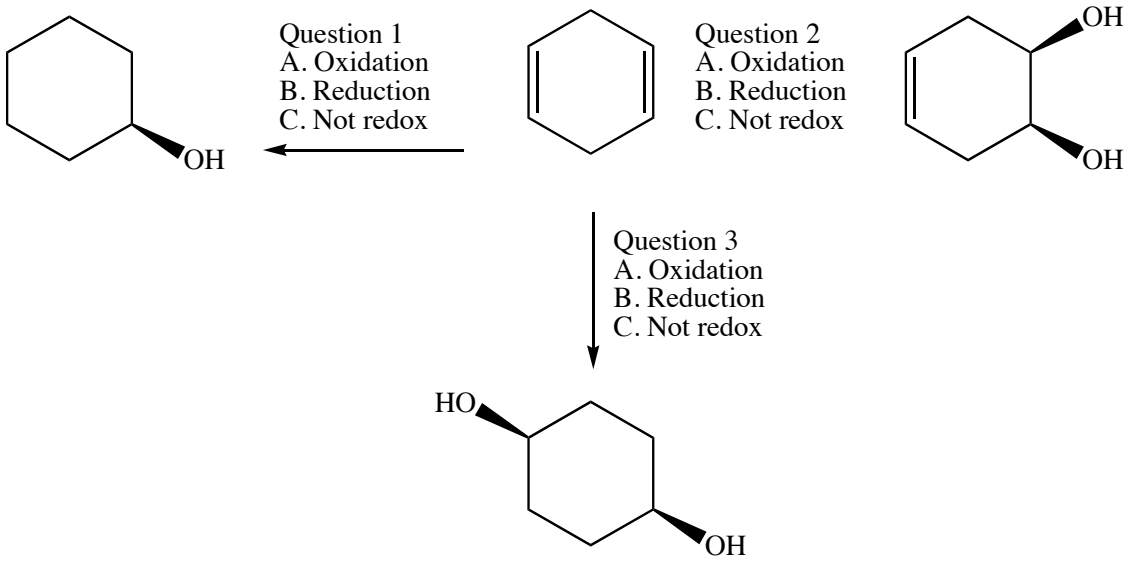
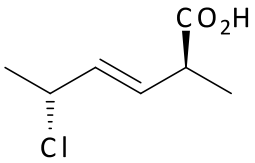
Practice Midterm 1 – A

Part 1 Multiple Choice

Questions 1-3. Classify each transformation as a formal reduction, oxidation, or neither.

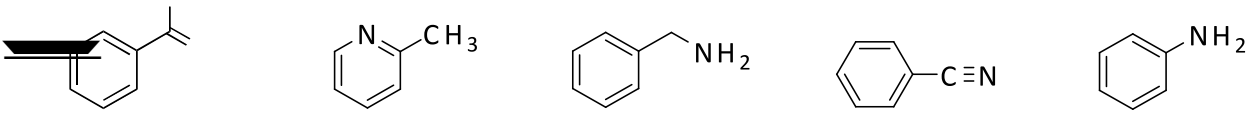


4. What are the stereochemical designations in the systematic (IUPAC) name of the following structure?



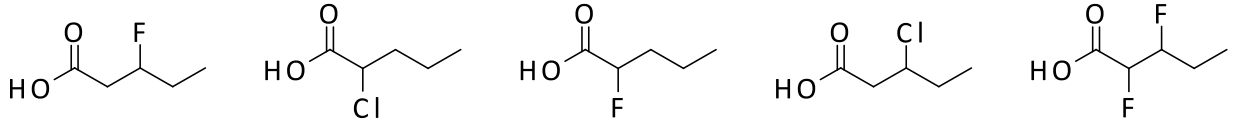
2R, 5R, E	2S, 5R, E	2S, 5S, E	2S, 5R, Z	2R, 5R, Z
A	**B**	**C**	**D**	**E**

5. Which compound contains the most basic nitrogen atom?



A **B** **C** **D** **E**

6. Which of the following is the strongest Brönsted-Lowry acid?

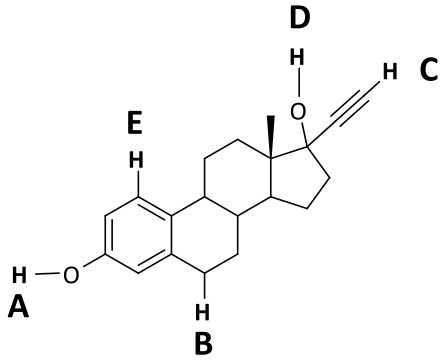


A **B** **C** **D** **E**

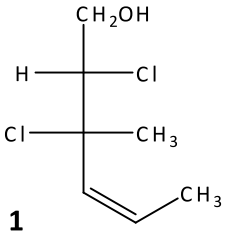
7. Which of the following is the predominant intermolecular force in 2-butanone?

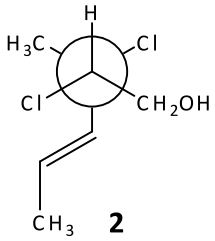
Dispersion forces	Dipole-dipole interactions	Ion-dipole interactions	Hydrophobic interactions	Hydrogen bonding
A	**B**	**C**	**D**	**E**

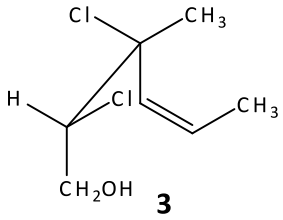
8. Which of the labelled hydrogen atoms has the smallest pK_a value?



Questions 9-11. Answer the next questions based on structures 1, 2, and 3 shown below.







9. What is the relationship between compounds 1 and 2?

conformers	constitutional isomers	diastereomers	enantiomers	identical
A	**B**	**C**	**D**	**E**

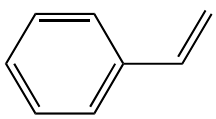
10. What is the relationship between compounds 1 and 3?

conformers	constitutional isomers	diastereomers	enantiomers	identical
A	**B**	**C**	**D**	**E**

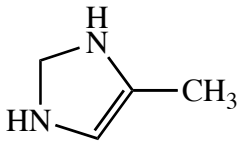
11. What is the relationship between compounds 2 and 3?

conformers	constitutional isomers	diastereomers	enantiomers	identical
A	**B**	**C**	**D**	**E**

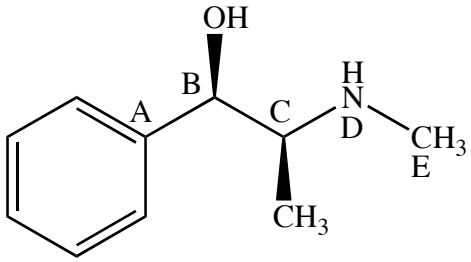
12. Classify this structure as A) aromatic or B) not aromatic.



13. Classify this structure as A) aromatic or B) not aromatic.



Questions 14 to 19. Ephedrine, shown below, is used as a decongestant in cold remedies. Five atoms in the structure are labeled (A-E).



14. What is the name of the functional group into which carbon B is incorporated?

alcohol	aldehyde	carboxylic acid	carboxylic ester	ketone
A	**B**	**C**	**D**	**E**

15. What is the hybridization of the carbon labeled A?

sp	sp^2	sp^3	sp^3d	sp^3d^2
A	**B**	**C**	**D**	**E**

16. What is the hybridization of the nitrogen atom labeled D?

sp	sp^2	sp^3	sp^3d	sp^3d^2
A	**B**	**C**	**D**	**E**

17. Which of the following applies to the stereochemistry of the carbon atom labeled A?

R configuration	S configuration	not stereogenic	E configuration	Z configuration
A	**B**	**C**	**D**	**E**

18. Which of the following applies to the stereochemistry of the carbon atom labeled B?

R configuration	S configuration	not stereogenic	E configuration	Z configuration
A	**B**	**C**	**D**	**E**

19. Which of the following applies to the stereochemistry of the carbon atom labeled C?

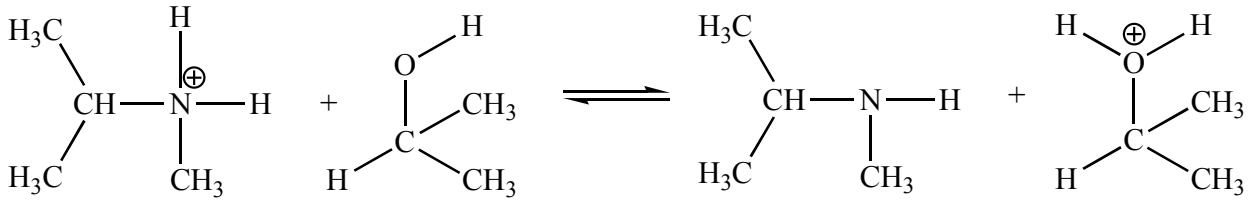
R configuration	S configuration	not stereogenic	E configuration	Z configuration
A	**B**	**C**	**D**	**E**

Part 2. Respond to the questions in part 2 *on this exam paper*.

Question 1

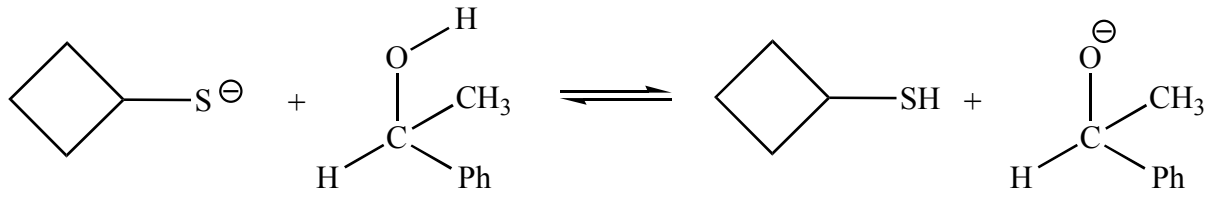
For each of the following equilibria, show which side of the reaction is favoured by writing the word **LEFT** or **RIGHT** above the equilibrium arrows. Note that all non-zero formal charges have been shown, but no lone pairs of electrons are drawn. Briefly rationalize your choice in the space provided (listing pK_a values is not a sufficient explanation).

a)



Rationale:

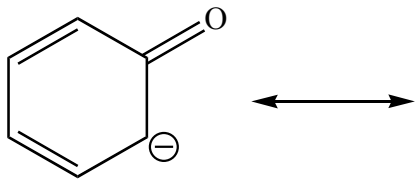
b)



Rationale:

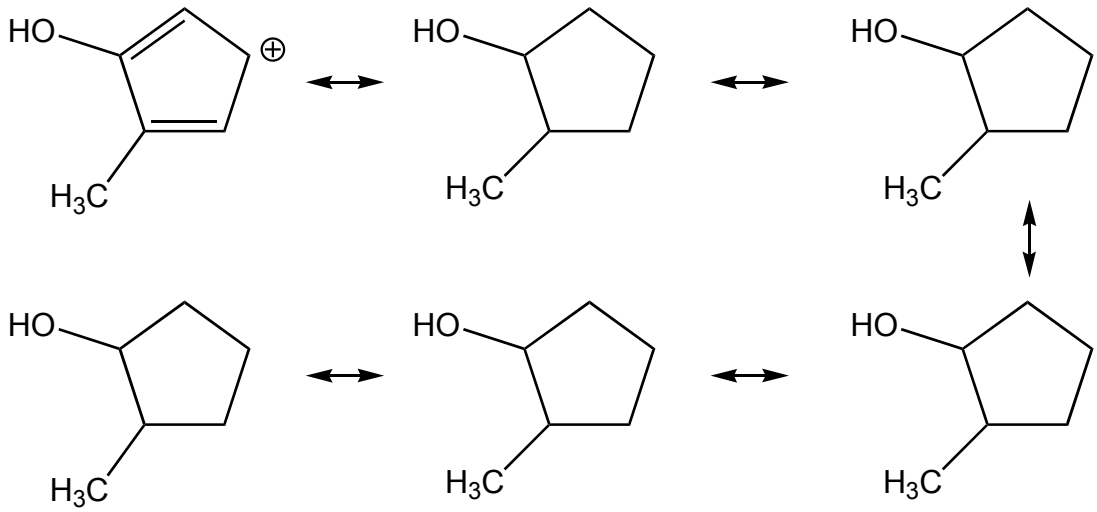
Question 2

a) Draw the major resonance contributors for the following structure. **Include all lone pairs, formal charges, and curved arrows.**



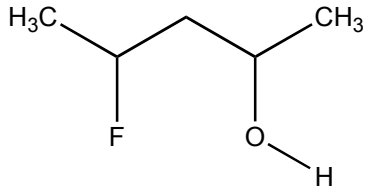
b) Circle the resonance contributor(s) from part a) that is/are the most stable and state ONE reason for your choice.

c) Draw the five most **contributing** resonance structures of the following molecular ion by adding to the templates below. Include all lone pairs of electrons and formal charges.



Question 3

a. Consider the molecule 4-fluoro-2-pentanol, shown below.



i) Add arrows (⟊⟶) to indicate the direction of bond dipoles. Do not include C-H bond dipoles.

ii) Draw a **CIRCLE** around all nucleophilic atoms and a **SQUARE** around any electrophilic atoms. Marks will be deducted for extra circles and squares.

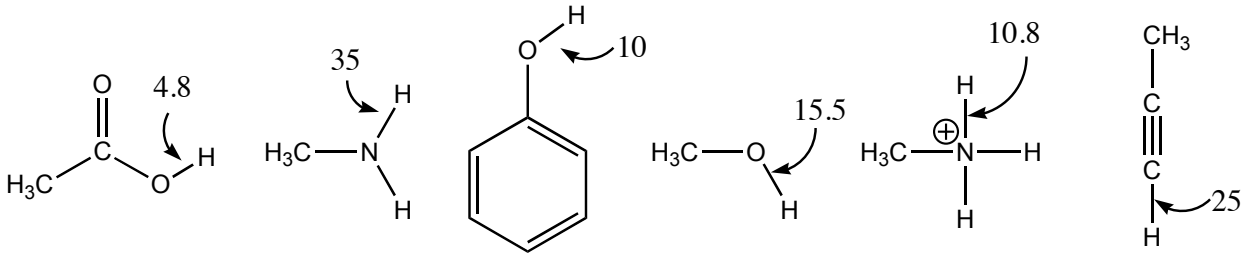
b. Diethyl ether does not mix with water, but THF (tetrahydrofuran) does. Explain.

c. Draw line bond structure of (E)-4-methyl-2-pentene.

d. Draw the Lewis structure of propyl ethanoate.

e. Draw a Fischer projection of (S,S)-2,3-dichlorobutane.

Question 4. Given below are the structural formulas of a number of compounds, along with an indication of pKa values of the designated O-H, N-H, or C-H bonds. On the bases of these data, answer questions i, ii, and iii.

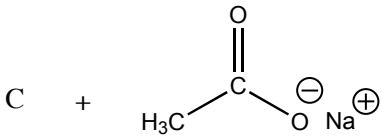


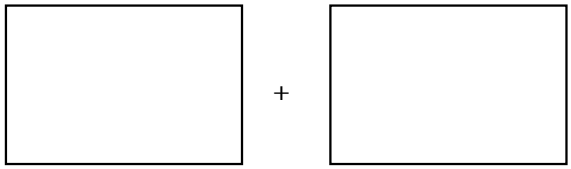
A B C D E F

i. In the space below, write the numbers corresponding to the structures shown that would be very largely deprotonated when treated with NaOH. The pKa of water is 15.7.

ii. When 6 is treated with the conjugate bases of ONE of A to F, a proton transfer takes place. Give the structural formula of the conjugate base capable of this deprotonation.

iii. Clearly draw the products of each reaction in the boxes below. Indicate, but use of arrows of different lengths, whether each equilibria lies to the left or the right.





A + B