

Instructions to candidates
Duration: Two (02) hours
Number of questions: Four (04)
Number of pages: Four (04)
Answer all questions
Marks allocation: 100 marks

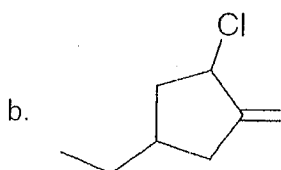
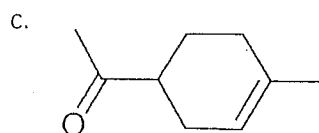
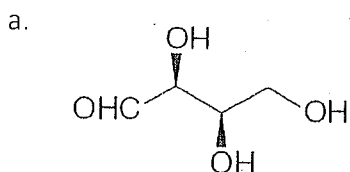
1.

1.1. Define the following terms.

- Enantiomers
- Meso compounds
- Racemic mixtures

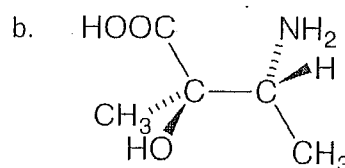
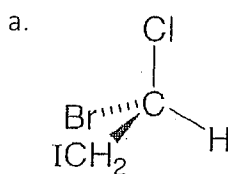
(6 marks)

1.2. Mark the chiral centers in the following molecules with an asterisk (*) and indicate whether they show optical activity.



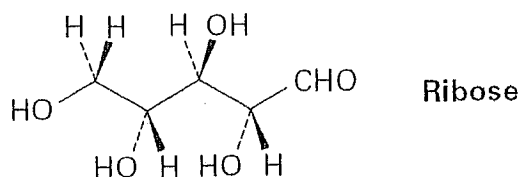
(6 marks)

1.3. State chiral centers of the following molecules are R or S? Show work leading to your conclusion.



(6 marks)

1.4. Ribose, an essential part of ribonucleic acid (RNA), has the following structure:



- Name the compound according to IUPAC nomenclature.
- How many chirality centers are present in ribose? Identify them.
- How many stereoisomers of ribose are possible?
- Draw the structure of the enantiomer of ribose.

(7 marks)

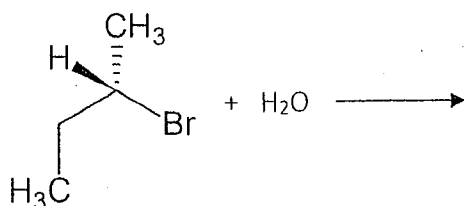
2.

2.1. Give explanation for the following observation:

"S_N2 reaction rates are much higher in acetonitrile than in methanol"

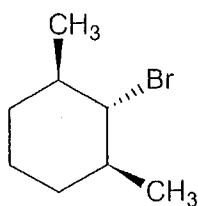
(3 marks)

2.2. Draw the structures of the intermediate carbocation and the expected S_N1 product with proper stereochemistry, for the following reaction.



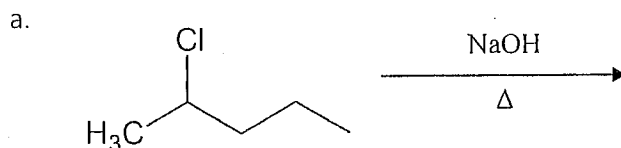
(5 marks)

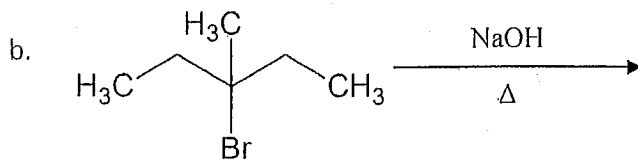
2.3. Explain why the following conformation of 2-bromo-1,3-dimethyl cyclohexane does not undergo E2 elimination with sodium methoxide (NaOCH₃). (Hint: Draw the chair conformation)



(5 marks)

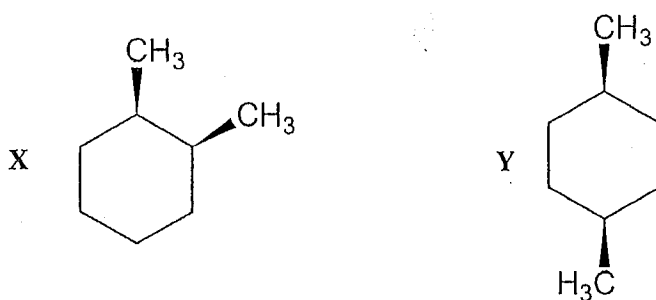
2.4. Show all possible alkenes formed by following elimination reactions.





(6 marks)

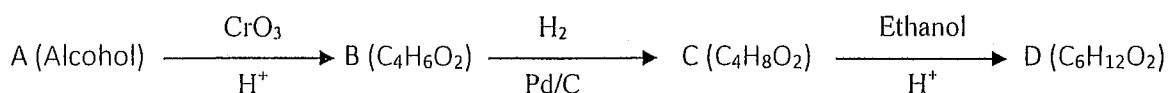
2.5. State which compound is most stable? Briefly give reasons for your choice. (Hint: Draw the chair conformation)



(6 marks)

3. An organic compound A having the molecular formula C_4H_8O showed IR absorption bands at ν_{max} 3360 and 1620 cm^{-1} . The $^1\text{H-NMR}$ spectrum of A showed the following signals.
 δ ppm 1.81 (3H, doublet, $J=7\text{ Hz}$), 2.38 (2H, doublet, $J=6\text{ Hz}$), 3.34 (1H, broad singlet), 5.12 (1H, doublet of triplet, $J=16\text{ \& } 6\text{ Hz}$) and 5.46 (1H, doublet of quartet, $J=16\text{ \& } 7\text{ Hz}$).

A underwent the following reactions.



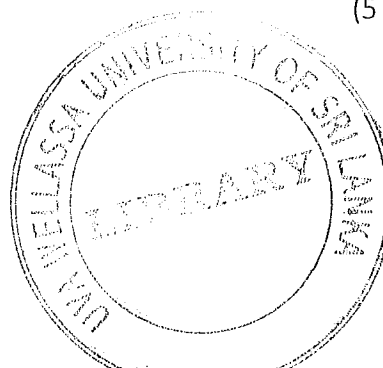
3.1. Identify A-D (8 marks)

3.2. Draw the structure of the compound A and label all the protons. Account for the spectral data of A by filling the following table.

Label of the proton	Chemical shift (δ)/ ppm	No. of protons	Multiplicity

(12 marks)

3.3. Draw the fragmentations responsible for the peaks at m/z 43 and 88 in the mass spectrum of D. (5 marks)



4.

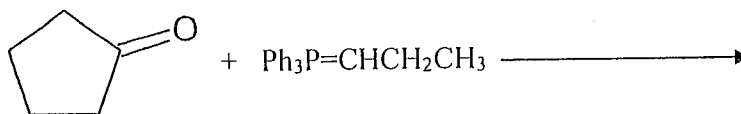
4.1. Draw the products formed when phenol (C_6H_5OH) is treated with each reagent.

- a. HNO_3, H_2SO_4
- b. $Br_2, FeBr_3$
- c. $CH_3CH_2Cl, AlCl_3$
- d. $CH_3CH_2CH_2Cl, AlCl_3$
- e. $CH_3COCl, AlCl_3$

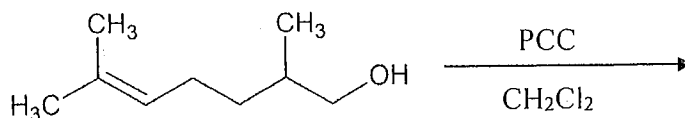
(8 marks)

4.2. Draw the products for the following reactions.

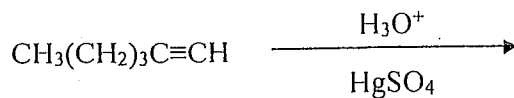
a.



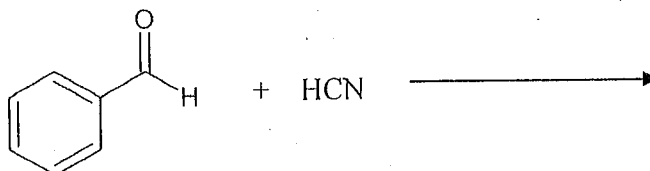
b.



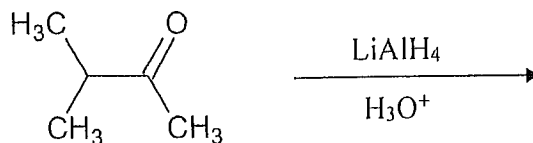
c.



d.

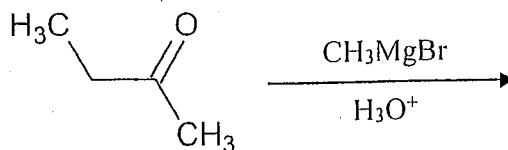


e.



(12 marks)

4.3. Propose a mechanism for the following reaction.



(5 marks)