Chemistry 2541
Fall 2010; Midterm 2 Exam

This exam has 8 problems on 7 pages. Make sure your copy is complete and correct.

Printed Name (Last, First) Key

Scores:

Problem 1 15

Problem 2 15

Problem 3 9

Problem 4 16

Problem 5 16

Problem 6 8

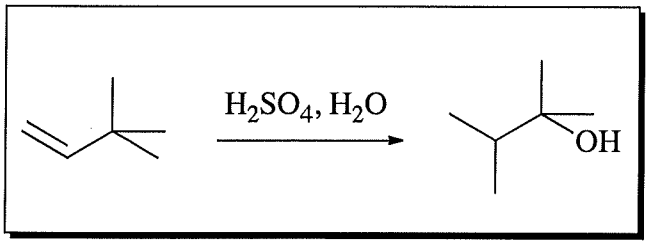
Problem 7 5

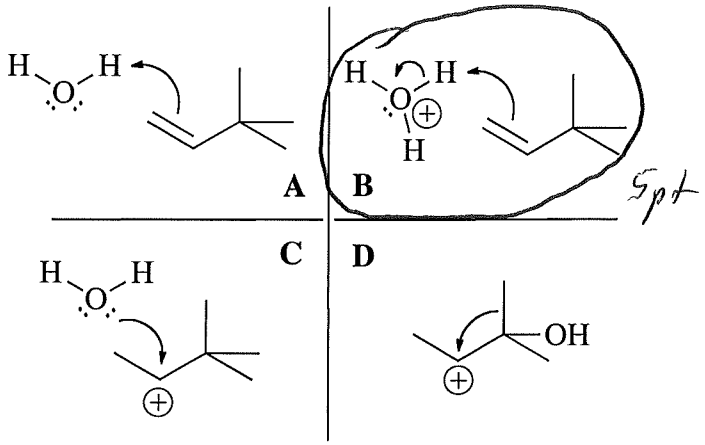
Problem 8 16

Total: 100

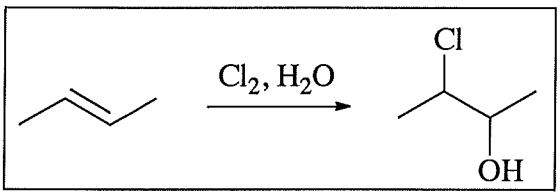
1. (15) Answer the questions on mechanism of the following reactions.

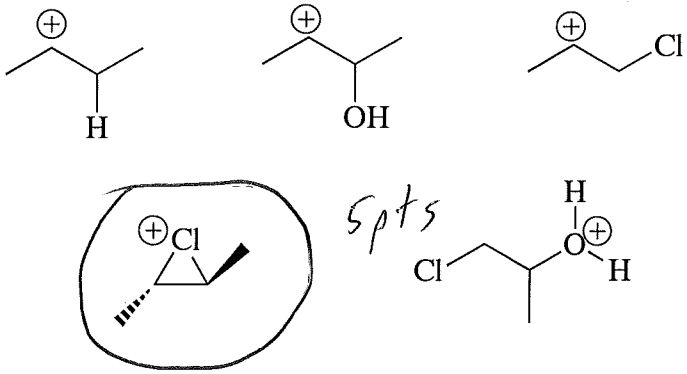
(a) Which one of the following four schemes (**A-D**) represents a **step** in the **mechanism** of the reaction in the box (circle the correct answer; 5 pts):



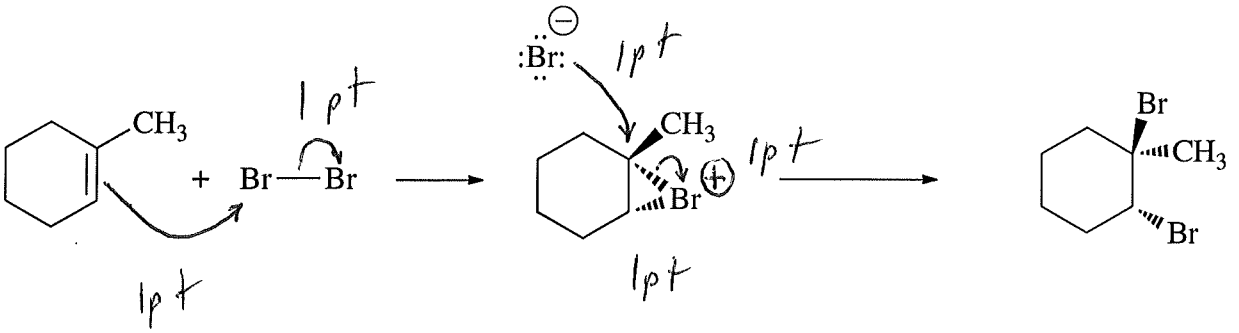


(b) Circle the structure of the reaction **intermediate** for the reaction in the box (circle the correct answer; 5 pts):



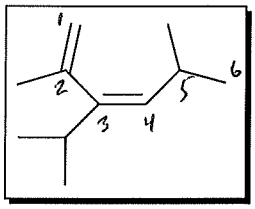


(c) Draw **4** curved **arrows** and one **formal charge** missing in the following mechanism (5 pts; 1 pt each missing fragment):



2. (15) Answer the following questions on the **IUPAC nomenclature**:

(a) Circle the correct name for each of the compounds shown in the boxes (3 pts each):

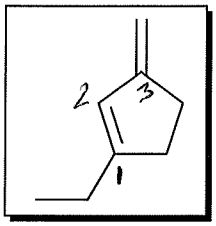


(*E*)-1,2-diisopropyl-3-methyl-1,3-butadiene (*E*)-3-isopropyl-2,5-dimethyl-1,3-hexadiene

(Z)-3-isopropyl-2,5-dimethyl-1,3-hexadiene (*Z*)-1,2-diisopropyl-3-methyl-1,3-butadiene

(Z)-3-vinyl-2,5-dimethyl-3-hexene (*E*)-3-vinyl-2,5-dimethyl-3-hexene

3pts

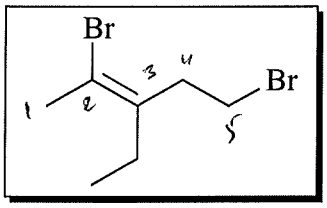


(Z)-5-ethyl-1,3-octadiene 1-ethyl-3-methylenecyclopentene

1-ethyl-3-vinylcyclopentene 1-ethyl-1,3-cyclopentadiene

1-ethyl-4-methylenecyclopentene (*E*)-1-ethyl-1,4-cyclopentadiene

3pts



(*E*)-2,5-dibromo-3-ethyl-2-pentene 1,4-dibromo-2-ethyl-1-methyl-1-butene

(*E*)-2,5-dibromo-3-ethyl-2-hexene (Z)-2,5-dibromo-3-ethyl-2-pentene

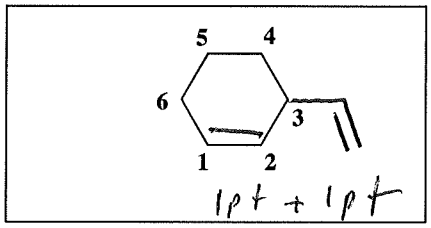
(Z)-1,4-dibromo-3-ethyl-3-pentene (*E*)-1,4-dibromo-3-ethyl-3-pentene

3pts

(b) Finish drawing the **line-angle structure** of each of the following compounds in the provided box by placing missing fragments on the numbered carbons (1 pt each missing fragment):

3-vinylcyclohexene

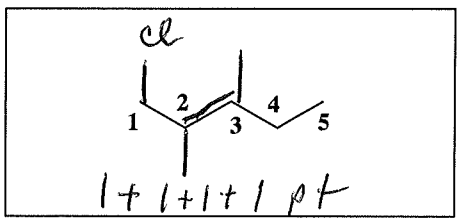
(2 pts)



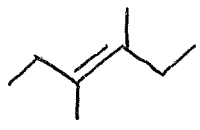
2pt

(*E*)-1-chloro-2,3-dimethyl-2-pentene

(4 pts)



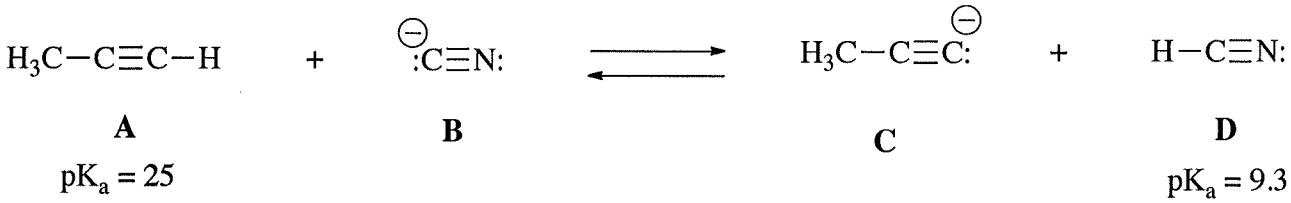
or



4pts

15pts

3. (9 pts) Answer questions **(a)-(c)** about the following Bronsted–Lowry acid-base reaction by placing the letters **A-D** on the answer lines.



A $pK_a = 25$ **B** **C** **D** $pK_a = 9.3$

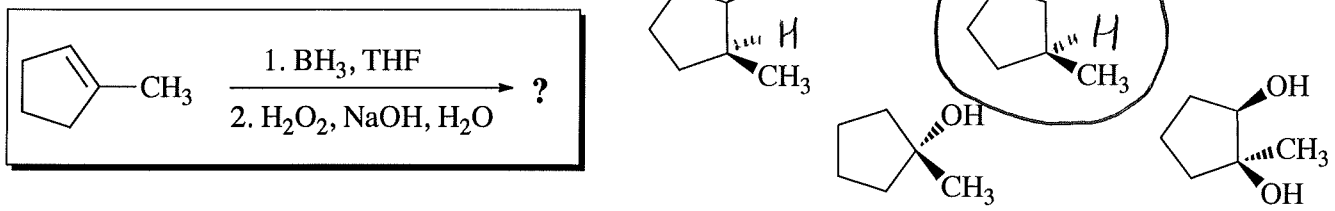
(a) (3 pts) Between structures **A** and **D** the **weaker** acid is: A 3pts

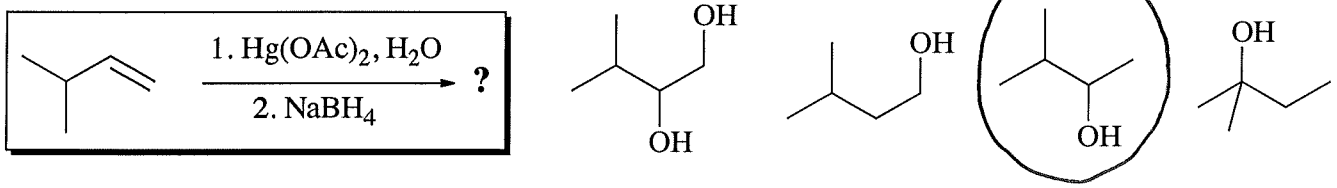
(b) (3 pts) The **conjugate acid** of compound **B** is: D 3pts

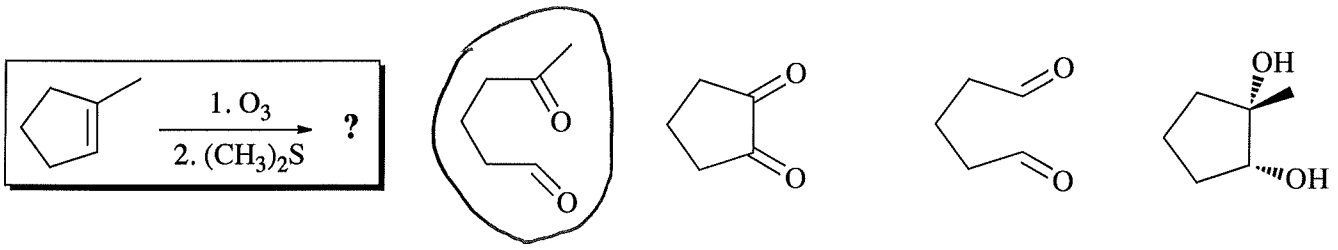
(c) (3 pts) The species that **predominate** at equilibrium are (two letters): AB 3pts

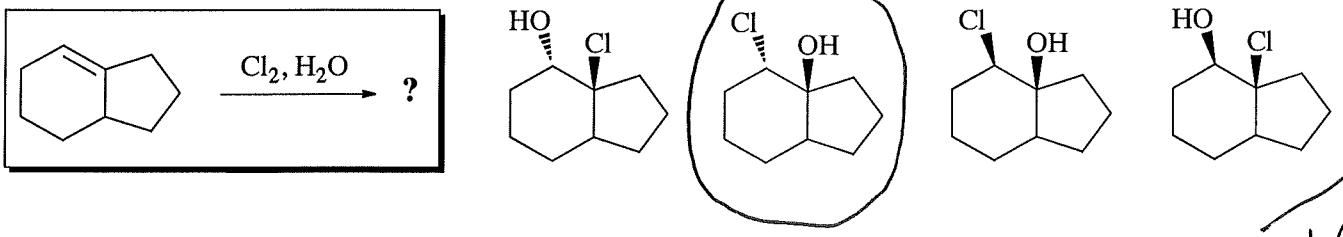
9pts

4. (16, 4 pts each) Circle the structure of the main **product** in each of the following reactions:



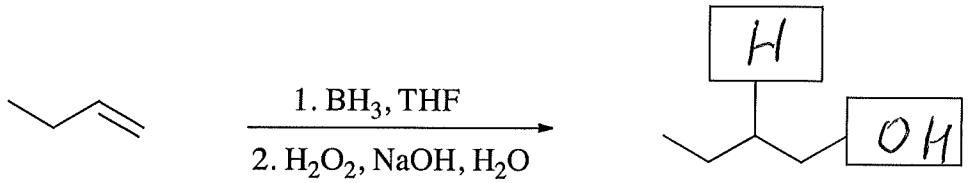


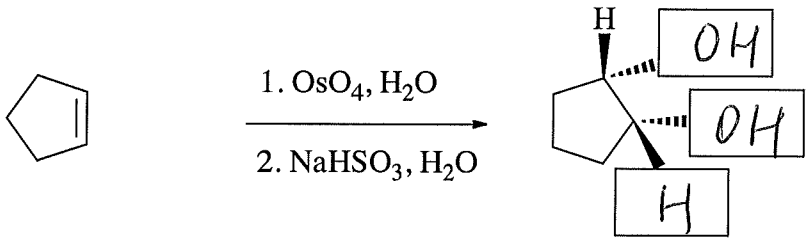




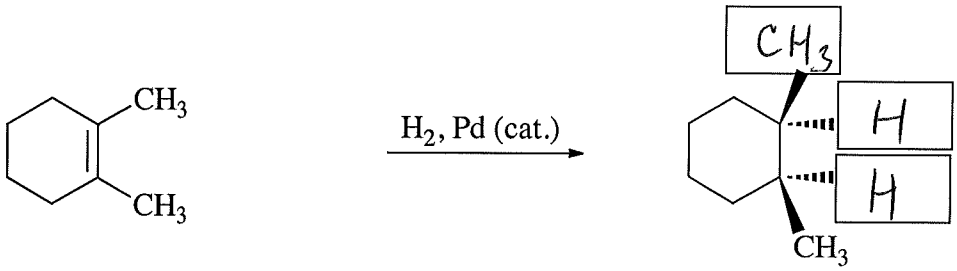
16pts

5. (16) Finish drawing the structures of main **products** in these reactions by placing appropriate substituents (including H) in the boxes on the bonds (2 pt each missing part).



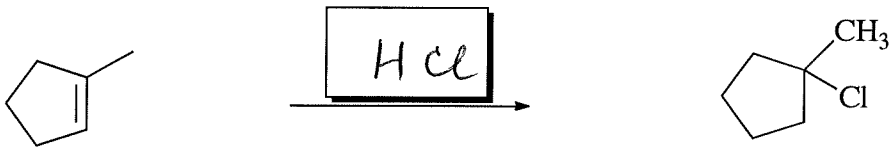


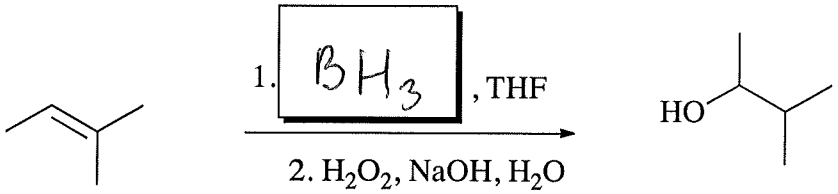
2pts each box



16pts

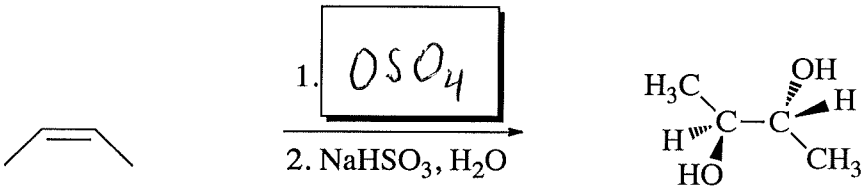
6. (8, 2 pts each box) Place in each box the molecule of a **reagent** that is required to perform each of the following reactions:

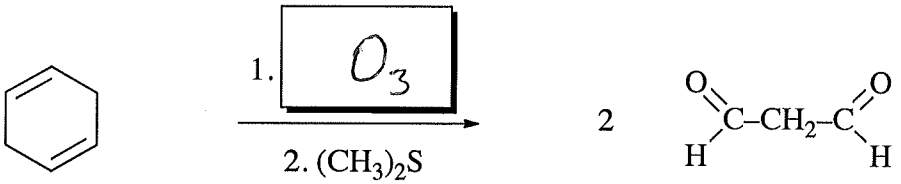




2pts each box

8pts





7. (5 pts) Arrange the following compounds according to their **acidity**:

(**1**) CH_3NHCH_3 (**2**) CH_3CO_2H (**3**) CH_3CH_2OH (**4**) H_2SO_4 (**5**) CH_3CH_2Cl

Weakest [5] < [1] < [3] < [2] < [4] **Strongest**

1pt each box

5pts

8. (16, 4 pts each) For each of the following questions (a)-(d) **circle** the item that is the correct answer.

(a) Which one of the following compounds has the **highest acidity**?

LiBr $CH_3CH_2CO_2H$ CH_3CH_2OH Na_2SO_4 $(CH_3)_3CLi$ $(CH_3)_3CNH_2$ CH_4

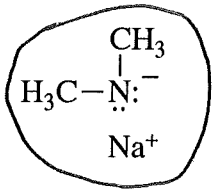
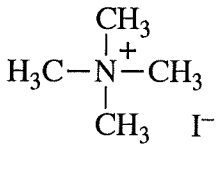
4pts

(b) Which one of the following **carbocations** is the **most stable**?

$(C_2H_5)_2\overset{+}{C}H$ $CH_3\overset{+}{C}H_2$ $CH_3CH_2\overset{+}{C}HCH_3$ $(CH_3)_3C\overset{+}{C}H_2$ $\overset{+}{C}H_3$ $(C_2H_5)_2\overset{+}{C}CH_3$

4pts

(c) Which one of the following compounds is the **strongest base**?

CH_3OCH_3   CH_4 NaI Na_2SO_4

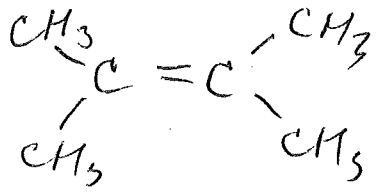
4pts

(most stable)

(d) Which of the following alkenes undergoes the *least* **exothermic hydrogenation** (has the lowest heat of hydrogenation)?

4pts

1-butene *cis*-2-butene *trans*-2-butene 2,3-dimethyl-2-butene 2-methyl-2-butene



16pts