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.*
*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.
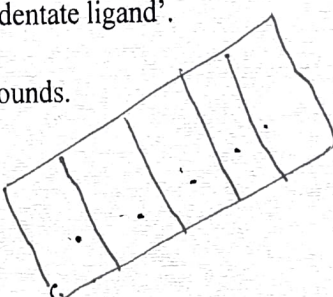
This paper consists of 5 printed pages.

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

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

1. (a) Explain the term electron affinity.   (2 marks)

    (b) The first electron affinity of oxygen is -140 KJmol⁻¹ and the second is +799 KJmol⁻¹.
         Explain why the first ionization energy is exothermic and the second is endothermic.
                                                                                (2 marks)

2. (a) Thorium -232 emits six alpha particles and four beta particles in its natural decay series.
         Determine the atomic and mass number of the final product.   (3 marks)

    (b) Write a nuclear equation to show the change that occurs when Lithium - 7 absorb a
         colliding proton to disintegrate into two similar fragments.   (1 mark)

3. Explain why some salts of copper (I), a transition element, are colourless. (4 marks)

4. (a) Sulfurtrioxide is absorbed in 98% sulphuric acid in the contact process. Explain.
                                                                                (2 marks)

    (b) Write an equation for the reaction taking place when zinc sulphide is heated in air.
                                                                                (2 marks)

5. (a) List **three** diagonal relationships between magnesium and lithium.   (3 marks)

    (b) Explain why diagonal relationships exists between magnesium and lithium.
                                                                                (1 mark)

6. (a) Explain the meaning of the term 'bidentate ligand'.   (1 mark)

    (b) Name the following complex compounds.

         (i) $[Pt(H_2O)_2Cl_4]$ (1 mark)

         (ii) $[Cr(NH_3)_6][Co(CN)_6]$ (1 mark)

         (iii) $[Cu(NH_3)_4][SO_4]$ (1 mark)

7. (a) Explain using an equation, why an aqueous solution of aluminium chloride is acidic.
                                                                                (2 marks)

    (b) Explain why aluminium sulphate is used in the water treatment process. (2 marks)

8. (a) State Pauli's exclusion principle.   (2 marks)

    (b) Using Helium atom, illustrate Pauli's exclusion principle.   (2 marks)

9. Table I, shows the melting points of halides of calcium.

Table I

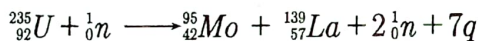| Halide	$CaCl_2$	CaF_2
Melting point (°C)	1425	720

Explain the difference in melting points of the halides. (4 marks)

10. (a) Explain the term catenation with respect to group IVA elements. (2 marks)

(b) Explain the significance of the M – M bond in catenation. (2 marks)

SECTION B (60 marks)

Answer any THREE questions from this section.

11. (a) $^{214}_{83}Bi$ has a half -life of 20 minutes.

$$\frac{0.693k}{20} \qquad \frac{20k = 0.693}{20} \qquad 0.034.$$

(i) Plot a graph the percentage of $^{214}_{83}Bi$ remaining against time for a period of 80 minutes. (7 marks)

(ii) From the graph in (a)(i), find the percentage of $^{214}_{83}Bi$ remaining after 50 minutes. (2 marks)

(b) (i) List the characteristics properties of Alpha and Beta particles. (4 marks)

Alpha - Have mass
- Low ponetrating power
Beta
- Have no mass
- Higher penetrating Power.

(ii) Determine the nature of particle q in the following radioactive equation

$$^{235}_{92}U + ^1_0n \longrightarrow ^{95}_{42}Mo + ^{139}_{57}La + 2^1_0n + 7q$$

$+2^0_1n$ (4 marks)

(c) State any **three** industrial applications of radioistopes. (3 marks)

$^0_1\beta$
$^0_{-1}\beta$

- Carbon-14 is used in dating of fossils.
- Used in leak detection in undergound pipes
- Deutorium is used in lamps

12. (a) Phospherous forms oxoacids with the formulae H_3PO_3, H_3PO_4 and H_3PO_2 among others.

(i) Give the names of the **three** acids above. (3 marks)

(ii) Draw the Lewis structures of the three acids. (3 marks)

$4s^1 3d^{10}$

100

$\frac{18}{29}$

(b)   (i)   Distinguish between polymorphs and allotropes.   (2 marks)

     (ii)   Give **one** suitable example for each of the phenomenas in b(i) above.

           (2 marks)

(c)   (i)   Explain the term 'silicones'.   (3 marks)

     (ii)   Give any **four** applications of silicones.   (4 marks)

(d)   List **three** similarities between silicon and boron.   (3 marks)

13. (a)   Sulphur and chlorine react under suitable conditions to form S_2Cl_2. 1g of S_2Cl_2 reacted with water to form 0.36 g of a yellow precipitate, as well as a solution containing a mixture of sulphurous acid and hydrochloric acid.

     (i)   Write and equation for the reaction between S_2Cl_2 and water.   (2 marks)

     (ii)   Determine the volume of 1.00 mol dm^{-3} sodium hydroxide required to neutralise the final solution.

           (6 marks)

(b)   Copper and silicon have properties that make them widely used materials.

     (i)   Explain why copper is a good conductor of electricity while silicon dioxide is not.   (2 marks)

     (ii)   Explain why silicon dioxide has a higher melting point than copper.

           (2 marks)

     (iii)   Give **three** reasons why silicon dioxide is used to make hot plates for electric cookers.   (3 marks)

     (iv)   Give **one** advantage and **one** disadvantage of using copper as an axe-head.

           (2 marks)

(c)   List **three** uses of molybdenum and its compounds.   (3 marks)

14. (a)   The atomic number of iron is 26.
State, giving reasons, the most stable oxidation state of iron.   (3 marks)

(b)   Iron III salt solution in water has a pH less than 7. Explain this observation.

the acidity of the solution $[Fe(OH)_6]^{+3} \rightleftharpoons [Fe(OH)_5]^{+2} + H^+$ the H^+ is responsible for   (3 marks)

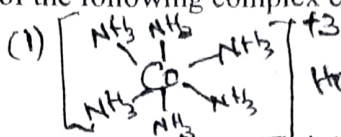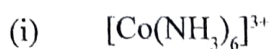(c)   (i)   State the effective atomic number (E.A.N) rule.   (1 mark)

en element in One of its common oxidation state. If its electron configuration is the × + noble gas. It is said to have obeyed EAN Rule.

     (ii)   State **four** characteristics of transition metals.   (4 marks)

- They form coloured complex
- Have variable Oxidation states
- They have catalytic property. e.g Vanadium.
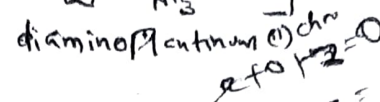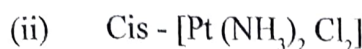- Have Higher m.p and B.p.

$1s^2 2s^2 2p^6 3s^2 3p^6$
Neon   Ars

(d) Draw a name the structures of the following complex compounds:

(i) $[Co(NH_3)_6]^{3+}$ (3 marks)

[handwritten] $\begin{bmatrix} NH_3 \ NH_3 \\ NH_3—Co—NH_3 \\ NH_3 \ NH_3 \end{bmatrix}^{+3}$ Hexaaminocobalt(III) ione

(ii) Cis - $[Pt(NH_3)_2 Cl_2]$ (3 marks)

[handwritten] diaminoplantinum (II) chro $x + 0 + 2 = 0$ $x = +2$ $x = 0$

(iii) $[Pt(NH_3)_4][Pt Cl_4]$ (3 marks)

15. (a) (i) Draw a Cathode ray diagram illustrating the effect of a magnetic field on cathode rays. (6 marks)

(ii) Give **four** othes properties of cathode rays. *— They* (4 marks)

(b) Name any **one** ore of aluminium and give its formula. (2 marks)

[handwritten] Bauxite. $Al_2O_3 \cdot 2H_2O$

(c) Aluminium is purified through the electrolytes process. (2 marks)

(i) Explain why cryolite is added during the process. *[handwritten] to lower the Melting Point from $800°C — 600°C$ thus saves Energy.*

(ii) Explain why aluminium and oxygen are discharged at their respective electrodes. (3 marks)

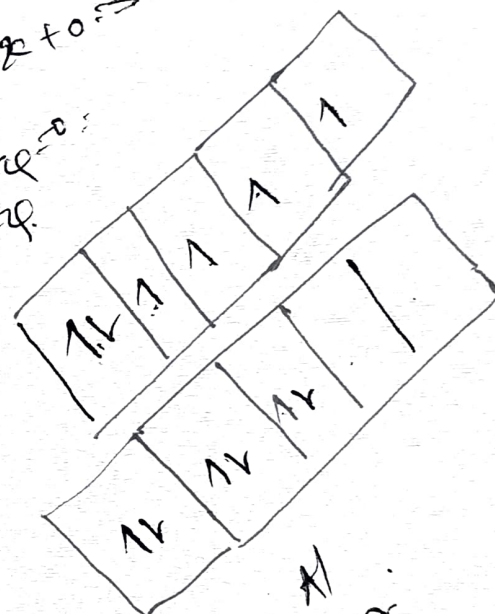(iii) Name **three** alloys of aluminium. (3 marks)

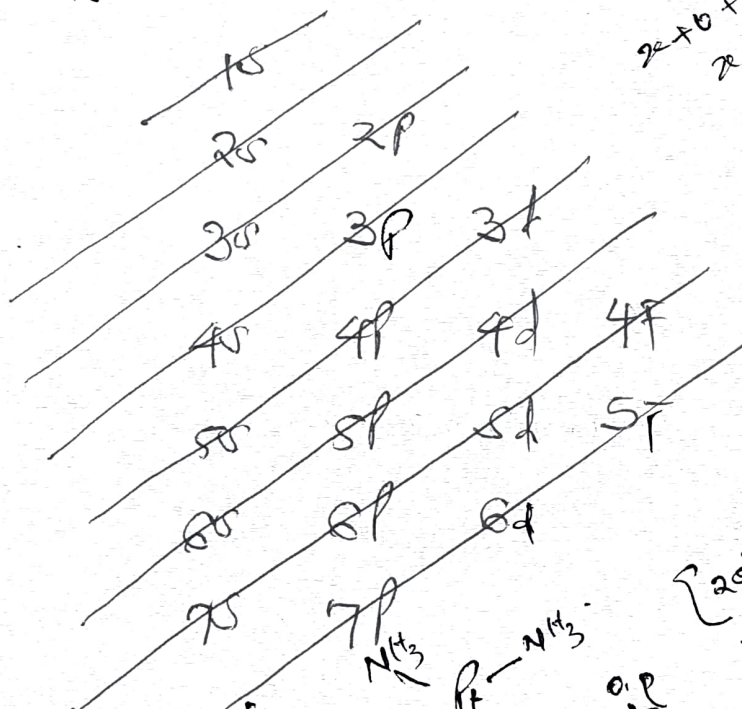*[handwritten] - Duralumin   alloy Duralumin*

[handwritten notes] (ii) $NH_3—Pt—NH_3$ Cl_2 (III) Pt $x + 0.\overset{..}{..}$

THIS IS THE LAST PRINTED PAGE.

[handwritten] $x + 6 + 2x = 0$ $x = 2x$.

[handwritten list] 1s / 2s 2p / 3s 3p 3d / 4s 4p 4d 4f / 5s 5p 5d 5f / 6s 6p 6d / 7s 7p

[handwritten] same as the

[handwritten bottom] $3d^9 4p^6 5s^2 4d^{10} 5p 6s 4f 5d$