

2411/302
INORGANIC CHEMISTRY
Oct./Nov. 2003,
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
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 as shown.

SECTION A

Answer ALL the questions in this section

1. (a) Define the term "Catenation": (1 mark)
(b) Both carbon and silicon catenate. Explain why carbon forms a greater number of compounds while silicon forms relatively few compounds (3 marks)
2. (a) With the aid of diagrams, show how the ionic radius changes for the 3rd period elements. (1 mark)
(b) Explain the trend in (a) above. (3 marks)
3. (a) State the TWO oxidation states exhibited by copper. (1 mark)
(b) Explain how each state arises. (3 marks)
4. An aqueous solution of carbon dioxide is heated. Suggest with reason(s) how the hot solution differs from the cold solution. (4 marks)
5. A white crystalline compound X produces a crimson colour in a colourless bunsen flame. When X is heated strongly in a test-tube it decomposes and a reddish-brown gas is observed.
(a) Identify
(i) the reddish-brown gas (1 mark)
(ii) Compound X (1 mark)
(b) Write a balanced equation for the thermal decomposition of x. (2 marks)
6. State with reason(s) which of the compounds $\text{Mg}(\text{OH})_2$ and $\text{Ba}(\text{OH})_2$ is a stronger base. (4 marks)
7. Suggest reason(s) why phosphorous Pentafluoride (PF_5) is known while Nitrogen Pentafluoride (NF_5) is not. (4 marks)
8. A transition metal element(E) has the electronic structure $[\text{Ar}] 3d^6 4s^2$.
(a) State with reason(s) the most stable oxidation state of E. (2 marks)
(b) In terms of E, write balanced equations for the reaction between E and;
(i) hydrogen chloride gas (1 mark)
(ii) Chlorine gas (1 mark)

9. (a) Super phosphate of lime $[\text{Ca}(\text{H}_2\text{PO}_4)_2(\text{s}) + 2\text{CaSO}_4(\text{s})]$ and triple super phosphate $3\text{Ca}(\text{H}_2\text{PO}_4)_2(\text{s})$ are common phosphatic fertilizers. State with reason(s) the fertilizer which would be used for a phosphorous deficient soil. (2 marks)
- (b) State the advantage of nitrophosphate $[\text{Ca}(\text{H}_2\text{PO}_4)_2(\text{s}) + 2\text{Ca}(\text{NO}_3)_2(\text{s})]$ over superphosphate of lime and triple superphosphate. (2 marks)
10. (a) State the relationship between ^{12}C and ^{14}C . (1 mark)
- (b) Give the Nuclear equation for the decay of ^{14}C . (1 mark)
- (c) A radioactive element $^{232}_{90}\text{X}$ emits SIX alpha-particles and FOUR beta-particles to form a stable nuclide Y.
- Determine:
- (i) the atomic number of Y (1 mark)
- (ii) the mass number of Y (1 mark)

SECTION B

Answer any **THREE** questions from this section

11. (a) Discuss the development of the periodic table to its current form. (11 marks)
- (b) State the advantages of the modern form of the periodic table. (4 marks)
- (c) Give FOUR anomalous properties of Lithium. (4 marks)
- (d) Account for the anomalous behaviour of Lithium. (1 mark)
12. (a) Define the term "radioactivity". (2 marks)
- (b) Name and state the origin of radioactive decay emissions. (9 marks)
- (c) Describe how radioactive radiations may be distinguished. ($3\frac{1}{2}$ marks)
- (d) A Nucleus X is unstable due to high Neutron: Proton (n/p) ratio
- (i) Predict the radioactive decay expected of X. (1 mark)
- (ii) Give the decay equation of X. (2 marks)
- (e) A radioisotope has a half-life of 4.5×10^9 years. Calculate the time taken for 0.75 to decay. ($2\frac{1}{2}$ marks)

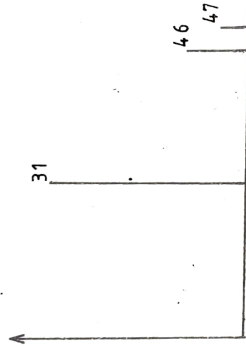
13. (a) (i) With the aid of a labelled diagram describe the Millikan's oil drop experiment (12½ marks)
 (ii) State the importance of the experiment in (a) (i) above (1½ marks)

(b) Distinguish clearly between:

- (i) Ionic and metallic bonding. (3 marks)
 (ii) Dative and polarised bond (3 marks)

14. (a) Draw a labelled diagram of a mass spectrometer and describe how it works. (16½ marks)

(b) The diagram below is a mass spectrum of ethanol (C_2H_6O)
 [C=12.0; O=16.0; H=1.0]



- (i) Label the axes (1 mark)
 (ii) State the name given to the peak at 31. (½ mark)
 (iii) Suggest with reasons(s) the name for the peak at 46 (½ marks)
 (iv) Suggest the origin of the small peak at 47. (½ marks)

15. (a) Differentiate between Paramagnetic and diamagnetic substances. (6 marks)

(b) State the behaviour of the following species in a non-uniform magnetic field.

- (i) NO (2 marks)
 (ii) O_3 (2 marks)
 (iii) a free radical (1 mark)

(c) Explain the following observations:

- (i) Copper II compounds are blue (4 marks)
 (ii) Transition elements exhibit varying oxidation states (1 mark)

(d) Complete the following equations:

- (i) ${}^{32}_{16}S + {}^1_0n \longrightarrow {}^?_{16}P + {}^1_1H$ (2 marks)
 (ii) ${}^{27}_{13}Al + {}^1_1H \longrightarrow {}^4_2He + ?$ (2 marks)