

CHEM 3311

Summer 2001

Exam II

Name: _____

Answer Key

Your TA's name: _____

Please put your name on each exam page.

Please check to see that you have all 7 questions.

Question #	Points Earned
1 (10 points)	_____
2 (14 points)	_____
3 (16 points)	_____
4 (24 points)	_____
5 (16 points)	_____
6 (13 points)	_____
7 (7 points)	_____
Max: 100	Total _____

TABLE 4.2

Acid Dissociation Constants K_a and pK_a Values for Some Brønsted Acids*

Acid	Formula [†]	Dissociation constant, K_a	pK_a	Conjugate base
Hydrogen iodide	HI	$\approx 10^{10}$	≈ -10	I^-
Hydrogen bromide	HBr	$\approx 10^9$	≈ -9	Br^-
Hydrogen chloride	HCl	$\approx 10^7$	≈ -7	Cl^-
Sulfuric acid	HOSO ₂ OH	1.6×10^5	-4.8	HOSO ₂ O ⁻
Hydronium ion	H—OH ₂ ⁺	55	-1.7	H ₂ O
Hydrogen fluoride	HF	3.5×10^{-4}	3.5	F ⁻
Acetic acid	$\begin{array}{c} O \\ \\ CH_3COH \end{array}$	1.8×10^{-5}	4.7	$\begin{array}{c} O \\ \\ CH_3CO^- \end{array}$
Ammonium ion	H—NH ₃ ⁺	5.6×10^{-10}	9.2	NH ₃
Water	HOH	$1.8 \times 10^{-16.4}$	15.7	HO ⁻
Methanol	CH ₃ OH	$\approx 10^{-16}$	≈ 16	CH ₃ O ⁻
Ethanol	CH ₃ CH ₂ OH	$\approx 10^{-16}$	≈ 16	CH ₃ CH ₂ O ⁻
Isopropyl alcohol	(CH ₃) ₂ CHOH	$\approx 10^{-17}$	≈ 17	(CH ₃) ₂ CHO ⁻
tert-Butyl alcohol	(CH ₃) ₃ COH	$\approx 10^{-18}$	≈ 18	(CH ₃) ₃ CO ⁻
Ammonia	H ₂ NH	$\approx 10^{-36}$	≈ 36	H ₂ N ⁻
Dimethylamine	(CH ₃) ₂ NH	$\approx 10^{-36}$	≈ 36	(CH ₃) ₂ N ⁻

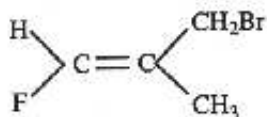
Name: _____

1. (10 points) Write correct IUPAC names or draw the structures as necessary.



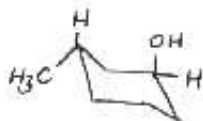
3-ethyl-8-methyl-3-nonene

(B)



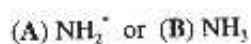
(E)-3-bromo-1-fluoro-2-methylpropene

(C) *trans*-3-methylcyclohexanol (most stable conformation) (OH is smaller than CH_3)

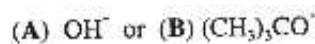


2. (14 points) For each of the following pairs place the letter **A** or **B** in the space at the right to indicate the appropriate answer to the question.

(i) Identify the stronger base in each pair shown below:

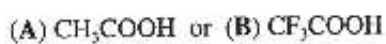


A

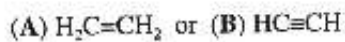


B

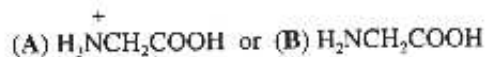
(ii) Identify the stronger acid in each pair shown below:



B

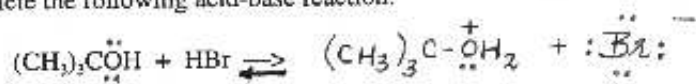


B



A

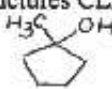
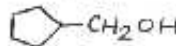
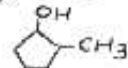
Complete the following acid-base reaction:



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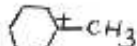
3. (16 points)

(i) Arrange the following alcohols in order of their decreasing reactivity with HBr (most reactive first). Draw the structures CLEARLY to receive partial credit.

- A. 1-Methylcyclopentanol 
- B. Cyclopentylmethanol 
- C. 2-Methylcyclopentanol 

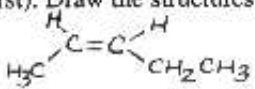
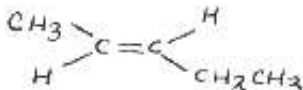
Decreasing reactivity: $\frac{A}{3^\circ} > \frac{C}{2^\circ} > \frac{B}{1^\circ}$

(ii) Arrange the following carbocations in order of their decreasing stabilities (most stable first). Draw the structures CLEARLY to receive partial credit.

- A. 1-Ethylbutyl cation $\text{CH}_3\text{CH}_2\text{CH}_2\overset{+}{\text{C}}\text{HCH}_2\text{CH}_3$
- B. Pentyl cation $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\overset{+}{\text{C}}\text{H}_2$
- C. 1-Methylcyclohexyl cation 

Decreasing stability: $\underline{C} > \underline{A} > \underline{B}$

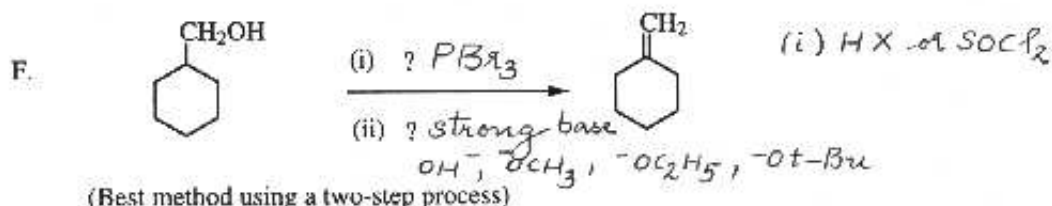
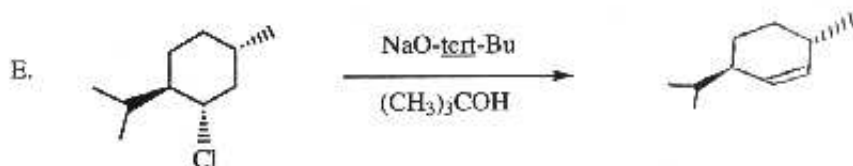
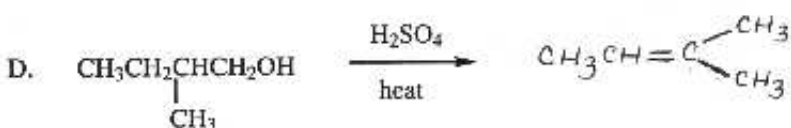
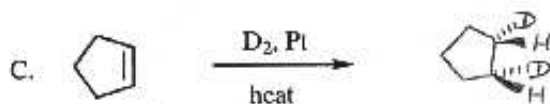
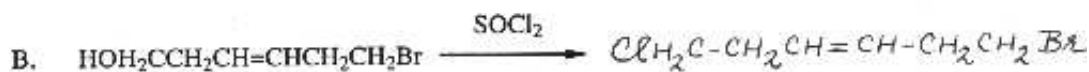
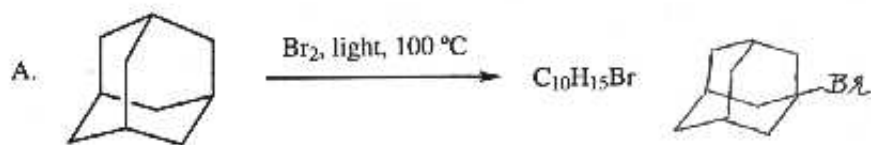
(iii) Arrange the following alkenes in order of their increasing heats of hydrogenation (lowest heat of hydrogenation first). Draw the structures CLEARLY to receive partial credit.

- A. *cis*-2-pentene 
- B. 2-methyl-2-butene $\text{CH}_3-\overset{\text{CH}_3}{\text{C}}=\text{CH}-\text{CH}_3$
- C. 1-pentene $\text{CH}_2=\text{CH}-\text{CH}_2\text{CH}_2\text{CH}_3$
- D. *trans*-2-pentene 

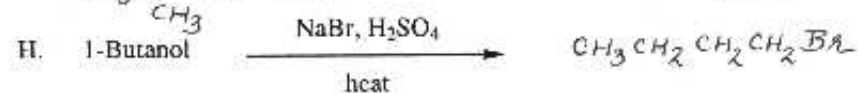
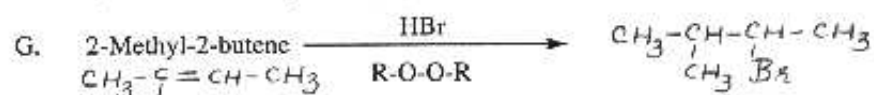
Increasing heats of hydrogenation: $\underline{B} < \underline{D} < \underline{A} < \underline{C}$

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4. (24 points) Draw clearly the structure (including stereochemistry where appropriate) of the major organic product in each of the following reactions:



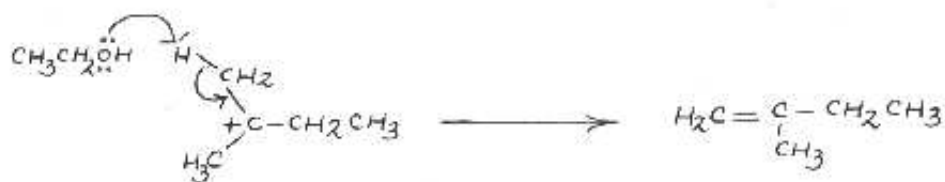
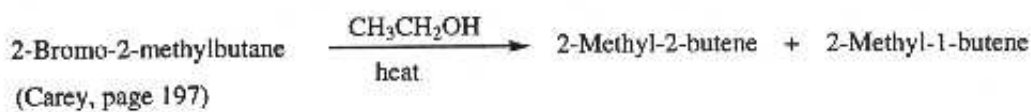
(Best method using a two-step process)



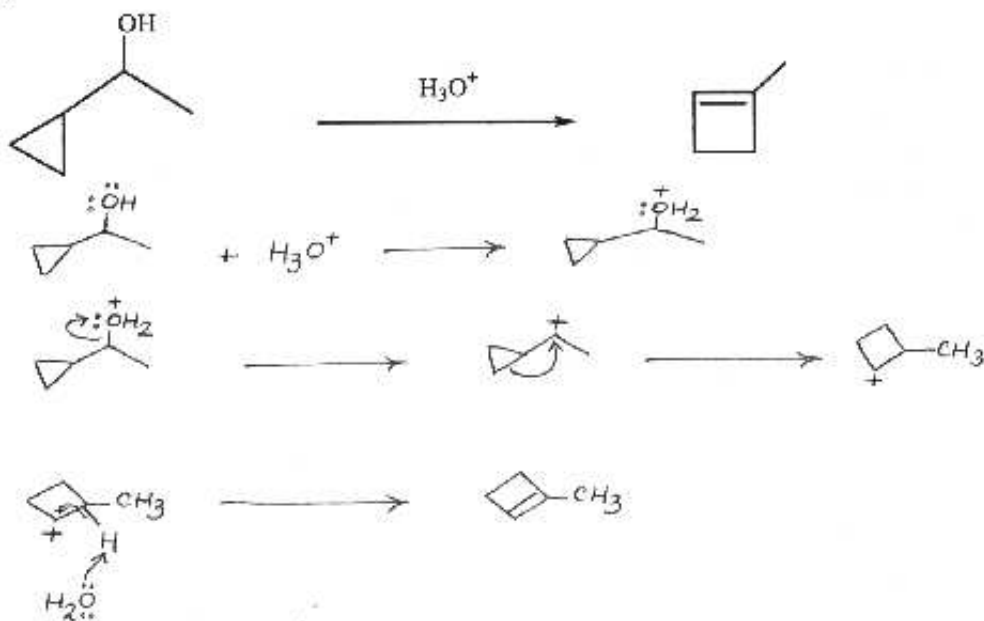
Name: _____

5. (16 points) Using the arrow formalism, draw a detailed, stepwise mechanism for each of the following reactions:

A.

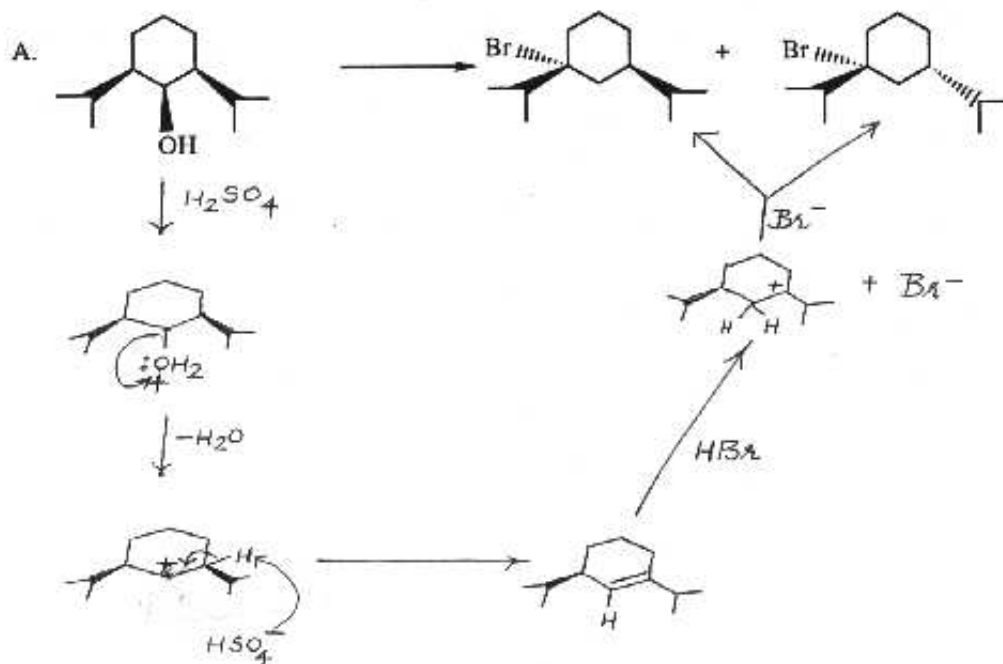


B.

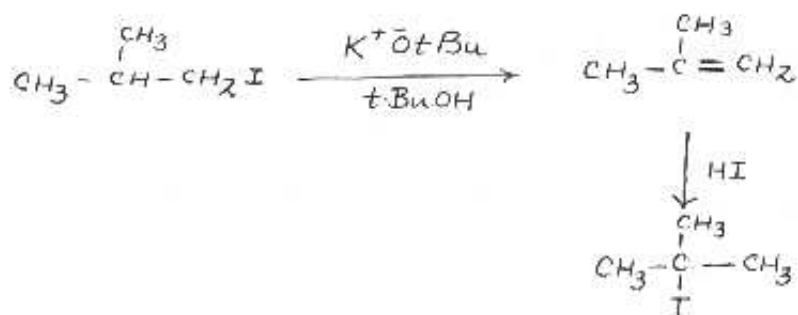


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6. (13 points) Showing all reagents and intermediate compounds, propose a reasonable synthesis of each product shown below, starting with the reactant specified in the question.



B. Isobutyl iodide \rightarrow t-Butyl iodide (Carey, page 254, question 6.32 g)



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7. (7 points) Draw a picture showing the orbitals in the transition state for concerted E2 elimination of an alkyl halide.

