**Name: ……………………………………………………… Index No: …………….….…….Class ..…..……**

School: …………………………………………………….. Candidate’s Signature………….………………

 Date: ……………….…………………………..

**233/2**

**Paper 2 (Theory)**

**July/August 2019**

**Time: 2 Hours**

**SCHOOL BASED FORM 4 EXMINATION 2019**

*Kenya Certificate of Secondary Education (K.C.S.E.)*

**CHEMISTRY**

**PAPER 2 (THEORY)**

**2 HOURS**

**Instructions to candidates:**

• Write your **Name** and **Index number** and **School** in the spaces provided **above**.

• **Sign** and write the **date** of examination in the spaces provided **above**.

• Answer **ALL** the questions in the spaces provided in the question paper.

• Mathematical tables and silent Scientific electronic calculators **may be** used.

• All workings **MUST** be clearly shown where necessary.

 **FOR EXAMINER’S USE ONLY**

|  |  |  |
| --- | --- | --- |
| **QUESTIONS** | **MAXIMUM** **SCORE** | **CANDIDATE’S** **SCORE** |
| **1** | **11** |  |
| **2** | **12** |  |
| **3** | **12** |  |
| **4** | **13** |  |
| **5** | **12** |  |
| **6** | **10** |  |
| **7** | **10** |  |
| **Total Score** | **80** |  |

1. The grid below shows part of the periodic table. Use it to answer the questions that follow.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  | S | U | V |
| P | R |  |  | X |  |  | T |  | W |
| Q |  |  |  |  |  |  |  |  |  |

1. Which of the elements has the largest atomic radius? (2 marks)

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Identify the most reactive metal.

Explain. ( 2 mark)

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Name the chemical family to which P and Q belong (1 mark)

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1. Compare the atomic radius of S and U.

Explain (2 marks)

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Select an element that does not form ion.

Explain (1 mark)

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1. Give the formula of one stable cation with an electron arrangement of 2.8.8. (1 mark)

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1. Draw the dot ( ) and cross ( X ) diagram to show bonding between Q and T. (2 marks)
2. Study the flow chart below and answer questions that follow.

 C3H8

Step 1

Step III CH3

CH3CH = CH2 CH­– CH2

Step II

Step V

Step VII/ Na(s)

Propanoic acid CH3CH2CH2OH Liquid N

and gas M

 Step VI Step IV

 Ethanol conc

 Sulphuric acid

 Warm

Substance L Sugars

1. i) Name the type of reaction in step marked III and IV. (2 marks)

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 ii) Name the important reagents and conditions in steps marked I and II.

 Step I \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (1 mark)

 Step II \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (1 mark)

1. Write balanced equation for the reaction taking place in step (VI). (1 mark)

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1. Identify liquid N and gas M. (2 marks)

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1. Describe a chemical test that can be used to distinguish between C3H8 and C3H6. (2 marks)

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1. i) If the relative molecular mass of the compound formed in step III is 42000, determine the value

 of n in the compound. (C = 12, O = 16, H = 1) (2 marks)

ii) State one disadvantage of the continued use of items made from the compound formed in

 e(i) above. (1 mark)

 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. a) The sketch below represents a graph obtained when zinc granules were reacted with excess

 0.2M sulphuric acid in the presence of a catalyst in a conical flask placed on an electronic

balance.

 

Write an equation for the reaction that took place. (1 mark)

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 ii) Explain why there is loss in mass. (1 mark)

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 b) Sketch on the same axes, the curve obtained when:

 I: Same mass of zinc powder was used under the same conditions. Label it P. (1 mark)

 II: No catalyst was used. Label it N. (1 mark)

 c) In the contact process, sulphur (IV) oxide is converted to sulphur (VI) oxide in the catalytic chamber in which a dynamic equilibrium is reached.

 2SO 2(g) + O 2(g) 2SO 3(g) ; ΔH = -97 kJ/Mol.

 i) What is meant by dynamic equilibrium? (2 marks)

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 ii) State and explain how each of the following would affect the position of the equilibrium.

1. Decrease in pressure (2 marks)

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1. Decrease in temperature (2 marks)

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 d) An equilibrium exists between chromate and dichromate ions as shown below.

 2CrO4 2- (aq) + 2H+ (aq) Cr2O7 2- (aq) + H2O (l)

 (Yellow) (Orange)

 State and explain the observation made when aqueous sodium hydroxide is added to the above mixture. (2 marks)

 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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1. a) Study the standard electrode potentials for the half cells given below and answer the

 questions that follow.

 K+ (aq) + e K (s) -2.92

 L+ (aq) + e L (s) +0.52

 C+ (aq) + e C2 (g) 0.00

 D+ (aq) + e D (s) -0.44

  E+ 2 (aq) + e E (aq) + 1.36

 i) Which element is likely to be hydrogen? Explain. (1 mark)

 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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 ii) Identify the strongest oxidizing agent. Explain. (1 mark)

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b) i) Which two half cells would produce the highest potential difference when combined?

 (1 mark)

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 ii) Draw the electrochemical cell of b(i) above.

c) Explain whether reaction represented by the equation below can take place. (2 marks)

 2A+ (aq) + D (s) 2A(s) + D 2+ (aq)

 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

d) 90cm3 of acidified water was electrolyzed using the set up below.

Gas F

Gas G

H

J

i) Identify electrodes H and J. (1 mark)

 H - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 J - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

ii) Describe how gas F can be identified. (2 marks)

 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

iii) In the above experiment 5A of electricity was passed through the acidified water for 3 minutes 21 seconds. Calculate the volume of gas G produced at room temperature and pressure. (Molar gas at r.t.p = 24000cm3, 1F = 96500c ) (3 marks)

1. The flow chart below shows the extraction of zinc ore. Study it and answer the questions that follow.

Gas Q Solid P

ZnS Roaster Roaster CaCO3

 S R

Oxygen

Slag Reduction

 Chamber

Molten zinc

1. i) Give the common names of the ore. (1 mark)
2. ZnS - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

(ii) Name the gas (2 marks)

 Q - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

(iii) Name the solids

1. R - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. S - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. P - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. Write the chemical equation for the reaction that produces zinc metal. (1 mark)

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1. What is the purpose of adding Calcium carbonate in the reaction chamber? (1 mark)

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1. Give two uses of zinc metal. (2 marks)

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1. Name one other industries that can be established alongside the zinc extraction plant.

(2 marks)

1. In an experiment, 50cm3 of 1.0M sodium hydroxide solution was placed in a suitable apparatus and 5.0cm3 portions of hydrochloric acid were added. The resulting mixture was stirred with a thermometer and the temperature recorded after each addition.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Volume of HCl (cm3)H | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 |
| Temperature (0C) | 21.5 | 22.5 | 24.0 | 25.0 | 26.0 | 27.0 | 27.5 | 27.5 | 27 | 20 |

1. Plot a graph of temperature against volume of the acid added. (3 marks)



1. i) From the graph determine volume of HCl used to neutralize 50cm3 of 1M NaOH. (1 mark)

ii) Hence determine concentration of the HCl in moles per litre. (3 marks)

1. i) Calculate the amount of heat produced in the reaction.

 (Specific heat capacity = 4.2 kJKg-1k-1 and density of the solution 1g/cm3) (2 marks)

 ii) Hence calculate the enthalpy of neutralization. (1 mark)

**7.** Study the scheme below and answer the questions that follow.

 X Y

 Step 1

 Catalyst

CuO

Dilute H2SO4

Salt F Ammonia Solid A

Step 3

Gas B

 Step 2 O2/H2O/Catalyst

Brown gas D

Heat

CU

 Substance C Cu(NO3)2

Step 4

 Colourless liquid E

1. Identify X and Y. (2 marks)

i) X - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

ii) Y - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Write the reaction between X and Y. (1 mark)

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Name the following substances. (2 marks)

i) F - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

ii) A - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

iii) B - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

iv) E - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Write chemical equation for the formation of salt F. (1 mark)

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Name the type of reaction that takes :-

i) Place between Ammonia and CuO (1 mark)

1. In the reaction in e (i) above which of the species undergo
2. Reduction (1 mark)

 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Oxidation (1 mark)

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. State one economic use of substance F. (1 mark)

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\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_