Chem 331 Practice FINAL EXAM

Name: _____

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1		/20
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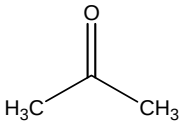
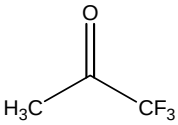
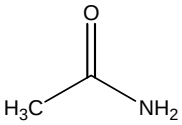
5		/36
6		/29
total:		/180

1. (20 pts.) **(a)** Circle the most **acidic** and box the least acidic structure below.



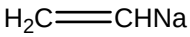


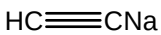


(b) Circle the most **acidic** and box the least acidic structure below.

CH_3SH $CH_3NH_3^+$ $CH_3OH_2^+$ CH_3NH_2

(c) Circle the most **basic** and box the least basic structure below.



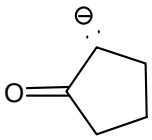


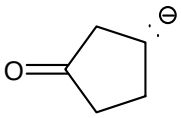
CH_3CH_2Na

(d) Circle the most **basic** and box the least basic structure below.

KOH CH_3Li NH_3 CH_3OK

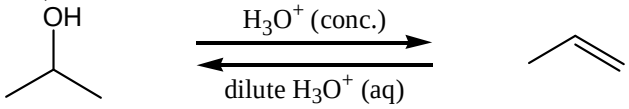
(e) Circle the most **basic** and box the least basic structure below.



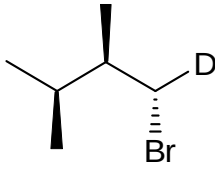


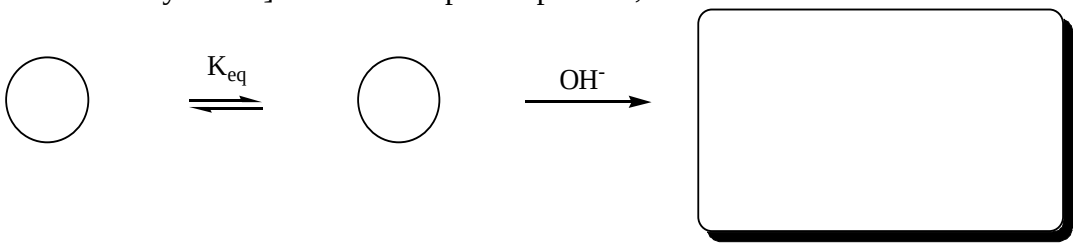
2. (20 pts.) Provide a synthesis of 2-pentyl isopropyl ether from any hydrocarbons and inorganic starting materials. Box your final answer with all reagents written out in the forward direction however your answer will be graded retrosynthetically (i.e., starting with the last step and working backwards)—any synthesis that gives the product, even if it doesn't start with hydrocarbons, will receive partial credit.

3. (20 pts.) Alcohols can undergo elimination reactions in concentrated sulfuric or phosphoric acid. These reactions, called dehydrations, are the opposite of hydration reactions. The dehydration of 2-propanol (shown below) favors the propene side of the equilibrium in concentrated acid but favors the 2-propanol side in dilute aqueous acid. Both reactions are catalytic in H_3O^+. **Briefly explain** why the change in conditions leads to a change in major product and provide a mechanism for the dehydration of 2-propanol that is *consistent with principle of microscopic reversibility* (show all bonds broken/made with appropriate arrows).



4. (24 pts.) Hydroxide reacts with the substrate, (1S,2R)-1-bromo-1-deuterio-2,3-dimethylbutane (shown at the right), yielding only one alkene product, **C**. The substrate is shown in an unreactive conformation. **(a)** Reproduce the same unreactive conformation by drawing a Newman projection using the circle labeled **A**. Now draw the reactive conformation using Newman projection **B** and <u>*circle the letter*</u> (**A** or **B**) corresponding to the more stable conformation. [Note: D and H are similarly small.] Fill in the expected product, **C**.





A (unreactive conformation)

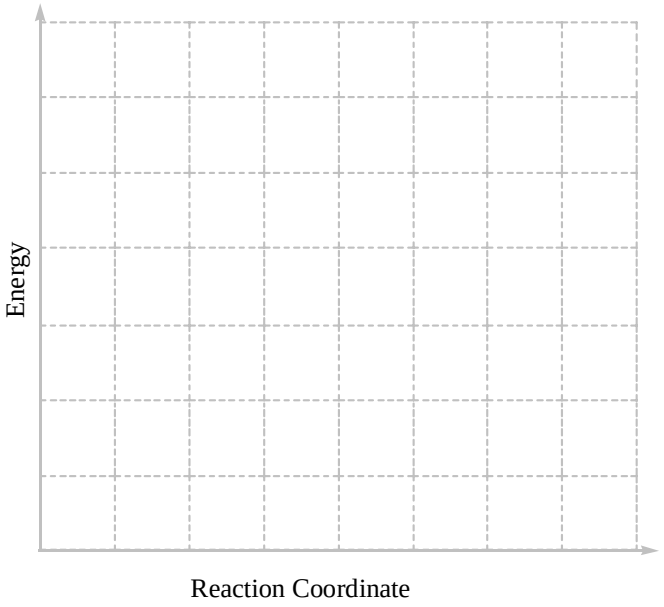
B (reactive conformation)

C (alkene product)

(b) Why is conformation **A** unreactive to elimination?

(c) For the K_{eq} between **A** and **B**, circle the one value that seems most reasonable: -10, -1, 0, 0.1, 1, 10

(d) Draw a reaction coordinate diagram for this *exothermic* reaction. Label **A**, **B**, and **C** and position them as well as their transition states appropriately. The barrier to bond rotation is less than that of elimination. **Label the activation energy for the overall reaction.**



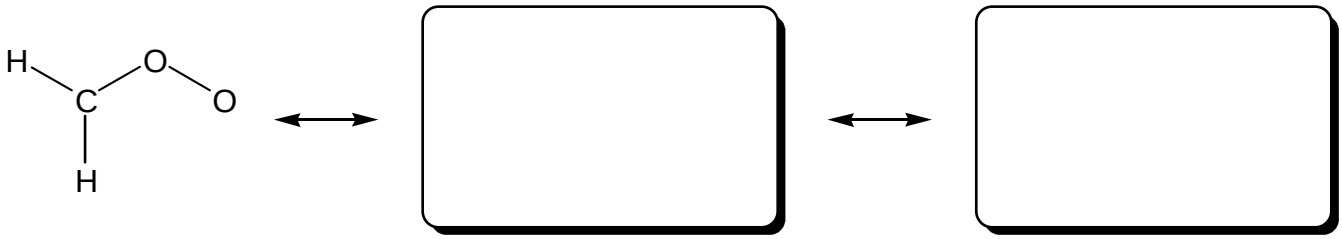
(e) In the box provided, draw a picture of the B→C transition state. Label the partial charges and pertinent bond orders. [Bond orders are 0.0 for no bond, 0.5 for half a bond, 1.0 for a full bond, and 2.0 for a double bond.]

B --> C Transition State

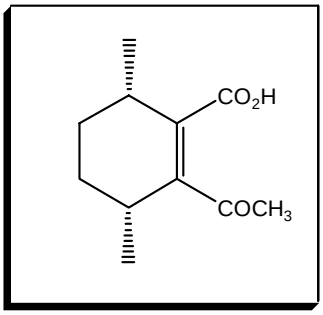
5. (20 pts.) A flask labeled **C_4H_8** was discovered in the laboratory. The cost for disposal of unidentified chemicals is too high so we would like to identify the substance. Someone suggested that if we were to hydrate the substance by reaction with H^+/H_2O, we could tell what the product was by the number of ^{13}C NMR signals of the resulting molecule. (a) Find all of the isomers (*constitutional and stereoisomers*) of C_4H_8 and show the hydration reaction product for each (write N.R. if there is no reaction). Be careful not to show the same molecule twice.

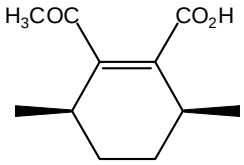
(b) Briefly explain why we can use NMR to determine the identity of the species after reaction but we can't use the number of ^{13}C NMR signals directly to tell the reactants apart.

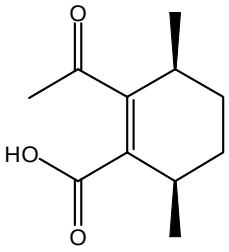
6. (11 pts.) A carbonyl oxide, CH_2O_2, is implicated as an intermediate in the reaction of ozone with ethylene. Complete the partial structure on the left to make a good Lewis structure then draw reasonable resonance structures to the right. Underneath each resonance structure list all of the "rules for evaluating resonance structures" that are broken by each resonance.

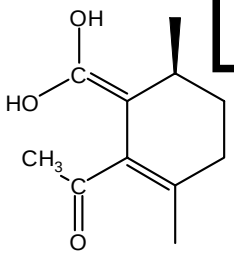


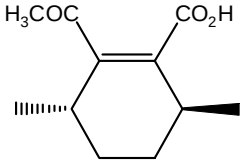
7. (12 pts.) Compare each molecule to the one in the box to the right. Describe the relationship as being the **same**, a **resonance** structure of the same molecule, an **enantiomer**, a **diastereomer**, a **constitutional isomer**, or completely **different**.

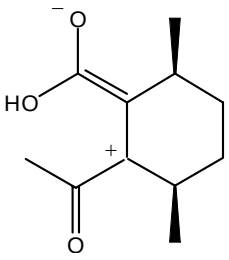


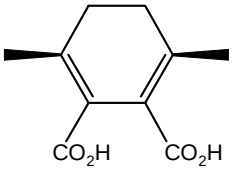












8. (24 pts.) The following compounds are improperly named or named with common names. Please draw a structure for each name **and give the correct IUPAC name**.

(a) allyl alcohol

(b) 5-fluoro-7-methyl-3-*tert*-butyloctane

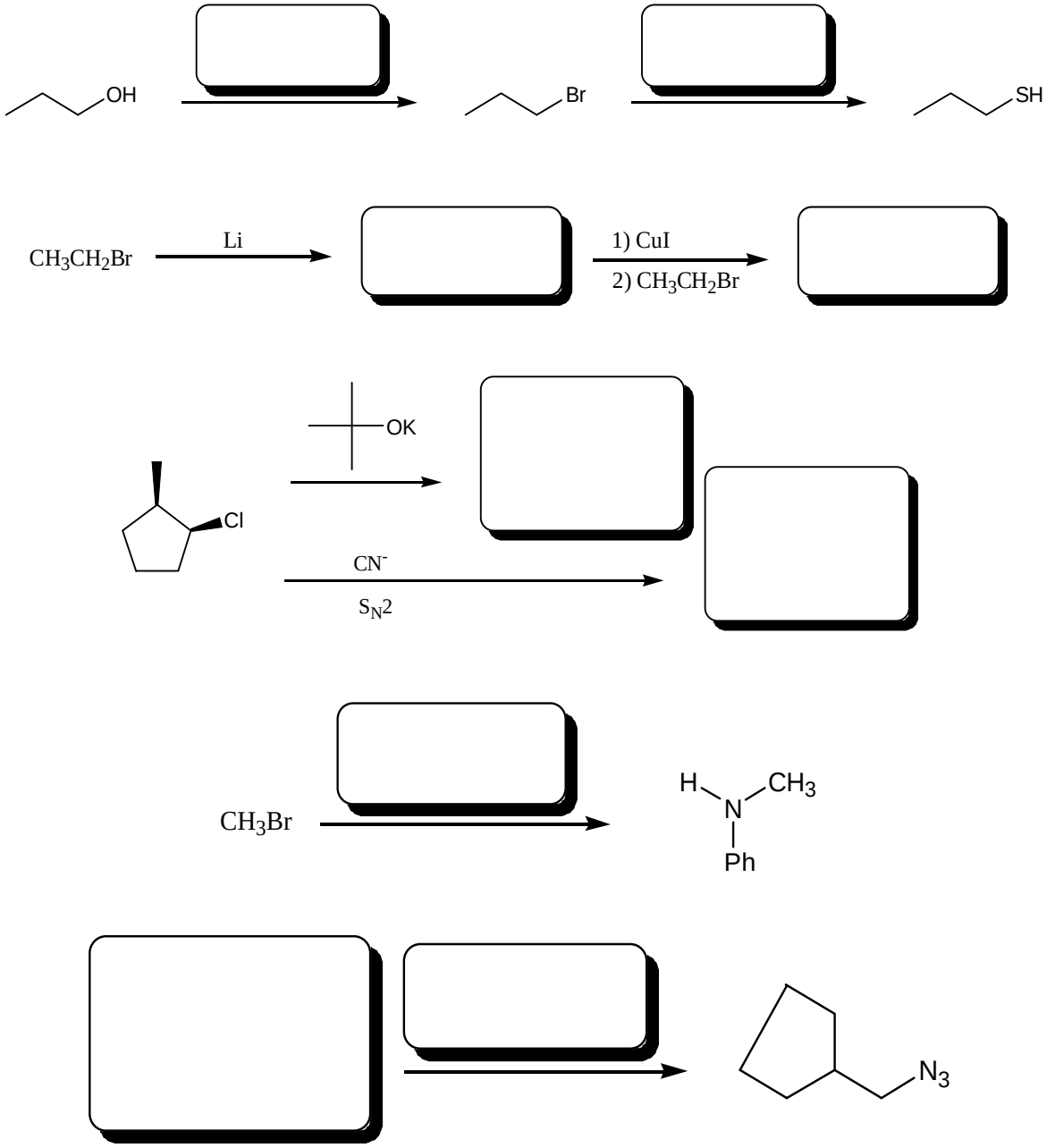
(c) methylene chloride

(d) *cis*-6-methoxycyclohex-1-en-3-ol

(e) (R)-5-fluoro-5-bromocyclopentene

(f) butylethylmethyl amine

9. (27 pts.) Provide the missing reactant or product to complete the reaction such that the major organic product is shown.



10. (2 pts.) Is the human body chiral? Explain.

Answer Key (click here): Please do not consult the answer key until after you have tried the problems on your own, preferably in an exam-like setting (fixed time/no notes).