



SIR ARTHUR LEWIS COMMUNITY COLLEGE
ACADEMIC YEAR (2024/2025) – SEMESTER TWO
END OF SEMESTER EXAMINATION

COURSE CODE : CHM217
COURSE TITLE : Organic Chemistry II
LECTURER(S) : Leralyn Hunte-Marty
DATE : April 30, 2025
TIME : 1 p.m.
DURATION : Two Hours
STUDENT ID # : _____

GENERAL INFORMATION AND INSTRUCTIONS

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. Write your student's ID number on the question paper.
2. This is a Two-hour examination consisting of TWO Sections and a Periodic Table
3. SECTION 1 consists of 45 multiple-choice questions. CIRCLE the correct answer on your question paper.
4. SECTION 2 consists of 3 compulsory structured questions. Answer the question on the question paper.
5. Write in dark blue or black pen and answer ALL questions for each section in the SPACES provided
6. Draw structural and displayed formulae using a blue or black pen
7. Do not use correction fluid.

Section	Number	Marks Earned	Moderated Mark	Maximum Marks
Section A Multiple Choice	1-45			45 marks
Section B Structured Questions	1			16 marks
	2			14 marks
	3			10 marks
	Total			80 marks

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

SECTION A – MULTIPLE CHOICE

Instruction: Circle the letter that corresponds to the correct answer for each question.

- Homolytic fission of C–C bond leads to the formation of:
 - Free radicals
 - Carbonium ions
 - Carbanions
 - None of these
- The order of stability of carbonium ions is
 - tertiary > secondary > primary
 - secondary > tertiary > primary
 - primary > secondary > tertiary
 - primary > tertiary > secondary
- The order of stability of carbanions is
 - primary > secondary > tertiary
 - secondary > tertiary > primary
 - tertiary > secondary > primary
 - tertiary > primary > secondary
- Which of the following species shows resonance?
 - NH₃
 - NO₃⁻
 - CH₄
 - H₂O
- Which of the following statements is TRUE about resonance?
 - Resonance structures interconvert rapidly
 - Resonance structures exist independently
 - The actual molecule is an average of all resonance structures
 - More resonance structures decrease stability
- Which of the following is the best resonance contributor for the acetate ion (CH₃COO⁻)?
 - A structure with a negative charge localized on one oxygen
 - A structure with the negative charge equally distributed between both oxygens
 - A structure with a positive charge on carbon
 - A structure without π -bonds
- Which of the following compounds has the most significant resonance stabilization?
 - Ethene
 - Cyclohexane
 - Benzene
 - Ethane
- Resonance in organic chemistry refers to:
 - The movement of atoms within a molecule
 - The delocalization of electrons within a molecule
 - The rotation of single bonds
 - The breaking of a π -bond
- Which of the following is NOT a valid rule for drawing resonance structures?
 - Lone pairs can be converted into π -bonds
 - Charges must be conserved
 - π -bonds can be shifted to adjacent atoms
 - σ -bonds can be broken and rearranged

10. Which of the following is true for diastereomers?
- A. They have identical physical properties
 - B. They are mirror images of each other
 - C. They are optically active but not mirror images
 - D. They cannot exist in nature
11. How many stereoisomers can a molecule with two chiral centers be possible?
- A. 2
 - B. 3
 - C. 4
 - D. 6
12. The specific rotation of a pure enantiomer is $+20^\circ$. What would be the specific rotation of the opposite enantiomer?
- A. -20°
 - B. $+40^\circ$
 - C. $+20^\circ$
 - D. 0°
13. Which property distinguishes enantiomers from each other?
- A. Boiling point
 - B. Density
 - C. Optical rotation
 - D. Molecular weight
14. What is the optical rotation of a racemic mixture?
- A. Zero
 - B. Positive
 - C. Negative
 - D. D) Unpredictable
15. If a molecule has an enantiomer, it must be:
- A. Achiral
 - B. Chiral
 - C. Optically inactive
 - D. Symmetrical
16. Which conditions must be met for a molecule to be optically active?
- A. It must have a double bond
 - B. It must have a plane of symmetry
 - C. It must lack a plane of symmetry and have a chiral center
 - D. It must be a cyclic compound
17. Which of the following molecules is chiral?
- A. 2-Butanol
 - B. 2-Propanol
 - C. Benzene
 - D. Acetone
18. The term "optical activity" refers to the ability of a compound to:
- A. Rotate plane-polarized light
 - B. Absorb ultraviolet light
 - C. Emit fluorescence
 - D. React with acids and bases
19. A molecule that rotates plane-polarized light to the right (clockwise) is called:
- A. Levorotatory (-)
 - B. Dextrorotatory (+)
 - C. Racemic
 - D. Achiral

20. Which of the following types of strain is associated with an eclipsed conformation in a Newman projection?
- Angle strain
 - Ring strain
 - Steric strain
 - Torsional strain
21. In a Newman projection of ethane, when the hydrogens on the front and rear carbon atoms are in the eclipsed position, what is the energy state of the molecule?
- Low energy
 - High energy
 - No energy difference between staggered and eclipsed
 - Stable energy state with no strain
22. Which of the following is the most stable conformation in a Newman projection for butane (C_4H_{10})?
- Staggered conformation
 - Eclipsed conformation
 - Antiperiplanar conformation
 - Chair conformation
23. Which of the following is true about the relationship between a compound's R and S configurations?
- R and S configurations are diastereomers, not enantiomers.
 - R and S configurations are identical and are non-enantiomers.
 - R and S configurations have the same physical properties.
 - R and S configurations are mirror images of each other and are enantiomers.
24. In the R and S nomenclature, how do you determine the priority of substituents at a chiral center?
- The priority is determined by the bond angle around the chiral center.
 - The size of the molecule determines priority.
 - Priority is determined by the atomic number of the first atom directly attached to the chiral center.
 - Priority is determined by the type of bonds involved (single, double, or triple).
25. Which of the following correctly describes the "Z" configuration in the E-Z system?
- The highest priority groups are on opposite sides of the double bond.
 - The highest-priority groups are on the same side of the double bond.
 - The molecule is non-polar.
 - The molecule is chiral.
26. Which compounds would not show cis-trans isomerism due to its molecular structure?
- 2-butene
 - 1,2-dichloroethene
 - Propene
 - 1-chloropropene
27. How are the substituents' priorities on each double bond carbon determined in the E-Z nomenclature?
- By the atomic number of the atoms attached to each carbon
 - By the molecular weight of the compound
 - By the position of the atoms in the periodic table
 - By the number of carbon atoms attached to the double bond
28. Which is defined as a species that accepts a proton?
- Lewis acid
 - Lewis base
 - Bronsted-Lowry acid
 - Bronsted-Lowry base

29. In the addition of HX to a double bond, the hydrogen goes to the carbon that already has more hydrogens is a statement of
- Hund's rule
 - Markovnikov's rule
 - Huckel rule
 - Saytzeff rule
30. Which of the following alkenes reacts with HBr in the presence of a peroxide to give anti-Markovnikov's product?
- 1-Butene
 - 2,3-Dimethyl-2-butene
 - 2-Butene
 - 3-Hexene
31. Which factor increases the likelihood of a Hoffmann elimination product in an E2 reaction?
- A bulky base
 - A weak base
 - A carbocation intermediate
 - A polar protic solvent
32. Which of the following will undergo E2 reaction the fastest?
- 1-Bromopropane
 - 2-Bromobutane
 - 2-Iodobutane
 - 3-Bromo-2, 2-dimethylpropane
33. Which of the following factors does NOT favor E1 over E2?
- A weak base
 - A strong base
 - A tertiary carbocation
 - A polar protic solvent
34. What is the key intermediate in an E1 reaction?
- Carbanion
 - Carbocation
 - Radical
 - Transition state
35. Which of the following correctly describes Zaitsev's rule?
- The least substituted alkene is the major product
 - The most electronegative atom stabilizes the charge.
 - The least stable carbocation is preferred
 - The most substituted alkene is the major product
36. The rate of an E2 reaction depends on:
- Only the substrate concentration
 - Only the base concentration
 - Both substrate and base concentration
 - Neither substrate nor base concentration
37. Which of the following best describes the rate law for an E1 reaction?
- Rate = $k[\text{substrate}]$
 - Rate = $k[\text{base}]$
 - Rate = $k[\text{substrate}][\text{base}]$
 - Rate = $k[\text{alkyl halide}][\text{solvent}]$
38. Which of the following compounds undergo E1 elimination most readily?
- 1-Bromobutane
 - 2-Bromo-2-methylpropane
 - 1-Chloropropane
 - 2-Fluorobutane

39. Which of the following is the general reaction for forming a Grignard reagent?
- A. $\text{R-X} + \text{Mg} \rightarrow \text{R-MgX}$
 - B. $\text{R-X} + \text{Li} \rightarrow \text{R-Li} + \text{LiX}$
 - C. $\text{R-X} + \text{Na} \rightarrow \text{R-Na} + \text{NaX}$
 - D. $\text{R-MgX} + \text{H}_2\text{O} \rightarrow \text{R-H} + \text{Mg(OH)X}$
40. Which solvent is typically used to stabilize Grignard reagents?
- A. Water
 - B. Acetone
 - C. Diethyl ether
 - D. Methanol
41. Which halide is most reactive in forming organolithium and Grignard reagents?
- A. Alkyl fluoride
 - B. Alkyl chloride
 - C. Alkyl bromide
 - D. Alkyl iodide
42. What distinguishes the reactivity of vinyl halides from alkyl halides when forming Grignard reagents?
- A. Vinyl halides react faster due to resonance stabilization
 - B. Vinyl halides are less reactive due to partial double bond character
 - C. Alkyl halides are unreactive compared to vinyl halides
 - D. Both react equally
43. A student wants to prepare an organolithium reagent using 1-bromopropane. Which metal and solvent combination would be the best choice?
- A. Magnesium in water
 - B. Lithium in hexane
 - C. Sodium in ethanol
 - D. Magnesium in acetone
44. Why do **S_N2 reactions** not proceed well with tertiary alkyl halides?
- A. Steric hindrance blocks backside attack
 - B. Carbocations are too stable
 - C. The nucleophile is too weak
 - D. The reaction requires a polar protic solvent
45. Which of the following factors would most significantly affect the rate of an **S_N1 reaction**?
- A. Strength of the nucleophile
 - B. Stability of the carbocation
 - C. Bulkiness of the nucleophile
 - D. Polarity of the solvent

SECTION B

Instruction: Answer ALL questions in the spaces provided.

Question 1

A carbanion is a highly reactive species that plays a crucial role in various organic reactions, including nucleophilic substitution (SN2), elimination (E2), alkylation, and conjugate addition. Carbanions are commonly encountered as intermediates in reactions such as the Grignard reactions, where their ability to donate electrons facilitates the formation of new carbon-carbon bonds.

a) What is a carbanion? [1mark]

b) What is the general structure of a carbanion? [1 mark]

c) Using an equation, explain the formation of carbanion [2 marks]

d) Discuss three factors that influence the stability of a carbanion. [6 marks]

e) Predict the most stable carbanion and explain why. [2 marks]

- i. CH_3^-
- ii. $\text{CH}_2=\text{CH}^-$
- iii. $\text{CH}\equiv\text{C}^-$

f) Rank the following carbanions in order of decreasing stability and justify your ranking: [4 marks]

- i. Benzyl carbanion ($\text{C}_6\text{H}_5\text{CH}_2^-$)
- ii. Allyl carbanion ($\text{CH}_2=\text{CH}-\text{CH}_2^-$)
- iii. Ethyl carbanion (CH_3CH_2^-)

Total 16 marks

Question 2

- a) What is an elimination reaction? [1 mark]
- b) What are the two major types of elimination reactions? [2 marks]
- c) How do E1 and E2 mechanisms differ regarding reaction steps? [2 marks]
- d) Given the following reaction conditions, predict whether the mechanism will be E1 or E2:
 $\text{CH}_3\text{CHBrCH}_3 + \text{NaOH}$ (ethanol, heat) [2 marks]
- e) Rank the following compounds in order of their likelihood to undergo an E1 reaction and explain ranking: [4 marks]
- i. 1-Bromopropane
 - ii. 2-Bromo-2-methylpropane
 - iii. 2-Bromobutane
- f) In an experiment, a tertiary alkyl halide undergoes elimination in water, producing both E1 and SN1 products. Explain why both occur. [3marks]

Total 14 marks

Question 3

- a) Define a Grignard reagent and provide a general equation for its formation. **[2 marks]**
- b) Explain why aryl and vinyl halides are less reactive than alkyl halides in forming Grignard reagents. **[3 marks]**
- c) Given a tertiary alcohol and HBr, predict whether the reaction will proceed through an S_N1 or S_N2 mechanism. Justify your answer **[3 marks]**
- d) Analyze why amines generally do not undergo S_N1 or S_N2 reactions effectively. **[2 marks]**

Total 10 marks

END OF EXAMINATION