

**Bago University**  
**Department of Chemistry**  
**Second Semester Examination, September 2019**

**Fourth Year**  
**(Chemistry Specialization)**  
**Answer any six Questions**

**Chem 4109**  
**Organic Chemistry VI**  
**Time Allowed: (3) hours**

1. (a) Fill in the blanks with the correct word(s), unit(s), and etc., as necessary.
- (i) A \_\_\_\_\_ is a molecule with two OH groups on the same carbon.
  - (ii) Ketones react with thiols to form \_\_\_\_\_.
  - (iii) The  $m/z$  value of the \_\_\_\_\_ gives the molecular mass of the compound.
  - (iv) Addition of hydrogen to an organic compound is \_\_\_\_\_ a reaction.
  - (v) The rate of hydrolysis of an ester can be increased by carrying out the reaction in a \_\_\_\_\_ solution.
  - (vi) The number of peaks in a signal is called the \_\_\_\_\_ of the signal.
- (b) Select the correct statement(s), word(s), unit(s) and etc., given in the followings.
- (i) Aldehydes are reduced to (primary, secondary, tertiary) alcohols.
  - (ii) If the  $M$  and  $M^{+2}$  peaks are about the same height, then the compound contains one (chlorine atom, bromine atom, iodine atom).
  - (iii) Aldehydes and ketones react with secondary amine to form an (enamine, imine, amine).
  - (iv) Acyl halides react with (carboxylate ions, alcohols, water) to form anhydrides.
  - (v) The aminolysis of an ester requires (only one, two, three) equivalent(s) of amine.
  - (vi) In 1,1-dichloroethane, the signal for the methyl protons is split into a (doublet, quartet, triplet).
2. (a) When a Grignard reagent reacts with: (i) formaldehyde (ii) ketone, what product will be formed?
- (b) Write the products for the reactions of 3-pentanone with each of these reagents.
- (i)  $\text{CH}_3\text{MgBr}$ ,  $\text{H}_3\text{O}^+$
  - (ii)  $\text{C}_6\text{H}_5\text{CH}_2\text{NH}_2$ ,  $\text{H}^+$
- (c) How would you prepare an enamine starting with the following compounds?
- (i) cyclopentanone
  - (ii) cyclohexanone
3. (a) How would you carry out the following conversion?
- (i) butanal  $\longrightarrow$  1-butanol
  - (ii) benzoic acid  $\longrightarrow$  benzyl alcohol
  - (iii) acetaldehyde  $\longrightarrow$  acetal
- (b) Describe the fragmentation behavior of 2-hexanol with its mass spectrum.
4. (a) Write down the fragmentation of C-C bond in molecular ion formed from pentane.
- (b) The mass spectra of two very stable cycloalkanes both show a molecular ion peak at  $m/z = 98$ . One spectrum shows a base peak at  $m/z = 69$ , the other shows a base peak at  $m/z = 83$ . Identify the cycloalkanes.

**P.T.O**

5. (a) Illustrate the following mechanisms.
- Acid – catalyzed hydrolysis of a nitrile
  - Conversion of acetyl chloride into acetic anhydride
- (b) How would you prepare ethyl acetate from each of the compounds given below?
- acetyl chloride
  - acetic anhydride
  - acetic acid
6. (a) Outline the relative reactivities of carboxylic acid derivatives by comparing with the basicity of leaving groups.
- (b) What products would you expect from the following reactions?
- A hydrolysis reaction of benzoic anhydride
  - A hydrolysis reaction of propane nitrile
  - A hydrolysis reaction of N-ethylacetamide in the presence of an acid
- (c) Complete the following reactions.
- ethyl propionate + methylamine  $\longrightarrow$  ?
  - acetyl chloride + ammonia  $\longrightarrow$  ?
7. (a) Define the followings.
- Chemically equivalent protons
  - Long-range coupling
  - Coupling constant
- (b) What operating frequency (in MHz) is required if an  $^1\text{H}$ NMR spectrometer is equipped with a magnetic field of 7.046 T? ( $\gamma = 2.675 \times 10^8 \text{ T}^{-1}\text{s}^{-1}$ )
- (c) How many signals would you expect to see in  $^1\text{H}$ NMR spectrum of each of the following compounds?
- 1-bromopropane
  - dimethyl ether
  - 2-bromopropane
  - benzene

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