Exam # 3 – October 31, 2001
Chemistry 2401

(4) I. Assuming that each of the following is a molecular formula for a compound with no rings and no double bonds, how many hydrogen atoms would each contain?

A. $C_{11}H_{???}O_2$ _____ B. $C_8H_{???}Br_2NO_2$ _____

(6) II. How many degrees of unsaturation are present in compounds that have the following molecular formulas. Show your work in the space provided.

A. C_7H_8O _____ B. $C_{10}H_{11}NO_4$ _____

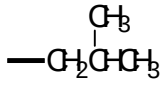
(6) III. A compound named Charlie had a formula of $C_{10}H_{14}$. When Charlie was allowed to react with H_2/Pd under conditions similar to those we used in lab, he was converted to a new compound named Rocky that had a formula of $C_{10}H_{18}$. In the space below draw structural formulas for Charlie and Rocky that are consistent with this information.

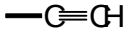
Charlie Rocky

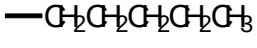
(9) IV. Draw structural formulas for each of the following:

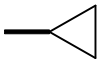
A. cis-1,4-octadiene B. 2,5-dimethyl-2-hexene C. 1-methylcyclopentene

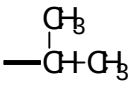
(5) V. Rank the following groups in terms of Cahn-Ingold-Prelog priority using 1 for the group with the highest priority.





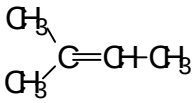


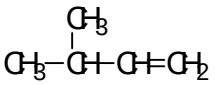




_____ _____ _____ _____ _____

(10) VI. We learned in chapter six that alkenes with more alkyl groups attached to the two double-bonded carbon atoms were lower in energy (more stable) than alkenes with fewer alkyl groups attached to these two carbon atoms.
A. Based on that principle circle the structure below that corresponds to the lower energy compound.





B. The explanation offered for this difference in energies was that $sp^2 – sp^3$ carbon-carbon bonds are stronger than $sp^3 – sp^3$ carbon-carbon bonds. What experimental measurement was cited in support of this suggestion?

C. Now bonds are formed by the overlap of orbitals and two different suggestions were made for how orbital interactions caused these bonds to be stronger. What were these two suggestions? Draw diagrams if they help.

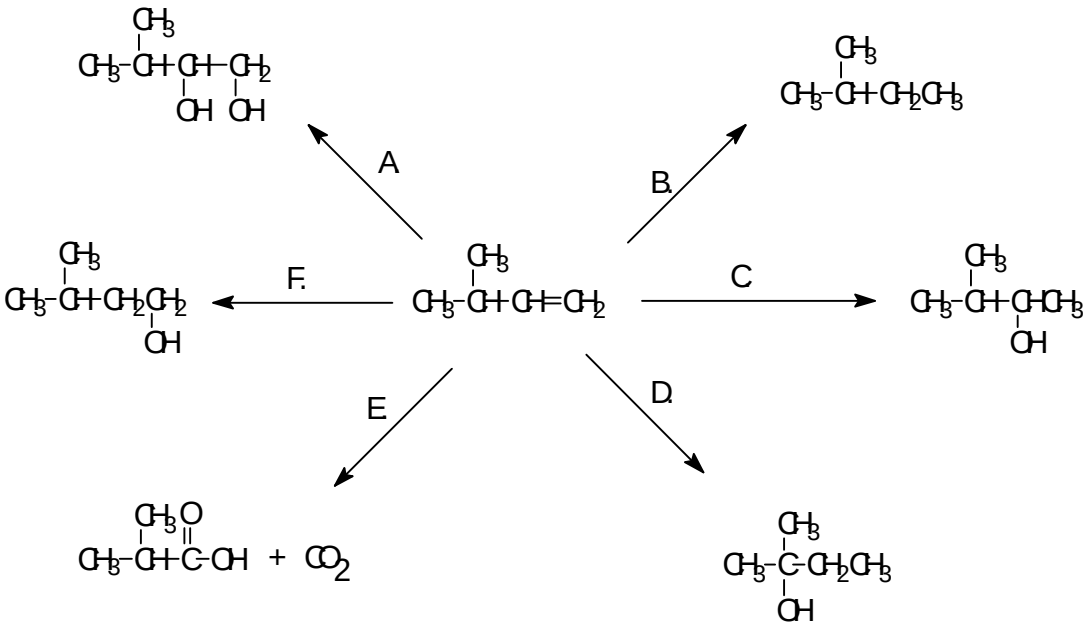
1)

2)

(4) VII. According to Hammond's postulate for what kind of chemical reaction step would the transition state look very much like the product that is being formed?

In such a reaction what is the relationship between the energy of the product and the rate at which it is produced by the reaction?

(18) VII. Below is a diagram showing the conversion of 3-methyl-1-butene to a variety of different products. Identify the reagent(s) that produce each of the results indicated. I provided two arrows, but in some cases you may need to use only one.

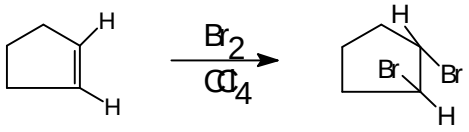


A → → B → →

C → → D → →

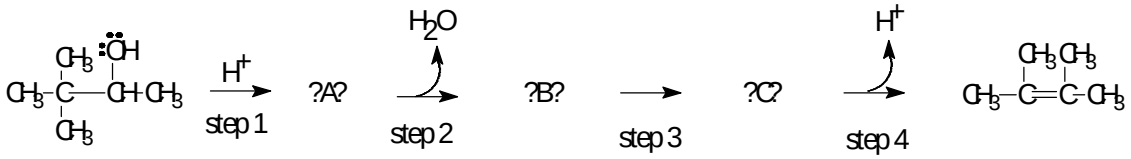
E → → F → →

(6) VIII. The reaction of bromine with cyclopentene yields 1,2-dibromocyclopentene that has <u>exclusively</u> the trans configuration. What causes this?



B. If you were conducting this reaction in the laboratory, what observation could you make that would indicate that the reaction was, in fact, taking place?

(12) IX. Draw structural formulas of the intermediates in the mechanism for the dehydration of 3,3-dimethyl-2-butanol shown below.



?A? ?B? ?C?

A. Which is the rate-determining step? _____

B. Is step 3 endergonic or exergonic? Explain.

C. Draw a structural formula representing the transition state for step 3.