2411/302
INORGANIC CHEMISTRY
Oct./Nov. 2017
Time: 3 hours

THE KENYA NATIONAL EXAMINATIONS COUNCIL

# DIPLOMA IN ANALYTICAL CHEMISTRY

INORGANIC CHEMISTRY

**3 hours**



## INSTRUCTIONS TO CANDIDATES

*You should have the following for this examination:*
*answer booklet;*
*a scientific calculator.*
*This paper consists of **TWO** sections; **A** and **B**.*
*Answer **ALL** the questions in section **A** and any **THREE** questions from section **B** in the answer booklet provided.*
*Each question in section **A** carries **4** marks while each question in section **B** carries **20** marks.*
*Maximum marks for each part of a question are indicated.*
***Candidates should answer the questions in English.***

**This paper consists of 4 printed pages.**

**Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.**



**Turn over**

## SECTION A (40 marks)

*Answer **ALL** the questions in this section.*

1. (a) Define oxidation and reduction. (2 marks)

   (b) Identify which of the following compounds undergo oxidation and reduction in the extraction of iron.

   $Fe_2O_{3(s)} + 3CO_{(g)} \longrightarrow 2Fe_{(s)} + 3CO_{2(g)}$. (2 marks)

2. Using first principles, write a balanced chemical equation for the reaction between chlorine and ferrous sulphate. (4 marks)

3. Identify the oxidation states of vanadium and chromium in the following inorganic species.

   (a) $VO^{2+}$;

   (b) $Cr(H_2O)_6^{3+}$. (4 marks)

4. Give a balanced chemical equation for the formation of oxides by the elements sodium and potassium when they react with oxygen. (4 marks)

5. With reasons, give the correct electronic configuration of chromium (Cr = 52). (4 marks)

6. (a) Define ionization energy. (1 mark)

   (b) List any **three** factors that affect ionization energy of an element. (3 marks)

7. Write the equations for the preparation of iodine ($I_2$) and bromine ($Br_2$) from their halides. (4 marks)

8. Draw the three dimensional structure of a diamond unit. (4 marks)

9. | | K |
   |---|---|
   | $Ni(H_2O)_6^{2+} + 6NH_3 \longrightarrow Ni(NH_3)_6 + 6H_2O$. | $4 \times 10^8$ |
   | $Ni(H_2O)_6^{2+} + 3en \longrightarrow Ni(en)_3 + 6H_2O$ | $2 \times 10^{18}$ |

   With a reason, identify which of the two complexes of nickel is more stable. (4 marks)

10. Name the following complex compounds:

    (a) (i) $[Fe(CN)_6]^{4-}$; (1 mark)

    (ii) $[Ag(NH_3)_2]^+$. (1 mark)

*(b) Explain the difference between low spin state and high spin state of iron. (2 marks)

**SECTION B** (60 marks)

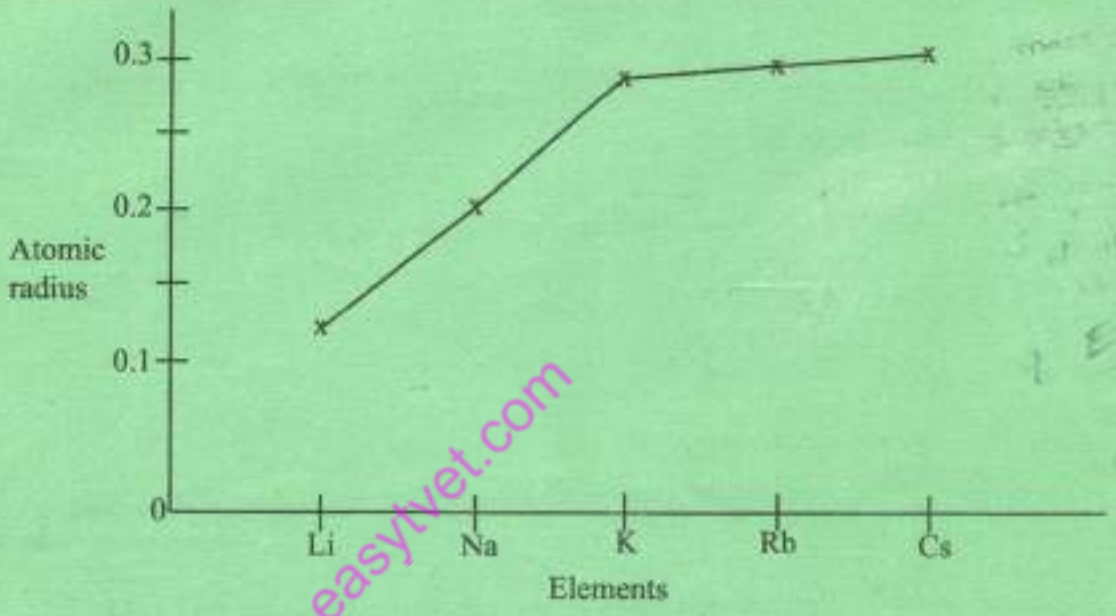
*Answer any **THREE** questions from this section.*

11. (a) Describe the Rutherford and Geiger-Marsden scattering. (10 marks)

(b) Explain any **five** applications of mass spectrometer. (10 marks)

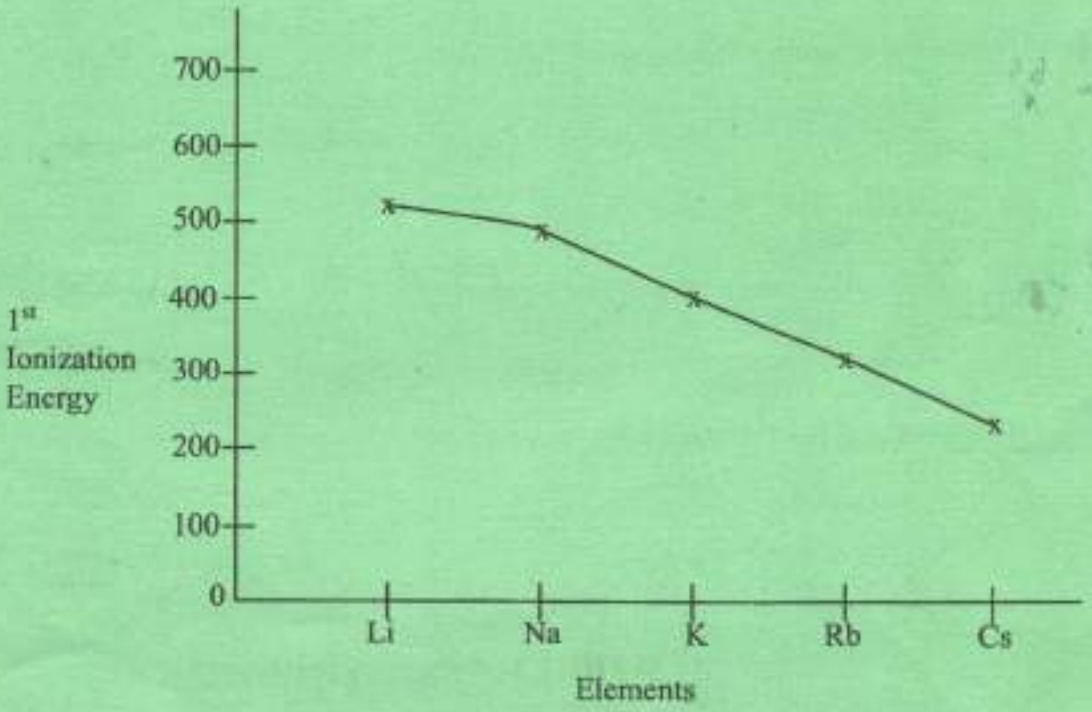
12. Explain the following trends in the physical properties of group I elements. (4 marks)

(a)






(b)



(c) (i) Explain the reactivity trend in the group I elements. (6 marks)

(ii) Write the electronic configurations of Li and Na using atomic orbital notation and explain the significance of the orbitals. (10 marks)

13. (a) Explain the origin of flame colours when group I elements are ignited in a flame. (7 marks)

(b) Explain the term paramagnetism as used in d-block complexes. (5 marks)

(c) (i) Explain the reasons for the ability of d-block elements to form complexes. (6 marks)

(ii) Give **two** reasons why the d-block complexes are coloured. (2 marks)

14. (a) Define an ore. (1 mark)

(b) Give the chemical formulae for the following ores:

(i) Chalcopyrite;
(ii) Bauxite;
(iii) Haematite. (3 marks)

(c) (i) Explain the considerations for choosing a reduction method in metal extraction. (5 marks)

(ii) Explain **three** methods of reduction of metals. (11 marks)

15. Explain the following observations:

(a) the oxide of aluminium oxide and sulphur are acidic in aqueous solution. (4 marks)

(b) $[Cu(H_2O)_6]^{2+}$ is paramagnetic. (3 marks)

(c) d-block elements are good catalysts. (2 marks)

(d) atoms with heavy nuclei spontaneously disintegrate. (3 marks)

(e) d-orbital has five degenerate sub orbitals. (8 marks)

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