark)

(iii) Substances A and C conduct electric current in liquid state. State how the two substances differ as conductors of electric current. (2 marks)

8. Describe how a sample of calcium carbonate can be prepared in the laboratory starting with calcium oxide. (3 marks)

 9. Carbon (II) oxide CO is prepared by passing carbon (IV) oxide over red hot charcoal.

1. Complete the diagram below showing how pure carbon (II) oxide can be collected. (2 marks)



1. Write chemical formulae of two other gases which can be similarly collected. (1mark)

10. Nitric (V) acid may be prepared in the laboratory by the reaction of concentrated sulphuric acid on a suitable nitrate and distilling off nitric (V) acid. This reaction is carried out in an all glass apparatus.

(i) Explain why the apparatus consisting of glass is only desirable for this preparation (2 marks)

(ii) Pure nitric (V) acid is a colourless liquid but the product in this preparation is pale yellow. Explain. (2 marks)

11. The diagram below represents pipes used in the Frasch pump for the extraction of sulphur.



Which substances pass through tubes?(3mks)

 1

2

3

12. The diagram below shows a set up for large scale manufacture of hydrochloric acid.



  (a) Name substance X (1 mark)

  (b) What is the purpose of the glass beads? (1 mark)

(c) Give one use of hydrochloric acid (1 mark)

13. The graph below shows the behaviour of a fixed mass of a gas at constant temperature.

(a) What is the relationship between the volume and pressure of the gas? (1 mark)

(b) A fixed mass of a gas at 750mmHg pressure and -23oC temperature occupies a volume of 600cm3. What volume will it occupy at 33oC and 900mmHg? (2 marks)

14. a) 10 molecules of an unknown gas have a mass of 1.0667 x 10-21g. Determine the relative molecular mass of the gas. (L = 6.0 x 1023) (2 marks)

15. 10cm3 of a gaseous hydrocarbon was mixed with 90cm3 of oxygen and sparked. The resulting volume at r.t.p was 70cm3 which was reduced by 30cm3 on shaking with sodium hydroxide. Find the empirical formula of the hydrocarbon. (3 marks)

16. (a) Draw the structural formulae of propane and propan-2-ol (1/2 mark)

  Propane

Propan-2-ol (1/2 mark)

  (b) Give the chemical test for distinguishing propane from propene. (1 mark)

17. Some average bond energies are given below.

|  |  |
| --- | --- |
| Bond | Energy in kJmol-1 |
|  | 348 |
|  | 414 |
|  | 243 |
|  | 340 |
|  | 432 |

 Calculate the energy change for the reaction below

C2H6 + Cl2(g)→ CH3CH2Cl(g) + HCl­(g (3 marks)

**SECTION B (50MKS)**

18. The table below shows the atomic numbers and boiling points of element **U**, **V**, **W**, **X** and **Y** (not their actual symbols). Study it and answer the questions that follow.

|  |  |  |
| --- | --- | --- |
| Element | Atomic number | Boiling point (°C) |
| **U** | 3 | 1330 |
| **V** | 13 | 2470 |
| **W** | 16 | 445 |
| **X** | 18 | -186 |
| **Y** | 19 | 774 |

**a)** Select the elements which belong to the same

  i) Group (1 mark)

  ii) Period (1 mark)

**b)** Which element :

i) Is gaseous at room temperature ? Explain (room temperature = 298K) (2 marks)

  ii) Does not form an oxide (1 mark)

**c)** Write the

(i) Formula of the sulphate of element (1 mark)

ii) Equation for the reaction between **Y** and **W**(1 mark)

d)What type of bond exists in the compound formed between **U** and **W**? Give a reason for your answer. (2 marks)

e)An aqueous sulphate of element **V** was electrolysed using carbon electrodes. Name the products at the:

(i) Cathode (1 mark)

(ii) Anode (1mrk)

19. Study the set up below which was used by Form Four students to prepare a gas in the laboratory.



(a)Write the equation for the reaction in the flask. (1 mark)

(b)State a chemical test for the gas prepared. (1 mark)

(c)When hydrogen sulphide gas was bubbled into an aqueous solution of iron (II) chloride a yellow precipitate was deposited.

(i) State the other observation that was made. (1 mark)

(ii) Write the reaction equation for c (i) above. (1 mark)

d) When sugar crystals were reacted with concentrated sulphuric (IV) acid, a black substance **T** was formed which when dried burnt in excess air to form a colourless gas **U** only. While when concentrated sulphuric (VI) acid is reacted with liquid **D** at temperature of 170oC, a colourless gas **W** is formed this turns brown bromine water to colourless and also turns colour of substance Y from purple to colourless.

(i) Identify substances (5 marks)

**T**

  Gas **U**

  Liquid **D**

  Gas **W**

  Substance **Y**

  (ii) Which property of concentrated sulphuric (VI) acid is being demonstrated by formation of a black mass? (1 mark)

20. The flow chart below shows some chemical reactions. Use it to answer the questions that follow.



  (a) Write the name and formula of the organic compounds **P**, **V** and **W**

1. Name **P** (½ mark)

  Formula (½ mark)

  (ii) Name **V** (½ mark)

.

Formula (½ mark)

  (iii) Name **W** (½ mark)

  Formula (½ mark)

1. Write the name of the process that leads to the formation of substance(s) (11/2mks)

V

T

P

(c) Give one necessary condition for the formation of compound **P** (1/2mark)

(d)If the relative molecular mass of compound **U** is 84,000 units, determine the value of n.

(c = 12, O = 1.0) (2 marks)

(e)Write an equation for the reaction leading to the formation of substance **S** (1 mark)

(f)State and explain the observation made when substance ‘**W**’ and C2H4 are burnt in excess air. (2 marks)

21. In an experiment to determine the molar heat of neutralisation of hydrochloric acid with sodium hydroxide, students of Kima Secondary school reacted 100cm3of 1M hydrochloric acid with 50cm3of 2M sodium hydroxide solution. They obtained the following results :

Initial temperature of acid = 25.0oC

Initial temperature of base = 25.0oC

Highest temperature reached with the acid - alkali mixture = 34.0oC

  (a)Define the term molar heat of neutralization. (1 mark)

  (b)Write an ionic equation for the neutralization reaction between hydrochloric acid and sodium hydroxide. (1 mark)

  (c) Calculate:

(i) The amount of heat produced during the reaction. (S.h.c of solution = 4.2kJkg-1k-1) (2 marks)

  (ii) The molar heat of neutralization of sodium hydroxide. (1 mark)

(iii) Explain why molar heat of neutralization of 1M NaOH is higher than that of 1M NH4OH when reacted with 2M HCl. (2 marks)

  (d)Write the thermochemical equation for the reaction involving neutralization of 1M hydrochloric acid with 2M sodium hydroxide. (1mk)

(1 mark)

(e)Draw an energy level diagram for the reaction in (d) above. (2 marks

f)Below are heats of combustion of carbon, hydrogen gas and ethanol.

  Hc(carbon)H = -393kJ/mol

Hc(hydrogen)H = -268kJ/mol

Hc(ethanol)H = -1368kJ/mol

  Calculate the heat of formation of ethanol (3 marks)

22.) a) Name the chief ore from which iron is extracted. (1 mark)

(b) Name the two impurities found in iron ores. (2 marks)

(c) Iron rusts in the presence of moist air. Give the chemical name of rust. (1 mark)