

2915/304
ORGANIC AND INORGANIC CHEMISTRY III
Oct./Nov. 2021
Time: 3 hours



THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN ANALYTICAL CHEMISTRY

MODULE III

ORGANIC AND INORGANIC CHEMISTRY III

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 indicated.

Candidates should answer the questions in English.

This paper consists of 8 printed pages.

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

SECTION A (40 marks)

Answer ALL the questions in this section.

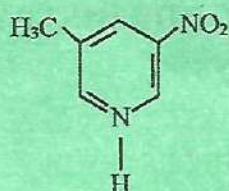
1. Explain the following observations:

(a) p-cresol is less acidic than phenol; (3 marks)

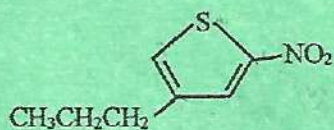
(b) pyrrole and pyridine are aromatic; (2 marks)

2. Give systematic names of the following compounds: (4 marks)

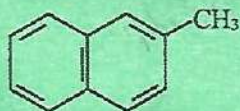
(a)



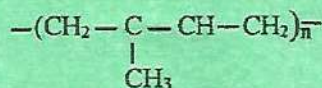
(b)



(c)



(d)



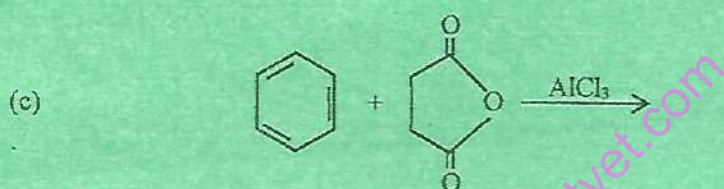
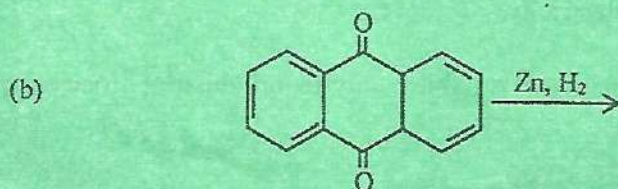
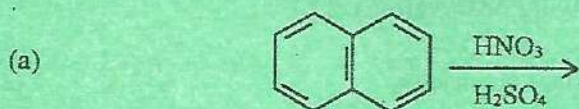
3. (a) Explain the meaning of the term *heterocyclic* compound. (2 marks)

(b) Give structures of the following compounds:

(i) Pyrrole; (1 mark)

(ii) Indole. (1 mark)

4. (a) Differentiate between addition polymerisation and condensation polymerisation. (2 marks)
- (b) State any two disadvantages of synthetic polymers to natural polymers. (2 marks)
5. Complete the following equations, giving the structure of the major organic product formed. (4 marks)



6. Consider the following transition metal ion Cr^{+} and Cu^{+}
Given that the $\text{Cr}_z = 24$ and $\text{Cu}_z = 29$:

- (i) State ions that forms coloured compounds; (1 mark)
- (ii) Explain your reason for the answer (i). (3 marks)

7. (a) Write the electronic configuration of the following d block ions:



- (b) Calculate the oxidation number of manganese in MnO_4^- . (2 marks)

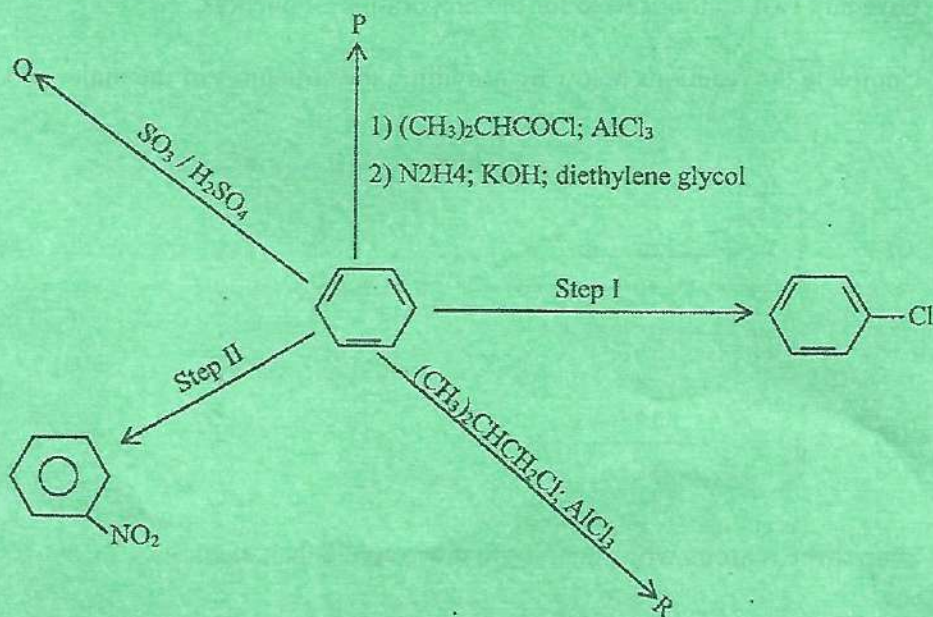
8. (a) State the meaning of the following words:
- (i) paramagnetism; (1 mark)
 - (ii) diamagnetism. (1 mark)
- (b) Explain why Mn^{2+} is more stable than Mn^{3+} . (2 marks)
9. Using crystal structures, explain the following observations:
- (a) diamond is hard and does not conduct electricity. (2 marks)
 - (b) graphite is soft and conducts electricity. (2 marks)
10. Explain why transition metals act as good and reliable catalysts in industrial processes. (4 marks)

SECTION B (60 marks)

Answer any THREE questions in this section.

11. (a) Starting with naphthalene and any other relevant reagents, show how anthraquinone can be synthesized. (10 marks)
- (b) (i) Explain the **two** preparation methods of obtaining pyrrole. (4 marks)
- (ii) State any **two** uses of pyrrole. (2 marks)
- (c) Explain the following observations:
- (i) Aniline is more reactive than benzene; (2 marks)
 - (ii) Nitrobenzene is less reactive than benzene. (2 marks)

12. (a) Study the reaction scheme below and use it to answer the questions that follow:



(i) Draw and name the structures of compounds

P: (2 marks)

Q: (2 marks)

R: (2 marks)

(ii) Give the reagents and conditions necessary for step I and II in the reaction scheme above. (4 marks)

(b) Using curly arrows, show the reaction mechanism when benzene reacts with acid chloride in presence of a Lewis catalyst. (6 marks)

(c) Explain any two drawbacks of Friedel-Craft Alkylation. (4 marks)

13. (a) Explain the meaning of the term Hock process. (2 marks)
- (b) Give any **two** methods used for the preparation of phenols. (2 marks)
- (c) Complete the reactions below by providing the structures of the major product.



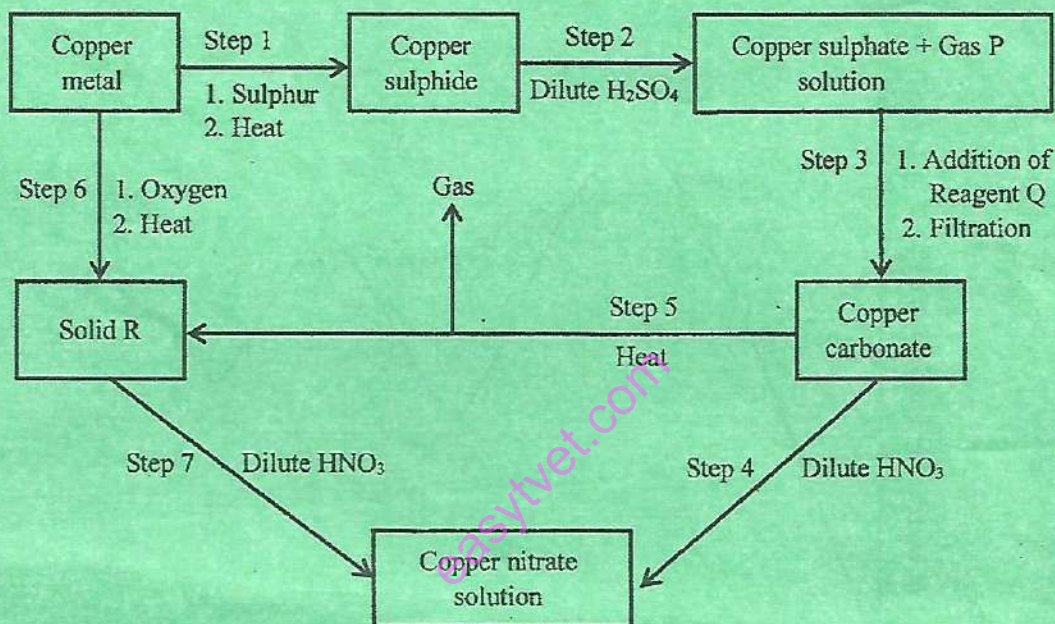
- (d) State **three** reasons why phenols are more acidic than alcohols. (3 marks)
- (e) Give **one** use of phenols. (1 mark)
- (f) State **two** differences between chemical reactions and nuclear reactions. (4 marks)
- (g) (i) Lithium is a group I element, with two stable isotopes namely ${}^6_3\text{Li}$ and ${}^7_3\text{Li}$ with abundance of 7.5% and 92.5% respectively. Given that ${}^6_3\text{Li}$ has a mass of 6.01512 amu and ${}^7_3\text{Li}$ has a mass of 7.016 amu. Calculate the atomic mass of lithium. (4 marks)
- (ii) State **two** uses of radioactivity. (2 marks)

14. (a) Differentiate the following terms:

(i) ore; (1 $\frac{1}{2}$ marks)

(ii) metallurgy. (1 $\frac{1}{2}$ marks)

(b) The chart below, shows reactions between copper and other compounds. Study and use it to answer the questions that follow.



(i) Identify the following:

I. Gas P; (1 mark)

II. Reagent Q; (1 mark)

III. Solid R; (1 mark)

(ii) Write a chemical equation, to represent the reaction in step 5. (2 marks)

(iii) State the observations, made in step 4 and 7. (2 marks)

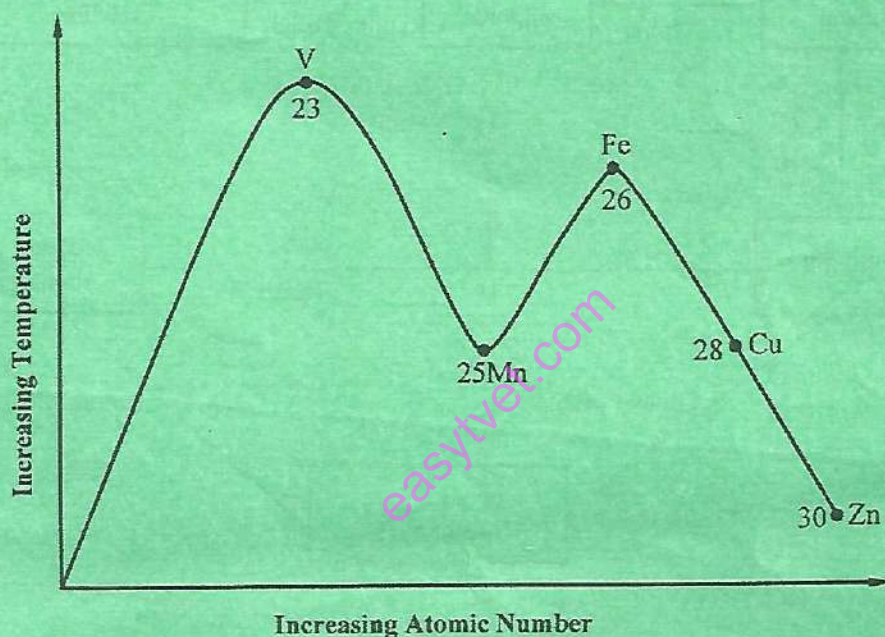
(iv) Bronze, is an alloy of copper and another metal:

I. name the other metal; (1 mark)

II. Give **one** use of bronze. (1 mark)

- (c) After extraction, impure copper can be purified via electrolysis:
- I. Write the equation that occurs at the cathode; (2 marks)
 - II. Explain why electrolysis is preferred to other methods of purification. (2 marks)
 - III. Give two uses of copper metal. (2 marks)

15. (a) The figure below, shows the trends of boiling points of transition metals of period 1.



- (i) Explain the shape of the graph; (9 marks)
 - (ii) Explain why transition elements have a variable oxidation state. (3 marks)
 - (iii) Explain why zinc, does not have an oxidation state more than +2. (3 marks)
- (b) Draw a well labelled diagram of a Geiger Muller counter. (5 marks)

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