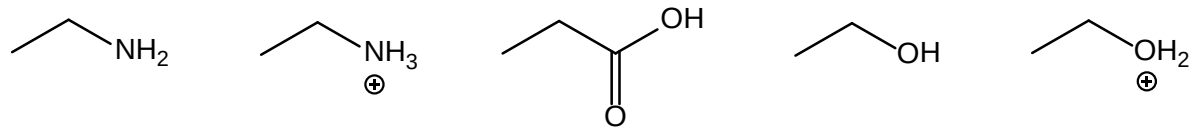
Organic Chemistry 1 Final Exam 12 June 2014 **Student #** **Name**

Total 140 points. Write your answers in the space provided. If you need more space, write on the back.

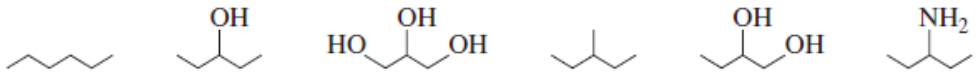
1. [6 x 4 pts] **Arrange the following compounds in the increasing order of the properties indicated.**

(a) Acidity: _____ < _____ < _____ < _____ < _____



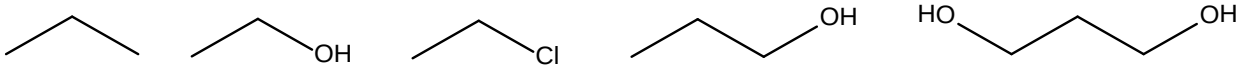
A B C D E

(b) Boiling point: _____ < _____ < _____ < _____ < _____< _____



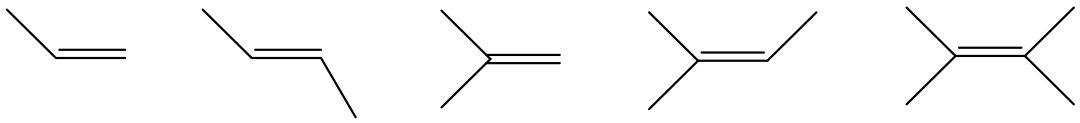
A B C D E F

(c) Solubility in water: _____ < _____ < _____ < _____ < _____



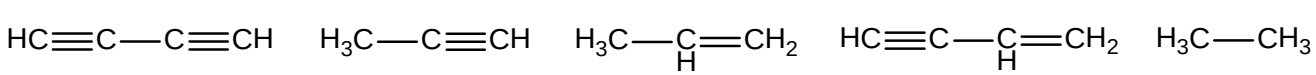
A B C D E

(d) Relative stability: _____ < _____ < _____ < _____ < _____



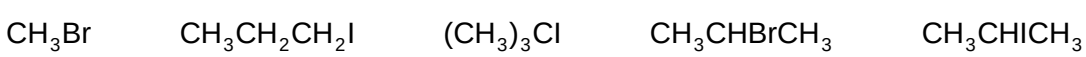
A B C D E

(e) Bond length of carbon-carbon single bond: _____ < _____ < _____ < _____ < _____



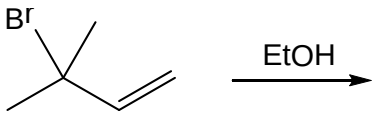
A B C D E

(f) Reactivity in E1 Reaction: _____ < _____ < _____ < _____ < _____



A B C D E

2. [3 x 5 pts] **For the following reaction answer the questions.**



(a) There are two possible substitution products of the reaction. Show how the two products are formed.

(b) One of the substitution products becomes more favorable over the other as the reaction temperature increases. Explain why by drawing a reaction coordination diagram.

(c) Show the elimination products possible from the reaction. Indicate the major product and explain.

3. [3 x 5 pts] **Give a brief explanation for each of the following observations.**

(a) In substitution reactions the amount of inversion of the configuration is always larger or the same to that of retention.

(b) A substitution reaction on vinyl chloride hardly proceeds.

(c) The reaction of butyl chloride to butylamine using ammonia is faster in a polar solvent, while that to butyl alcohol using sodium hydroxide is slower in a polar solvent.

4. [4 x 5 pts] **Answer the following questions.**

(a) Show the structure of the major substitution product from the reaction of *trans*-1-chloro-2-methylcyclohexane and CH_3OH.

(b) Give the Fisher projection of the substitution product from the reaction of (2*S*,3*R*)-2-bromo-3-methylpentane and CH_3O^-.

(c) Show the structure of the major elimination product(s) from the reaction of *trans*-1-bromo-2-ethylcyclohexane and CH_3O^-.

(d) Show the structure of the major elimination product(s) from the reaction of (3*R*,4*R*)-3-bromo-4-methylhexane and CH_3O^-.

5. If you want to obtain ethyl *t*-butyl ether from *t*-butyl bromide, you <u>have to</u> use a weak base.

(a) [4 pts] Explain why you have to use a weak base.

(b) [4 pts] Write (draw) the substitution reaction equation showing the structure of the reactants, products, and steps in the mechanism.

(c) [2 pts] What do you call this type of reaction from the viewpoint of the nucleophile?

6. If you want to obtain ethyl isopropyl ether from isopropyl bromide, you <u>better</u> use a weak base.

(a) [4 pts] Explain why the use of a weak base is preferred.

(b) [4 pts] Write the reaction equation showing the structure of the reactants and <u>all possible products</u>.

(c) [2 pts] Which solvent would you use in this reaction, ethanol or DMF? Why?

7. Alcohols are cheap and abundant starting materials for organic synthesis, but they do not undergo substitution reaction. Answer the following questions.

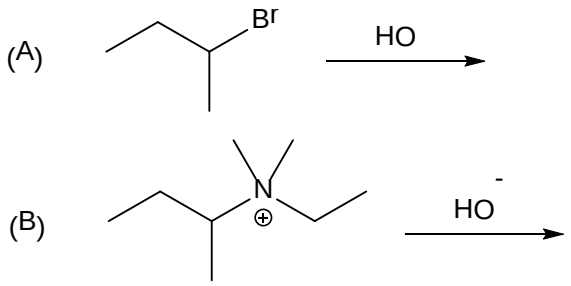
(a) [6 pts] There are three (3) <u>types</u> of methods suggested to convert hydroxy group to a better leaving group. Starting with ROH, describe the 3 methods with necessary reagents and the resulting structures.

(b) [4 pts] Alkoxy groups of ether are also not readily available for substitution reactions. Not all of the three methods of (a) above are not applicable for alkoxide group, however. Explain.

(c) [6 pts] Are amino groups of amines available for substitution reactions? Discuss the relative reactivity of amino, hydroxyl, and alkoxy groups.

8. [3 x 5 pts] **Answer the following questions.**

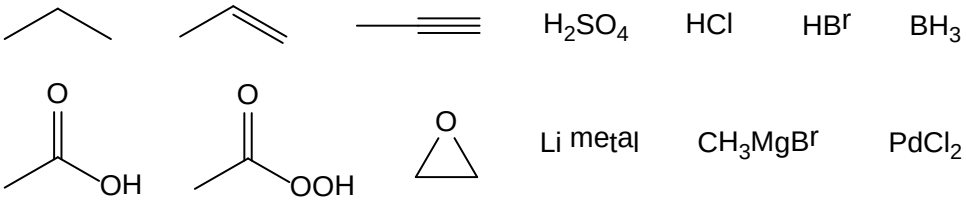
(a) Show the major elimination product of the following reactions.



(b) Explain why the major products are different from each other.

(c) If you want to obtain the same major product as in (B) from the starting material of (A), what would you do? Explain your answer.

9. [3 x 5 pts] **Show the steps for the preparation of the following compounds by selecting proper reagents or compounds from the pool given below.**



(a) cyclohexene to 2-methylcyclohexanol

(b) cyclohexyne to 1-propenylcyclohexane

(c) cyclohexyne to 1-propylcyclohexane