SIR ARTHUR LEWIS COMMUNITY COLLEGE

ACADEMIC YEAR (2024/2025) – SEMESTER ONE

END OF SEMESTER EXAMINATION

COURSE CODE	:	**CHM211**
COURSE TITLE	:	**Organic Chemistry**
LECTURER(S)	:	**Shirniah Emmanuel, Jolie Pistol**
DATE	:	**10th December 2024**
TIME	:	**1 p.m. – 3 p.m.**
DURATION	:	**2 Hours**
STUDENT ID #	:	_____

GENERAL INFORMATION AND INSTRUCTIONS

- Students must sign **IN** and **OUT** on the examination class list.
- Write your ID number on the question paper.
- For Section A, shade the letter corresponding with the correct answer on the ANSWER SHEET provided. For Section B, write your answer in the spaces provided on your QUESTION paper.
- Answer ALL questions.
- Use of pocket electronic calculators is permitted.

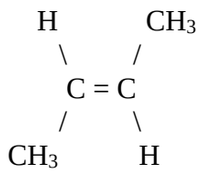
Section	Marks Earned	Maximum Marks
A		**60**
B		**40**
Total		**100**

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO

SECTION A

Instructions: Read each question carefully then select the most appropriate answer. Shade the corresponding letter (a), (b), (c) or (d) to the answer on the **ANSWER SHEET** provided.

1. Which of the following statements are true about the following molecule?



I. It displays geometric isomerism.
II. The isomers have different physical properties.
III. The -CH_3 groups are free to rotate about the double bond.
IV. The isomers have different spatial arrangement of atoms.

a) I and II only
b) II and III only
c) Il and IV only
d) I, II, and IV only

2. Lactic acid, $CH_3CH(OH)CO_2H$, exists in sour milk, and it also causes fatigue in muscles. Which of the following statements are true about this molecule?
I. It has two optical isomers.
II. It has two chiral carbons.
III. There is no plane, axis, or centre of symmetry.
IV. The optical isomers are mirror images of each other.

a) I and II only
b) Il and III only
c) II and IV only
d) I, III, and IV only

3. Optical isomerism exists in molecules which

a) have a double bond.
b) have a plane of symmetry.
c) have at least one asymmetric carbon atom.
d) are linked together in different bonding orders.

4. How many isomers does $C_2H_2Br_2$ have?

a) 2
b) 3
c) 4
d) 5

5. An important reaction of alkanes is combustion. Alkanes burn to form carbon dioxide and water. Which of the following statements are true?
I. The reaction is exothermic.
II.The alkane C_8H_{18} is burnt in the internal combustion engine.
III. Incomplete combustion of alkanes produces carbon monoxide.
IV. The reaction is endothermic.

a) I only
b) I and II only
c) I, II, and III only
d) I, I, II, and IV

6. Which of the following statements are true about the reaction of methane with chlorine?
I. It occurs in the presence of sunlight.
II. The products are CH_3Cl and HCl
III. Ethane, C_2H_6 can also be formed in the reaction.
IV. Further substitution may give CH_2Cl_2, $CHCl_3$ and CCI_4

a) I and II only
b) I and IV only
c) I, II, and III only
d) I, II, III, and IV

7. Which of the following statements are true about a homologous series?
I. They all have the same molecular formula.
II. They have the same functional group.
III. They have different chemical properties.
IV. Each member differs from its nearest neighbour by a unit -CH_2.
a) I and II only
b) I and III only
c) II and IV only
d) III and IV only

8. The reaction mechanism in the halogenation of methane is
a) nucleophilic substitution
b) free radical substitution
c) electrophilic substitution
d) electrophilic addition

9. When ethene is bubbled through bromine in an organic solvent, which of the following occur?
I. HBr gas is produced.
II. The bromine is decolourised.
III. The product is 2-bromoethanol.
IV. The product is 1,2-dibromoethane.
a) I and II only
b) II and III only
c) II and IV only
d) I, II, and IV only

10. When ethene is bubbled into cold acidified potassium manganate (VII) solution, which of the following occur?
I. Ethene is oxidised.
II. The product is ethane-1,2-diol.
III. The colour changes from colourless to purple.
IV. The oxidation state of manganese goes from +2 to +7.
a) I and II only
b) I and III only
c) II and IV only
d) III and IV only

11. Which of the following names of halogenoalkanes are correctly matched?

	Halogenoalkane	Name
l	CH_3CHCl_2	1,1-Dichloroethane
ll	CH_2ClCH_2Cl	1,2-Dichloroethane
lll	$CH_3CH_2CH(Cl)CH_3$	3-Chlorobutane
lV	$CHCl_3$	Trichloromethane

a) I and II only
b) I, II, and IV only
c) II, III, and IV only
d) I, II, III, and IV

12. In the cracking of large alkanes, the products may include alkanes, alkenes, and hydrogen. Which of the following is a balanced equation for the cracking of $C_{12}H_{26}$?
a) $C_{12}H_{26} \rightarrow C_6H_{14} + C_7H_{12}$
b) $C_{12}H_{26} \rightarrow C_8H_{18} + C_4H_{10}$

c) $C_{12}H_{26} \rightarrow C_{10}H_{22} + C_2H_4$
d) $C_{12}H_{26} \rightarrow C_9H_{20} + C_3H_6 + H_2$

13. When hydrogen bromide reacts with ethene,
a) bromoethane, CH_3CH_2Br, is formed.
b) the product is 1,2-dibromoethane.
c) the double bond is not affected.
d) the reaction is an oxidation.

14. The mechanism for the reaction of bromine with ethene is
a) electrophilic addition
b) nucleophilic addition
c) electrophilic substitution
d) nucleophilic substitution

15. The intermediates formed in the reaction of hydrogen bromide with ethene in an organic solvent comprise the following:
a) A bromide ion and a carbocation
b) A bromonium ion and a carbocation
c) A bromide ion and a bromonium ion
d) A bromonium ion and a hydroxide ion

16. Butan-2-ol, $CH_3CH_2CH(OH)CH_3$ can display
I. chain isomerism
II. optical isomerism
III. cis-trans isomerism
IV. positional isomerism
a) I and II only
b) I and IV only
c) II and III only
d) I, II, and IV only

17. The correct name of the compound with the formula $CH_3CH_2COCH_2CH_3$ is
a) pentanal
b) pentan-3-ol
c) pentan-3-one
d) ethyl propanoate

18. Alcohols are oxidised by acidified potassium permanganate. Which of the following statements are true?
I. The colour change is purple to colourless.
II. Primary alcohols are oxidised to carboxylic acids.
III. Secondary alcohols are oxidised to aldehydes.
IV.Tertiary alcohols are oxidised to ketones.

a) I and II only
b) I, II, and III only
c) I, II, and IV only
d) I, II, III, and IV

19. Ethanol is oxidised by acidified potassium dichromate (VI). Which of the following is true?
a) The colour change observed is green to orange.
b) The colour change observed is orange to green.
c) The oxidation number of chromium changes from +3 to +6.
d) Ethanol is oxidised directly to ethanoic acid at room temperature.

20. Ethanol reacts with butanoic acid in the presence of heat and concentrated sulphuric acid to give

a) butyl ethanoate
b) butyl propanoate
c) ethyl propanoate
d) ethyl butanoate

21. Butan-2-ol reacts with concentrated sulphuric acid at 170 °C. Which of the following statements are true?
I. But-1-ene is formed.
II. But-2-ene is formed.
III. The reaction is oxidation.

a) I and II only
b) I and III only
c) II and III only
d) I, II, and III

22. Which of the following statements are true of the reaction of a tertiary halogenoalkane with aqueous sodium hydroxide?
I. An alcohol is formed.
II. The reaction is hydrolysis.
III. A carbocation is formed in the transition state.

a) I and II only
b) I and III only
c) II and III only
d) I, II, and III

23. Which of the following alcohols would give a positive iodoform test?
I. CH_3CH_2OH
II. $CH_3CH_2CH_2OH$
III. $CH_3CH(OH)CH_3$
IV. $CH_3CH(OH)C_2H_5$

a) I only
b) I, II, and III only
c) I, III, and IV only
d) I, II, III, and IV

24. Which of the following statements are true of the reaction of pentanal with 2,4-dinitrophenylhydrazine?
I. Pentanal is hydrolysed
II. It is a condensation reaction.
III. An orange precipitate is formed.
IV. Pentanal 2,4-dinitrophenylhydrazone is formed.

a) I and II only
b) II and III only
c) III and IV only
d) II, III, and IV only

25. Which of the following is true of the reaction of propanone with HCN?

a) The CN^- ion is the nucleophile.
b) An orange precipitate is formed.
c) The mechanism for the reaction is nucleophilic substitution.
d) The product is oxidised to a carboxylic acid using acidified $KMnO_4$

26. Aldehydes react with acidified potassium manganate (VII). Which of the following statements are true?
I. The aldehyde is reduced.
II. A carboxylic acid is formed.
III. The colour change is purple to colourless.

a) I and II only
b) I and III only
c) II and III only
d) I, II, and III

27. The name of the compound with the formula $C_3(CH_2)_3CHO$ is
a) butanal
b) pentanal
c) pentanol
d) pentanone

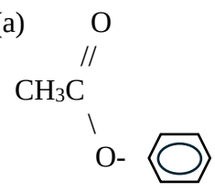
28. Tollens reagent is a complex containing $[Ag(NH_3)_2]^+$ ions in an alkaline solution. Which of the following statements is true?
a) It oxidises both aldehydes and ketones.
b) It gives a silver mirror with aldehydes.
c) It gives a silver mirror with ketones.
d) The product formed is a silver salt.

29. Aldehydes and ketones react with tetrahydridoaluminate ($LiAH_4$). Which of the following statements is correct?
a) $LiAlH_4$ is an oxidising agent.
b) $LiAlH_4$ is a dehydrating agent.
c) Aldehydes are reduced to carboxylic acids.
d) Ketones are reduced to secondary alcohols.

30. Fehling's solution contains complexed Cu^{2+} ions in an alkaline solution. Which of the following statements is true?
a) Ketones reduce Fehling's solution.
b) Fehling's solution is a reducing agent.
c) This reagent cannot distinguish between aldehydes and ketones.
d) Aldehydes form a brick red precipitate of copper (I) oxide with Fehling's solution.

31. Compound X behaves in the following ways:
- It gives an orange precipitate with 2,4-dinitrophenylhydrazine.
- It does not give a brick-red precipitate with Fehling's reagent.
- It gives a positive iodoform reaction.

Compound X is most likely to be

(a)


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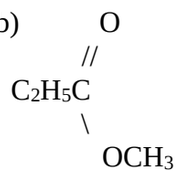

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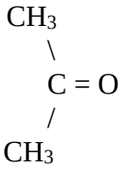

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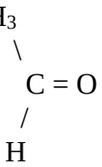


32. Esters are hydrolysed using either an acid or a base. Which of the following statements are correct?
I. The reaction is reversible in base hydrolysis.
II. The reaction is not reversible in acid hydrolysis.
III. A carboxylic acid and an alcohol are formed in acid hydrolysis.
IV. A salt of the carboxylic acid and an alcohol are formed in base hydrolysis.

a) I and II only
b) II and III only
c) III and IV only
d) II, III, and IV only

33. When methylbenzene reacts with Br, in the presence of a halogen carrier at room temperature, where does substitution of the bromine occur?

a) On the methyl group
b) On carbon number 3 of the benzene ring
c) On carbon number 2 or 4 of the benzene ring
d) On carbon number 2 and 4 of the benzene ring

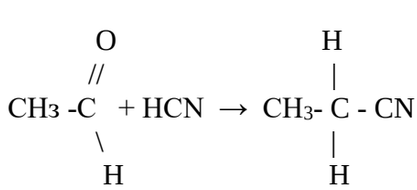
34. In the conversion of ethanoic acid to ethanoyl chloride, CH_3COCl, which of the following reagents could be used?
I. HCI
II. PCI_3
III. PCl_5
IV. $SOCl_2$

a) I only
b) I, II, and III only
c) II, III, and IV only
d) I, II, III, and IV

35. Which of the following statements are correct for the reaction of hydrogen with aldehydes and ketones?
I. Aldehydes are oxidised to primary alcohols.
II. Ketones are reduced to secondary alcohols.
III. The reaction occurs at room temperature.
IV. A catalyst is required.

a) I and II only
b) II and III.only
c) II and IV only
d) I, III, and IV only

36. Ethanal undergoes the reaction shown below.



Which of the following are true?
I. The reaction is nucleophilic addition.
II. The carbon chain increases by one in ethanal.
III. The final product is 2-hydroxypropanoic acid.

a) I and II only
b) I and III only
c) II and III only
d) I, II, and III

37. Which of the following is **not** true about the reaction of ethanoic acid with sodium hydrogencarbonate?

a) Rapid effervescence is observed.
b) The products are ethyl ethanoate, carbon dioxide, and water.
c) The products are sodium ethanoate, carbon dioxide, and water.
d) It distinguishes carboxylic acids from weaker acids such as phenols.

38. Propanoic acid reacts with thionyl chloride ($SOCl_2$) to form

a) propanoyl chloride and sulphur dioxide.
b) propanoyl chloride and hydrogen chloride.
c) propanoyl chloride, hydrogen chloride, and water.
d) propanoyl chloride, hydrogen chloride, and sulphur dioxide.

39. In the nitration of methylbenzene, which of the following statements are correct?
I. NO_2^+ is substituted on the carbon 3 of the aromatic ring at 50°C.
II. NO_2^+ is substituted on the carbon 2 or carbon 4 of the aromatic ring at 30°C.
III. NO_2^+ is generated by mixing conc. HNO_3 and conc. H_2SO_4

a) I and II only
b) I and III only
c) II and III only
d) I, II, and III

40. The reaction for the conversion of nitrobenzene to phenylamine is

a) reduction
b) oxidation
c) hydration
d) Hydrolysis

41. Which of the following statements is **not** true about phenol?

a) It is more acidic than ethanol.
b) It reacts with acid halides to form esters.
c) It reacts with $NaOH_{(aq)}$ to form salt and water.
d) It is more acidic than ethanoic acid.

42. Which of the following industries use azo compounds?
I. Food
II. Paint
III. Clothing
IV. Cosmetics

a) I and III only
b) I, II, and III only
c) II, III, and IV only
d) I, II, III, and IV

43. In the laboratory, nitrobenzene, $C_6H_5NO_2$ is reduced to phenylamine, $C_6H_5NH_2$. The reducing agent used is

a) tin and dilute hydrochloric acid.
b) tin and concentrated hydrochloric acid.
c) concentrated hydrochloric acid and a halogen carrier.
d) concentrated nitric acid and concentrated hydrochloric acid.

44. Which compound would give up a hydrogen ion most readily?

	Compound	pK_a
a	CH_3COOH	4.76
b	C_2H_5COOH	4.88
c	$CH_2ClCOOH$	2.86
d	$CHCl_2COOH$	1.29

45. Which of the following statements are true when bromine reacts with benzene at room temperature?
I. A halogen-carrier is used.
II.Bromobenzene and hydrogen bromide are formed.
III. The reaction mechanism is electrophilic aromatic substitution.

a) I and II only
b) I and III only
c) II and III only
d) I, II, and III

46. Which of the following statements are true of the nitration of benzene?
a) NO_2^+ acts as an electrophile
b) NO_2^+ acts as a nucleophile
c) The reaction mechanism is a nucleophilic substitution
d) The reaction mechanism is an electrophilic addition

47. Which of the following statements is true?

a) Ethanol is more acidic than phenol.
b) Phenol is more acidic than ethanoic acid.
c) Chloroethanoic acid is less acidic than ethanoic acid.
d) Dichloroethanoic acid is less acidic than trichloroethanoic acid.

48. The pKa values of ethanoic acid, phenol, and ethanol are 4.76, 10, and 16, respectively. Which of the following statements are true?
I. Ethanoic acid is the strongest acid because it has the lowest pKa.
II. Ethanol is the strongest acid because it has the highest pKa.
II. Phenol will donate a proton more readily than ethanol.

a) I only
b) II only
c) I and III only
d) II and III only

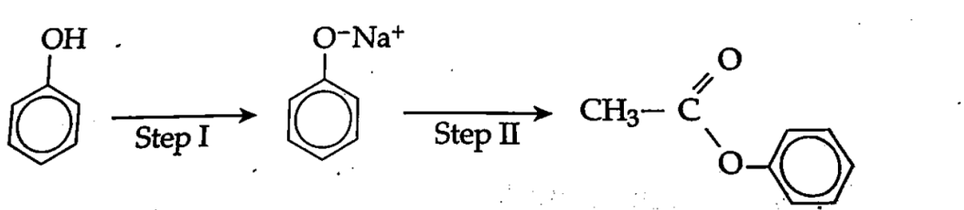
49. Which of the following is **not** true about proteins?

a) They occur naturally.
b) Monomers are joined by ester linkages.
c) They are formed from condensation polymerisation.
d) Each protein has a different sequence of amino acids.

50. Primary amines are

a) acidic
b) basic
c) amphoteric
d) Neutral

51. The following chain reaction is used for the esterification of phenol.



Which of the following are true about the reaction?
I. The reagent for step I is aqueous sodium hydroxide.
II. The reagent for step II is ethanoyl chloride.
III. Both step I and step II occur at room temperature.

a) I and II only
b) I and III only
c) II and III only
d) I, II, and III

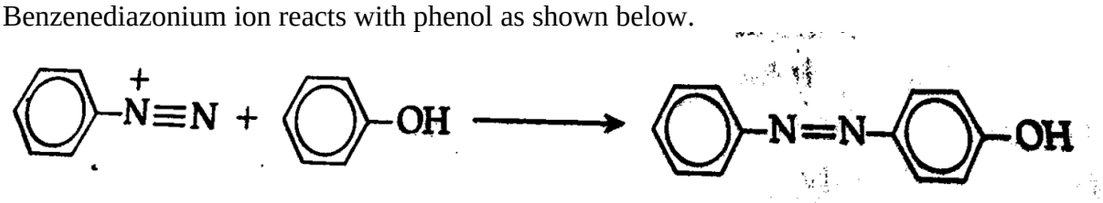
52. Which of the following statements are true about the reaction of phenol with ethanoyl chloride, CH_3COCI?
I. The reaction is faster when phenol is converted to sodium phenoxide.
II. Phenyl ethanoate and sodium chloride are formed.
III. It is an esterification reaction.

a) I and II only
b) I and III only
c) II and III only
d) I, II, and III

53. Which of the following are true about azo compounds?
I. They can be formed by the coupling reaction.
II. An N=N is formed between the two aromatic rings.
III.The N=N group is responsible for the colour of azo compounds.

a) I and II only
b) I and III only
c) II and III only
d) I, II, and III

54. Benzenediazonium ion reacts with phenol as shown below.



Which of the following are true about the reaction?
I.The product is an azo dye.
II. The reaction is known as a coupling reaction.
III. The benzenediazonium ion is an electrophile.
IV. Benzenediazonium ion attacks phenol at the third carbon on the aromatic ring.

a) I and II only
b) II and III only
c) I, II, and III only
d) I, II, and IV only

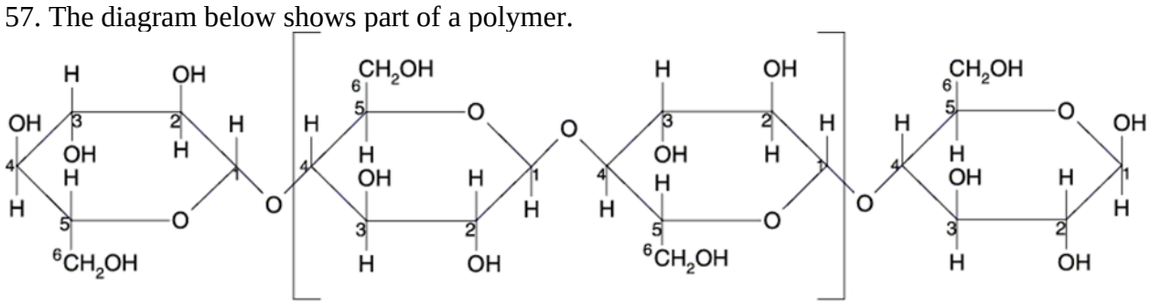
55. Starch consists of glucose molecules which are linked by

a) β-1,4 glycosidic bonds
b) α-1,4 glycosidic bonds
c) α-1,6 glycosidic bonds and β-1,4 glycosidic bonds
d) α-1,4 glycosidic bonds and α-1,6 glycosidic bonds

56. Polyvinylchloride (PVC) is produced from chloroethene monomers. The repeat unit for PVC is

a) $(-CH_2-)$
b) $(-CCl_2-)$
c) (-CHCI-)
d) $(-CH_2-CHCI-)$

57. The diagram below shows part of a polymer.



The structure represents which of the following?

a) Polyester
b) Cellulose
c) Starch
d) Pectin

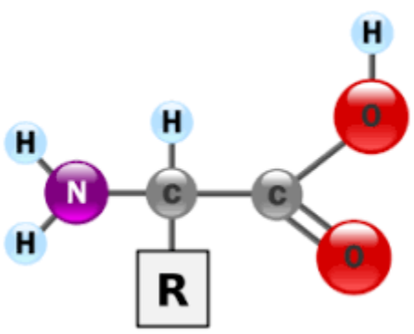
58. Cellulose consists of glucose molecules which are linked by

a) β-1,4 glycosidic bonds
b) α-1,4 glycosidic bonds
c) α-1,6 glycosidic bonds and β-1,4 glycosidic bonds
d) α-1,4 glycosidic bonds and α-1,6 glycosidic bonds

59. Chloroethene, $CHCI=CH_2$ is a monomer used in the production of a polymer. Which of the following are true about the polymer?
I. The polymer is called PVC.
II. The product is a condensation polymer.
III. The repeat unit is $[-CHCI-CH_2-]$

a) I and II only
b) I and III only
c) Il and III only
d) I, II, and III only

60. Amino acids have the general formula as shown below.

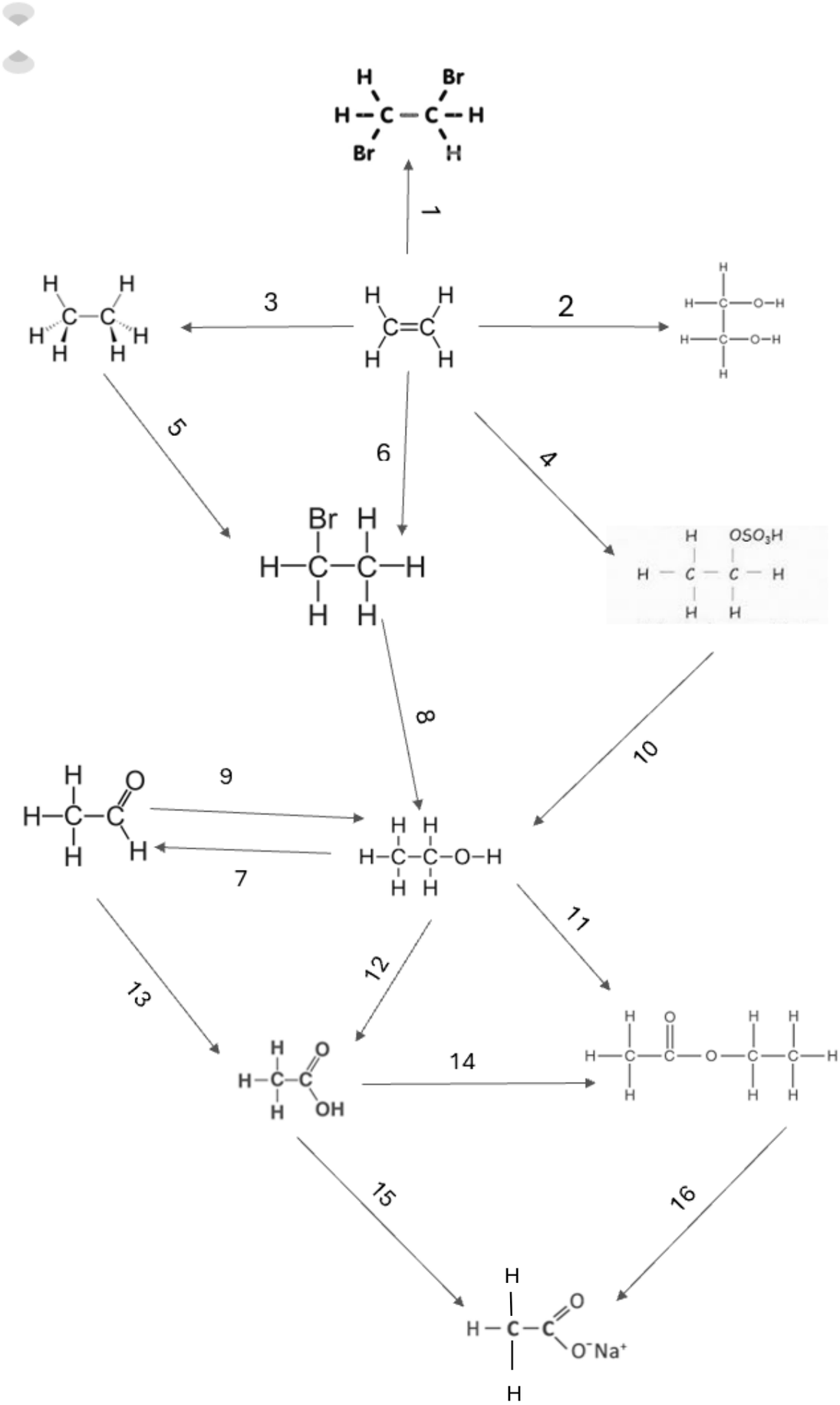


Which of the following are true?
I. The molecule has two functional groups.
II.They exist as dipolar ions in aqueous solution.
III. Crystalline amino acids have high melting points.

a) I and II only
b) I and III only
c) II and III only
d) I, II, and III

SECTION B

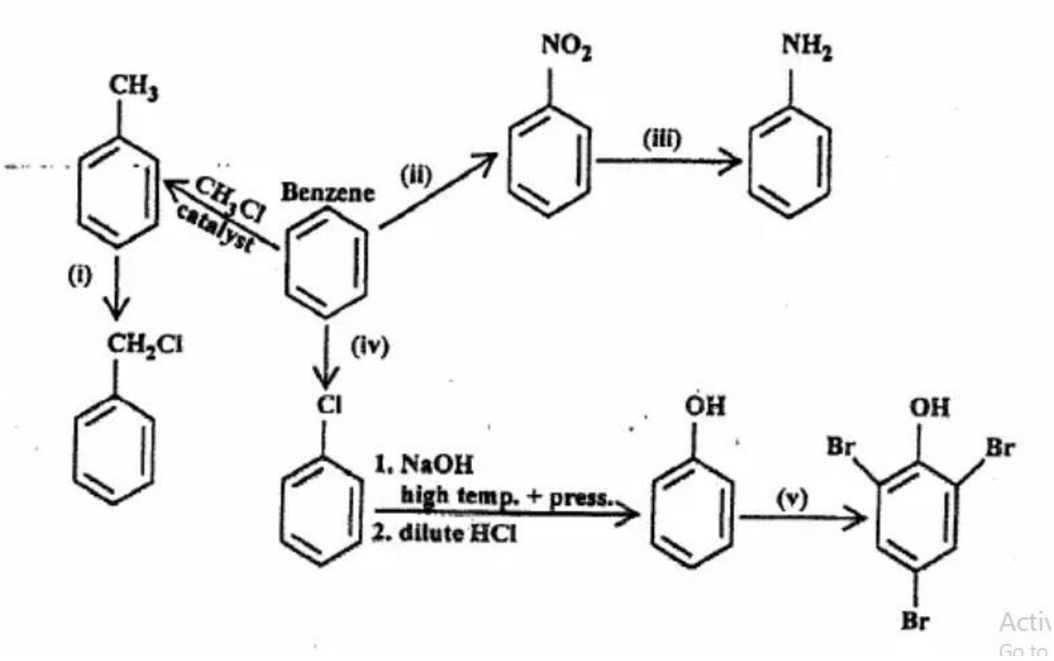
Instructions: Read carefully and answer all questions in this section.
Carefully observe the summary of reactions below and fill in the table on the next page.



A. Fill in the missing reagents and conditions where necessary.

	REAGENT AND/OR REACTANT	CONDITION	TYPE OF REACTION
1		[redacted]	
2		Oxidizing agent must be cold	Oxidation
3	Hydrogen gas/ H_2		
4			
5			
6	Hydrogen bromide / HBr	[redacted]	
7	Acidified Potassium dichromate		
8		[redacted]	
9		[redacted]	
10			[redacted]
11		Under reflux	
12		• excess oxidizing agent • under reflux	
13			
14	Ethanol		
15	Sodium hydroxide/ NaOH	[redacted]	Acid base/ neutralization reaction
16		Heat	

B.



I) Identify reagents i, ii, iii, iv and v.

_____

_____

_____

_____

(5 marks)

II) Phenylamine reacts with nitrous acid in the presence of hydrochloric acid to form a diazonium salt. This process is called diazotization. What is the general formula for diazonium salts?

_____

(1 mark)

END OF EXAM