

Name \_\_\_\_\_

SCA

Index No. \_\_\_\_\_

2411/303

ORGANIC CHEMISTRY

Oct./Nov. 2015

Time: 3 hours

Candidate's Signature \_\_\_\_\_

Date \_\_\_\_\_



THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN ANALYTICAL CHEMISTRY

ORGANIC CHEMISTRY

3 hours

**INSTRUCTIONS TO CANDIDATES**

Write your name and index number in the spaces provided above.

Sign and write the date of the examination in the spaces provided above.

You should have a scientific calculator (non-programmable) for this examination.

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 spaces provided in this question paper.

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.

Do **NOT** remove any pages from this booklet.

Candidates should answer the questions in English.

For Examiner's Use Only

**SECTION A**

Question	1	2	3	4	5	6	7	8	9	10	TOTAL SCORE
Candidate's Score											

**SECTION B**

Question	11	12	13	14	15	TOTAL SCORE	GRAND TOTAL
Candidate's Score							

This paper consists of 20 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 in the spaces provided after each question.

1. The boiling point of n-pentane and its isomer neopentane are  $36.2^{\circ}\text{C}$  and  $9.5^{\circ}\text{C}$  respectively. Account for these difference. (4 marks)

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2. Explain why mineral oil dissolves in n-hexane but not in water or ethyl alcohol. (4 marks)

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3. Dehydration of 1-butanol yields 2-butene rather than 1-butene. Account for this observation. (4 marks)

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4. (a) Outline the principle used to relate the mechanisms for dehydration of alcohols and hydration of alkenes. (2 marks)

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- (b) Give the conditions that favour dehydration rather than hydration reactions. (2 marks)

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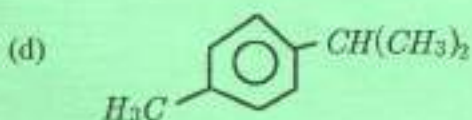
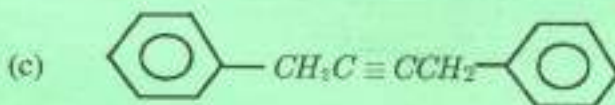
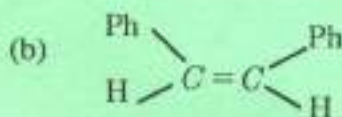
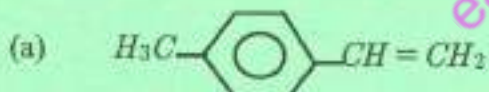
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5. Name the compounds below systematically: (4 marks)



6. A compound with molecular formula  $CH_3CHIC_2H_5$  is enantiomeric. Draw projections of the enantiomers corresponding to:

(a) Newman; (2 marks)

(b) Fischer. (2 marks)



7. Draw the structures of the following heterocyclic compounds:

(a) 1,3 diazine; (1 mark)

(b) 1,3 thiazole; (1 mark)

(c) 1,2 oxazole; (1 mark)

(d) Quinoline

(1 mark)

8. Describe a chemical test that can be used to distinguish between the following sets of compounds:

(a)  $\text{CH}_3\text{COCl}$  and  $(\text{CH}_3\text{CO})_2\text{O}$ ;

(2 marks)

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(b) Nitrobenzene and benzamide.

(2 marks)

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9. Define the following types polymer:

(a) Homopolymer;

(1 mark)

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\_\_\_\_\_

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(b) Thermosetting plastics;

(1 mark)

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(c) co-polymer,

(1 mark)

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(d) block co-polymer.

(1 mark)

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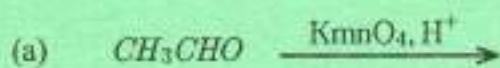
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10. Complete the reactions below and name the products systematically.



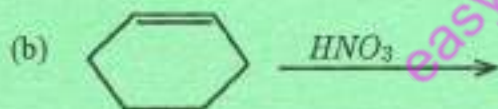
(2 marks)

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(2 marks)

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SECTION B (60 marks)



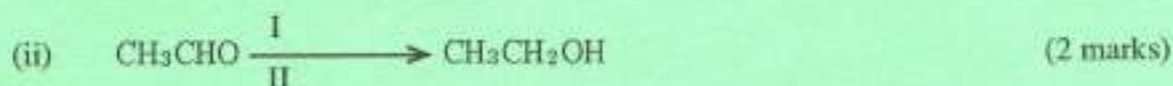
Answer any **THREE** questions from this Section in the spaces provided after question 15.

11. (a) (i) Draw all possible structural isomers with the molecular formula  $C_4H_9Br$ . (4 marks)
- (ii) Give the systematic names and classes of the isomers in (a) (i) above. (4 marks)
- (iii) Name the types of reaction taking place between the isomers in (a) (ii) above with ammonia. (1 mark)
- (iv) Identify, with a reason, the most reactive isomer from (a) (i) above. (2 marks)

(b) Propene reacts with bromine to yield 1,2 - dibromopropane.

- (i) Write the equation for the reaction. (1 mark)
- (ii) Name the mechanism for reaction in (b) (i) above. (1 mark)
- (iii) Outline the mechanism for the reaction in (b) (i) above (3 marks)

(c) Indicate the reagents and conditions necessary for the reactions below:

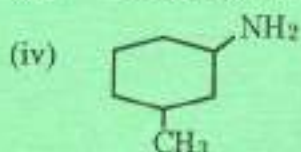
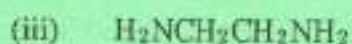


12. (a) Amines react with alkylhalides to yield a mixture of higher degree amines.

- (i) Name the type of reaction in (a) above. (1 mark)
- (ii) Write an equation for the reaction between ethylamine and excess methylchloride. (3 marks)
- (iii) Outline the mechanism for the reaction in (a) (ii) above. (4 marks)

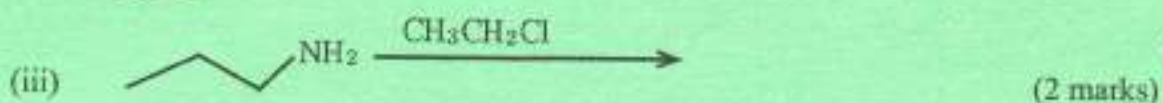
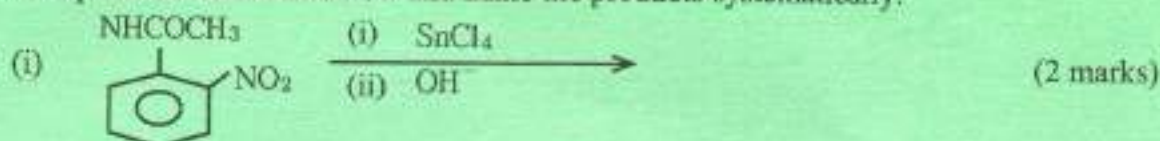
(b) Name and classify the following amines:

- (i)  $(CH_3)_3CNH_2$
- (ii)  $C_6H_5N(CH_3)_2$



(6 marks)

(c) Complete the reactions below and name the products systematically:



13. (a) Three compounds **P**, **Q** and **R** have the same molecular formula  $\text{C}_3\text{H}_6\text{O}$ . **P** is an alcohol, **Q** is an alkanone and **R** is an alkane.

(i) Draw the possible structural formulae for **P**, **Q** and **R**. (3 marks)

(ii) Describe chemical tests that can be used to show that:

I. **P** is an alcohol, while **Q** and **R** are not; (2 marks)

II. **Q** and **R** are carbonyl compounds while **P** is not; (2 marks)

III. **R** is an alkanol while **P** and **Q** are not. (3 marks)

(b) Account for the following physical properties of carboxylic acids:

(i) Only carboxylic acids with five or less carbon atoms are soluble in water, but many with six or more are soluble in alcohols. (4 marks)

(ii) Acetic acid in vapour form has a molecular weight of 120 and not 60. (2 marks)

(iii) The boiling point of carboxylic acids are higher than those of corresponding alcohols. (2 marks)

(iv) Explain why highly branched carboxylic acids are less acidic than linear acids. (2 marks)





14. (a) Explain the structure of benzene based on:

(i) resonance;

(2 marks)

(ii) the orbital picture.

(6 marks)

(b) Table I below shows the percentage yield of products of substitution of various alkylbenzenes. Study it and answer the questions that follow.

Table I

Reaction			
	% Yield		
R-Group	ORTHO	META	PARA
- CH <sub>3</sub>	45	8	45
- CH <sub>2</sub> CH <sub>3</sub>	40	9	50
- CH(CH <sub>3</sub> ) <sub>2</sub>	25	10	63
- C(CH <sub>3</sub> ) <sub>3</sub>	15	12	72

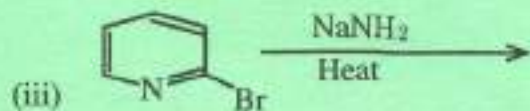
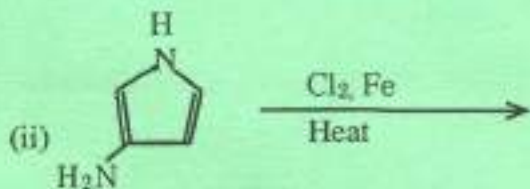
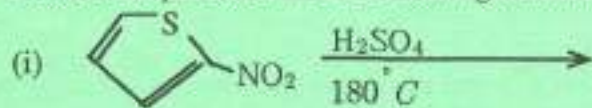
Explain the trend in the percentage yields of the isomeric products.

(4 marks)

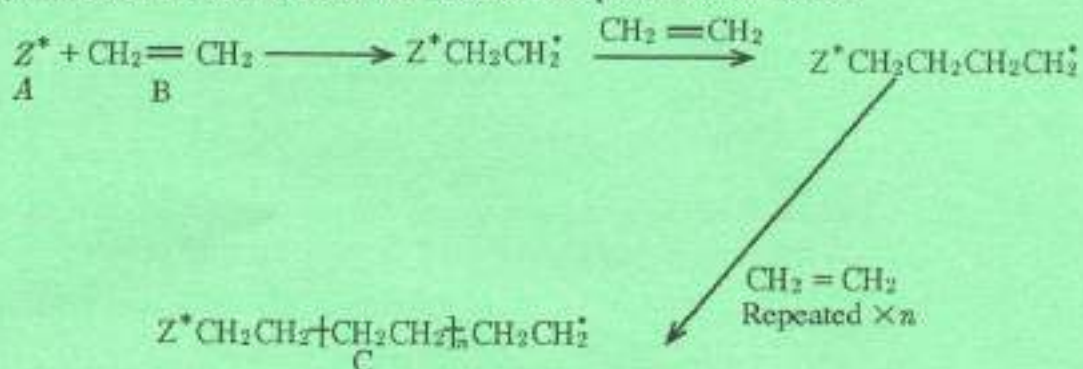
(c) Anthracene and phenanthrene are readily oxidised to quinones. Show the structures of the respective quinones and account for their formation.

(5 marks)

(d) Predict the products in the following reactions:



15. (a) Study the reaction scheme below and answer the questions that follow.



- (i) Identify the species labelled A and B in the scheme. (2 marks)
- (ii) Name the mechanism for the reaction illustrated in the scheme. (1 mark)
- (iii) Give the name of the compound labelled C. (1 mark)
- (iv) Give **two** ways by which the reaction in (a) above can be terminated. (2 marks)
- (b) A 1.5 g sample of an enantiomer is dissolved in ethanol to make 50 ml of solution. Determine the specific rotation at  $20^\circ$  for sodium light ( $\lambda = 589.3 \text{ nm}$ , the D line); if the solution has an observed rotation of  $+2.79$  in a 10 cm polarimetre tube. (4 marks)
- (c) Draw the structure of a meso alkane with the molecular formula  $C_8H_{18}$ . Name the compound systematically. (2 marks)
- (d) D- (+)-Glyceraldehyde is oxidised to (-) -glyceric acid. Give the D, L designation of the acid and explain. (4 marks)
- (e) Account for the following observations:
- (i) When (R) -2-butanol is allowed to stand in aqueous  $H_2SO_4$ , its optical activity disappears. (2 marks)
- (ii) Optical activity of (S) -2-iodobutane disappears if it is treated with aqueous potassium iodide (KI) solution. (2 marks)

