# BSJE JOINT EXAMINATION

# - 2024 -

*Kenya Certificate of Secondary Education*

**233/1** **CHEMISTRY** **PAPER 1**

**June, 2024** **TIME: 2½ Hrs**

Name: …… Admission No: ……

School: ……

Stream: …….. Signature: …….....

***Instructions to Candidates***

***a)*** *Write your name and Admission number in the spaces provided above.*

***b)*** *Sign and write the date of examination in the spaces provided above*

***c)*** *Answer **ALL** the questions in the spaces provided below each question.*

***d)*** *Mathematical tables and silent electronic calculators may be used.*

***e)*** *All working **MUST** be clearly shown where necessary.*

***f)*** ***This paper consists of 13 printed pages***

**For Examiner's Use Only**

| Questions | Max. Score | Candidate's Score |
|---|---|---|
| 1 – 27 | 80 | |

1. The electronic configuration of two particles $_{a}{}^{27}X$ and $_{b}{}^{32}Y$ are 2.8 and 2.8.8 respectively.

   a) Write the values of

      a **13** (½ mark)

      b **16** (½ mark)

   b) Identify the period and group of the periodic table to which element Y belong.

      Period =**2.8.6; period 3 // three//III** (½ mark)

      Group **6//six/VI** (½ mark)

2. You are provided with the following; thermometer, boiling tube, beaker, Bunsen burner, pure solid X, whose boiling point is about 80°C, water and any other apparatus that may be required. Draw a labeled diagram for an experiment that would be used to determine the melting point of X. (3marks)

Thermometer in boiling tube with solid X (1mk)

Water bath present (1mk)

Workability (heat; immersed in water)

3. (a) Other than sulphur, name an element that shows allotropy. (1mark)

   **Carbon//Phosphorus**

   (b) Draw the structure of the allotrope of sulphur that is stable below 96°C. (1mark)

Rhombic

   (c) State any one use of sulphur apart from manufacture of sulphuric (VI) acid. (1mark)

**-Vulcanisation of rubber**

**-Making skin ointment**

**-Gunpowder**

**-Match Stick**

4. Study the organic compounds below and answer the questions that follow.

   I. $C_3H_8O$

   II. $CH_3CHCH_2$

   III. $CH_3CH_2CH_2COOH$

   IV. $CH_3(CH_2)_2CH_3$

   V. $CH_2CH_2$

   Select,

   (a) One compound which is a saturated hydrocarbon. (1mark)

   **IV//$CH_3(CH_2)_2CH_3$**

   (b) Two compounds which are members of the same homologous series. (1mark)

   **II and V// $CH_3CHCH_2$ and $CH_2CH_2$**

   (c) Two compounds that will react together to produce a pleasant smelling compound. (1mark)

   **I and III// $C_3H_8O$ and $CH_3CH_2CH_2COOH$**

5. Explain the following observations.

   (a) When air is bubbled into distilled water, the $p^H$ of the water drops from 7.0 to 6.0. (1mark)

   **Air contains <u>CO2</u> (1/2 mk), which dissolves in water to form <u>weak carbonic acid</u> (1/2 mk).**

   (b) A bee keeper stung by a bee applies baking powder onto the stung surface for relief. (1mark)

   **Baking powder is <u>basic/alkaline</u> (1/2mk)// contains $NaHCO_3$ which <u>neutralizes the acid</u> (1/2mk) in the sting.**

6. (a) Explain why calcium oxide is not used to dry hydrogen chloride gas. (2marks)

**<u>CaO is basic/alkaline</u> (1mk) and <u>reacts with</u> (1mk) with $HCl_{(g)}$**

(b)Name one suitable drying agent for hydrogen chloride. (1mark)

**-Conc. Sulphuric (VI) acid (1mk)**

**-Fused Calcium Chloride**

**–Silica gel**

7. The table below gives the boiling points of three liquids.

| **Liquid** | **Boiling point($^oC$)** |
|---|---|
| Hexane | 69.0 |
| Butan-1-ol | 99.5 |
| water | 100 |

(a) Describe how the following mixtures can be separated.

(i) **Hexane and Butan – 1 – ol** (1½ marks)

**By <u>fractional distillation</u> (1/2mk); put in <u>fractionating column</u> (1/2mk), heat, <u>hexane distils</u> (1/2mk) at 69℃**

(ii) **Hexane and Water** (1½ mks)

**<u>Use separating funnel</u> (1/2mk); they are <u>immiscible liquids</u> (1/2mk). <u>Drain water from bottom</u> (1/2mk) of the funnel.**

8. In an experiment, 2.4g of sulphur was ontained by reacting hydrogen sulphide and chlorine as shown in the equation below.

$$H_2S\ (g) + Cl_2(g) \longrightarrow S\ (s) + 2\ HCl(g)$$

(a) State the chemical property of chlorine shown in the reaction above. (1mark)

**Oxidising property**

(b) Given that the yield of sulphur in the above reaction is 75%, calculate the volume of hydrogen sulphide gas used. (molar gas volume = 24dm$^3$, H=1, S= 32). (2marks)

$\frac{2.4}{32}$ **= 0.075 moles**

$\frac{0.075 \times 100}{75}$ **= 0.1 moles**

**Volume =** $0.1 \times 24$

**= 2.4 dm$^3$**

9. (a) Write the equation for the reaction when a piece of graphite is completely burnt in air.

(1mark)

**$C(s) + O_2(g) \longrightarrow CO_2(g)$**

(b) Give one use of graphite and diamond and relate the use to properties of each. (2marks)

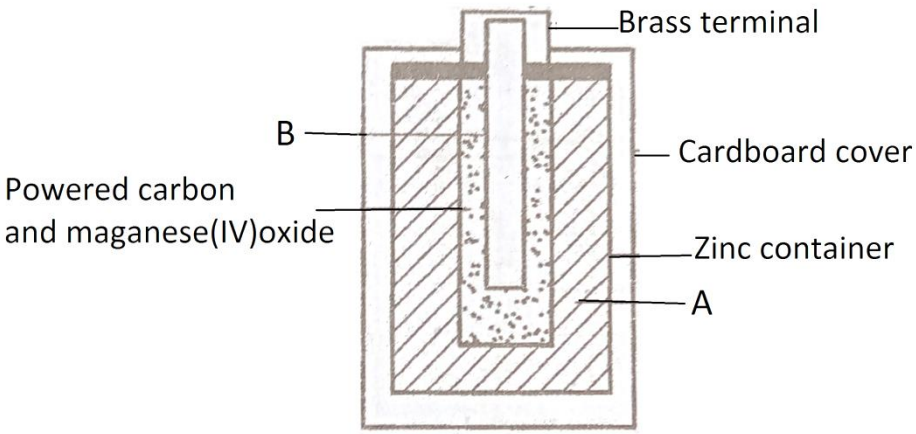
I. Graphite :

| **Use** | **Property** |
|---|---|
| **Lubricant (1/2mk)** | **Slippery/Soft(1/2mk)** |
| **Making pencils** | **Slippery/Soft** |
| **Making electrodes** | **Good conductor of electricity** |

II. Diamond:

| **Use** | **Property** |
|---|---|
| **Drilling rocks (1/2mk)** | **Hard(1/2mk)** |
| **Cutting metals** | **Hard** |
| **Making jewels** | **Shinny** |

10. The diagram below shows a section of a dry cell. Study it and answer the questions that follow.




(a) Name the part labeled B. (1mark)

**Anode**

(b) The part labeled A is a paste. Give a reason why it is not used in dry form. (1mark)

Ions are mobile

(c) (i) What is the purpose of zinc container. (1mark)

**Acts as cathode**

(ii)Apart from the use in c(i) above, state any other use of zinc. (1mark)

**-Galvanizing of iron**

**-Making of brass**

11. (a) A student electroplated a spoon with copper metal. Write the equation for the reaction on the surface of the spoon. (1mark)

**$Cu^{2+}(aq) + 2e^{-} \longrightarrow Cu(s)$**

(b)Calculate the amount of steady current that was passed for 30 minutes if 1.184g of copper was deposited. (1 Faraday = 96500C,Cu = 63.5) (2marks)

**$63.5 = 96500 \times 2\ (1/2mk)$**

**$1.184g = (193000 \times 1.184) \div 63.5 (1/2mk) = 3598.6\ C$**

**Q= It**

**$3598.6 \div (30 \times 60)$(1/2mk)= 1.999$\approx$ 2.0*A* (1/2mk)**

12. (a) State Gay Lussac's Law. (1mark)

**When gasses react, they do so in volumes that bear simple ratio to one another and to the volume of the product, if gaseous, temperature and pressure being constant.**

(b) $60cm^3$ of methane was mixed with $200cm^3$ of oxygen. The mixture was sparked to complete reaction. If the final volumes were measured at room temperature, determine the volume of the resultant gaseous mixture. (2marks)

**$CH_4(g) + 2O_2(g) \longrightarrow CO_2(g) + 2H_20\ (l)$**

1 : 2 : 1

$60cm^3$ $120cm^3$ $60cm^3$ **(1/2mk)**

**Excess $O_2$ = 200-120 = 80 (1/2mk)**

**$CO_2$ Produced = 60 (1/2mk)**

**Total volume = 140 $cm^3$ (1/2mk)**

13. (a) State Le Chatelier's principle. (1mark)

**When a change in conditions is applied to a system in equilibrium, the system moves so as to oppose that change.**

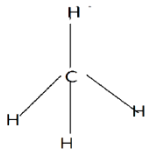
(b)State and explain the observation made when drops of 2M sodium hydroxide solution were added to the system in equilibrium shown below. (2marks)

$$2CrO_4^{2-}(aq) + 2H^+(aq) \longrightarrow Cr_2O_7^{2-}(aq) + H_2O\ (l)$$

**Solution turns to green/yellow**

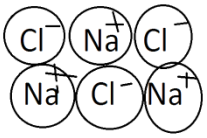
**The system produces more $H^+$ as the equilibrium shifts to the left**.

14. Study the structures given in the diagrams below to answer the questions that follow.

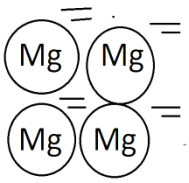



A


B




C




D

(a) Identify the structure with:

(i) Simple molecular structure. (1mark)

**A** (1/2mk) and **B** (1/2mk)

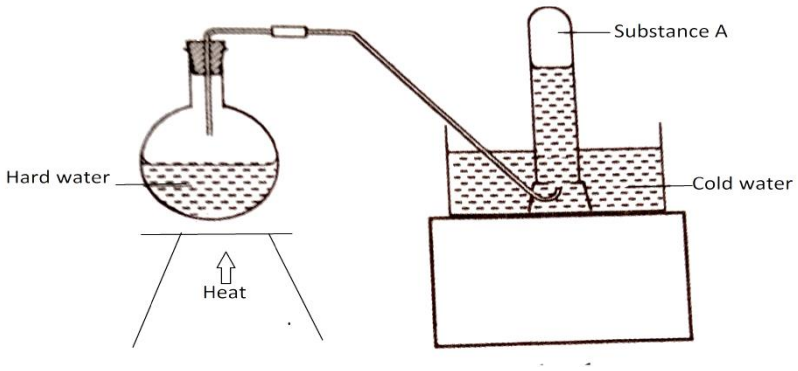
(ii) Giant atomic structure (1mark)

**C** (1/2mk) and **D** (1/2mk)

(b) Which structure conducts electric current both in solid and molten state. (1mark)

**D**

15. The set up below was used to demonstrate the effect of heat on hard water.




(a) Name substance A. (1mark)

**Carbon (IV) Oxide**

(b) Explain why heating of hard water produced substance A. (2marks)

**Temporary hard water contains <u>hydrogen carbonate</u> (1mk) that <u>decomposes</u> (1mk) to produce CO2 on heating OR**

**$Ca(HCO_3)_2$ (aq) ⟶ $CaCO_3$(s) + $H_2O$(l) + $CO_2$(g) (award 2 full marks for this equation).**

16. (a) Distinguish between deliquescent and efflorescent salts. (2marks)

**Deliquescent salt- <u>Absorbs water</u> from the atmosphere and form solution.**

**Efflorescent salt- <u>Loses</u> some of its water of crystallization when exposed to the atmosphere.**

(b)You are provided with the following; Potassium carbonate, Lead (II) sulphate, Sodium hydroxide, nitric (V) acid and Copper (II) carbonate. Select any: (1mark)

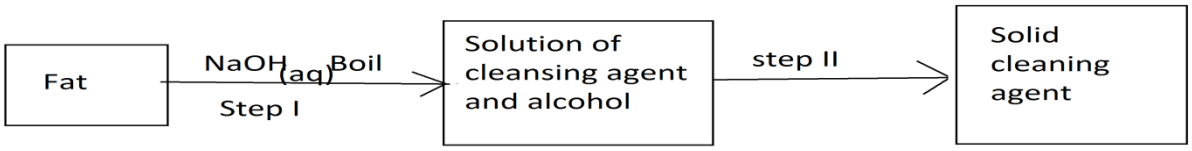
(i) Two that would produce neutralization reaction.

**NaOH and $HNO_3$ acid (1/2mk)**

(ii) One that would decompose on heating to produce carbon (IV) oxide,

**$CuCO_3$ (1/2mk)**

17. The scheme below was used to prepare a cleansing agent. Study it and answer the questions that follow.




Name;

(a) The cleansing agent. (1mark)

**Soap**

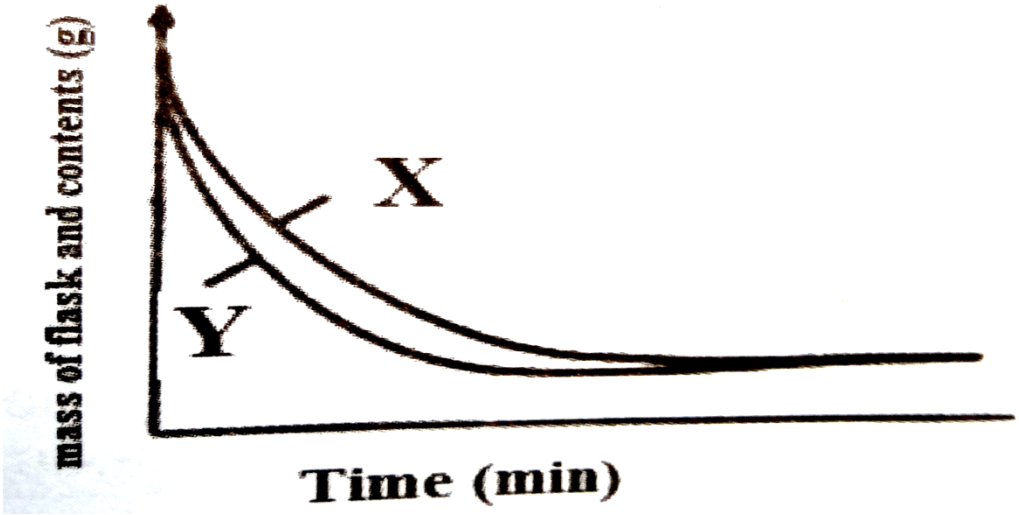
(b) Process in step I. (1mark)

**Saponification**

(c) Chemical substance added in step II. (1mark)

**Sodium Chloride / Brine**

18. The curves below represent the change in mass when equal amounts of powdered zinc and zinc granules were reacted with excess 2M hydrochloric acid. Use the graph to answer the questions that follow.




(a) Identify the curve for zinc granules. Explain. (2marks)

**Curve Y (1mk); Small surface area (1/2mk) therefore rate is slow (1/2mk)**

(b) Other than the factor demonstrated above, state one factor that may be varied to affect the rate of the above reaction. (1mark)

**-Concentration of the acid** (1mk)

**-Temperature of the acid**

19. A white solid Q was heated. It produced a brown gas Y and a colourless gas Z that relights a glowing splint. The residue left was yellow after cooling.

(a) Identify: (1mark)

**(i)** Gas Y - **Nitrogen (IV) Oxide //$NO_2$**

(ii) The residue - **Lead (II) Oxide**

(b) Write the equation for the decomposition of solid Q. (1mark)

**$2Pb(NO_3)_2(s) \longrightarrow 2PbO(s) + 4NO_2(g) + O_2(g)$**

20. A crystalline sample of sodium carbonate, $Na_2CO_3$. $XH_2O$ was heated until there was no further change. The mass of the residue reduced by 14.5%. Determine the value of X in the formula. (3marks)

Residue= (100%-14.5%) = 85.5%

**$Na_2CO3$** **$H_2O$** **$Na_2CO3$ =106 (1/2mk); $H_2O$ = 18 (1/2mk)**

$\frac{85.5}{106}$ $\frac{14.5}{18}$ **(1/2mk)**

**0.807** **0.806**

$\frac{0.807}{0.806}$ $\frac{0.806}{0.806}$ **(1/2mk)**

**1** **1 (1/2mk)**

**X= 1 (1/2mk)**

21. In an experiment to identify the compound in an aqueous solution, three properties of the solution in test tubes were tested and the results obtained were recorded in the table below. Study it to answer the questions that follow.

| **Portion** | **Test** | **Observation** |
|---|---|---|
| 1 | Add a few drops of dilute nitric (V) acid. | Effervescence. Forms a white precipitate with lime water. |
| 2 | Add aqueous sodium hydroxide drop wise until excess. | A white precipitate soluble in excess. |
| 3 | Add aqueous ammonia drop wise until excess. | A white precipitate soluble in excess. |

(a) Identify the:

(i) Cation in the compound. (1mark)

**$Zn^{2+}$**

(ii) Anion in the compound. (1mark)

**$CO_3^{2-}$**

(b) Write the formula of the colorless solution formed in portion 3. (1mark)

**$[Zn(NH_3)_4]^{2+}$**

22. Excess zinc powder was added to $50cm^3$ of 2M copper (II) sulphate solution and the reaction allowed to complete. The highest temperature change was $15^oC$.

(a) State the observations made in the above reaction. (1mark)

(b) If the molar enthalpy of displacement is -63kJmol$^-$. Calculate the concentration in moles per liter of the copper (II) sulphate solution. (3marks)

**Heat change ($\Delta H$) = $50\times 4.2\times 15 = 3150J = 3.15kJ$**

**63kJ= 1 mole**

**3.15kJ = $\frac{1\times 3.15}{63} = 0.05M$**

23. Draw a well labeled diagram of a set up that can be used to prepare and collect dry sample of chlorine gas using manganese (IV) oxide and concentrated hydrochloric acid. (3marks)

24. An oxide of K has the formula $K_2O_5$.

(a) Determine the oxidation number of element K. (1mark)

**2k+5(-2) = 0**

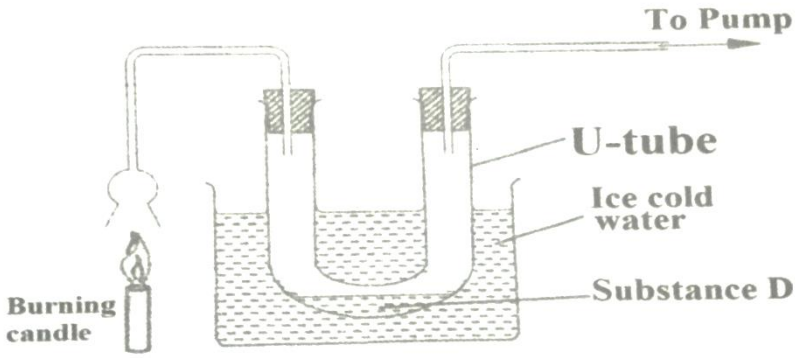
**2k=10**

**K= +5**

(b) Which group of the periodic table does element K belong. (1mark)

**Group 5 / V/ Five**

25. An experiment was set up as shown in the diagram below.




(a) Suggest the aim of the experiment. (1mark)

**-To determine substance candle wax is made of (1mk)**

**-To establish products candle wax forms when burnt in air**

(b) Identify substance D. (1mark)

**Water / $H_2O$**

(c) Describe how the other product of the burning candle could be prevented from getting into the environment. (1mark)

**Bubble through NaOH // Ca(OH)2 / KOH**

26. Calculate the values x and y in the following nuclear equation.

$$^{239}_{92}U \longrightarrow {}^{x}_{y}Th + 2\alpha + 2\beta$$ **(2marks)**

$$^{239}_{92}U \longrightarrow {}^{x}_{y}Th + 2{}^{4}_{2}He + 2{}^{0}_{-1}e$$ **(1mk)**

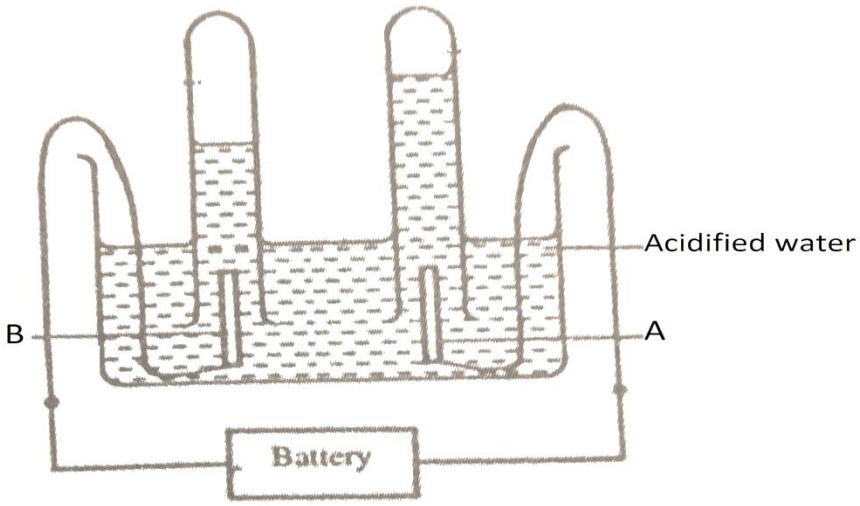
**239 = x + 8+ 0; x = 231 (1/2mk)**

**92 = y + 4 - 2; y = 90 (1/2mk)**

27. Given the following substances; soap, potassium chloride and aluminium chloride, classify the substances as acidic, basic or neutral. (2marks)

| Acidic | Basic | Neutral |
|---|---|---|
| **Aluminium chloride** | **Soap** | **Potassium chloride** |

28. The diagram below represents the set up used for electrolysis of acidified water.




(a) Name the electrode B. (1mark)

**Cathode**

(b) Why is water acidified. (1mark)

**To introduce ions**

(c) Write the equation for the reaction on the surface of electrode A. (1mark)

$$4OH^-(aq) \longrightarrow 4e^- + 2H_2O\ (l) + O_2(g)$$