

Last Name _____

First Name _____

Student ID# _____

Chemistry 343 – Hour Exam #3

Friday, May 5, 2000

General Instructions:

- (i) Do not open exam until 9:55 (when bell rings).
- (ii) Use blank paper on the back of each page to work out answers. Final answers must be written legibly in the space provided.
- (iii) Print your name on each page.

*****No credit will be given for illegible and/or ambiguous answers.*****

Grade

page 3	_____ /15
page 4	_____ /15
page 5	_____ /17
page 6	_____ /17
page 7	_____ /12
page 8	_____ /14
page 9	_____ /8
correct room?	_____ /2
TOTAL	_____ /100

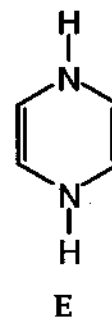
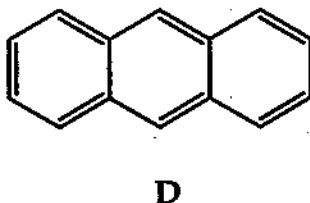
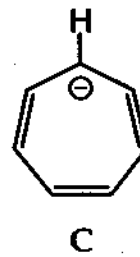
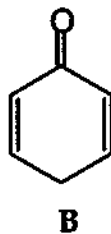
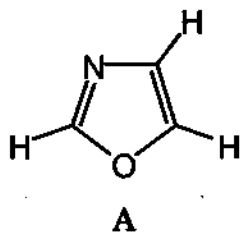
(Substantiated evidence for cheating or other misconduct is grounds for automatic course failure and subject to further prosecution.)

Name _____

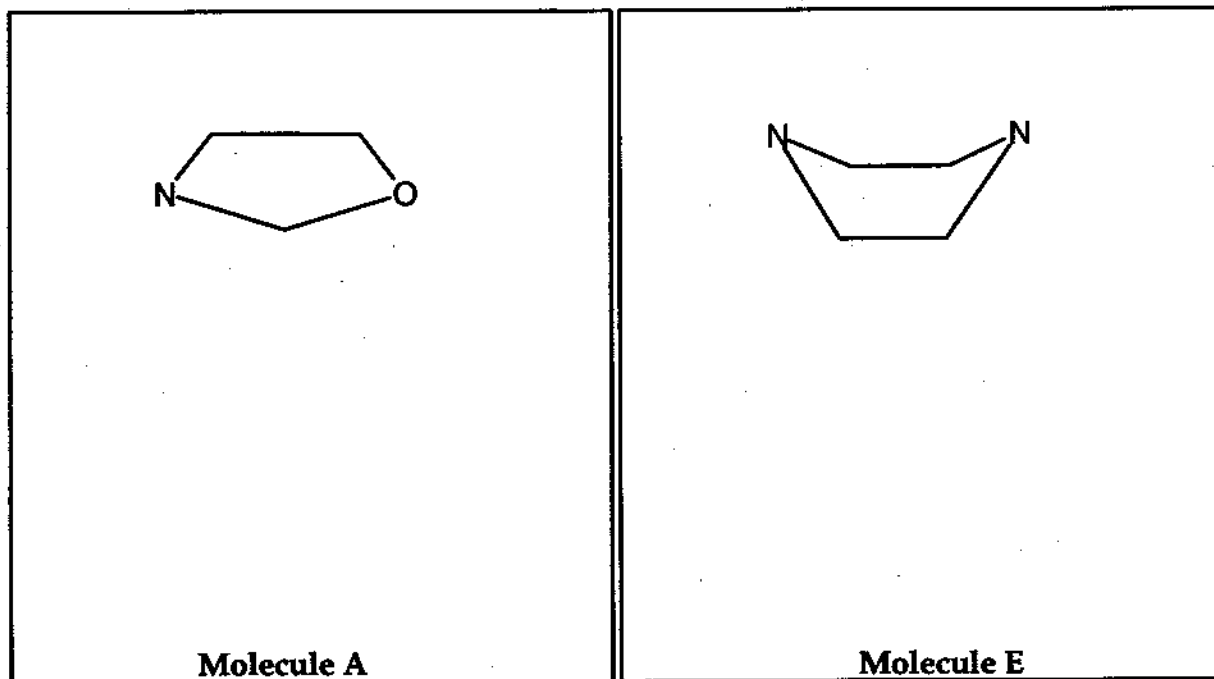
(scratch paper)

1. [15 pts]

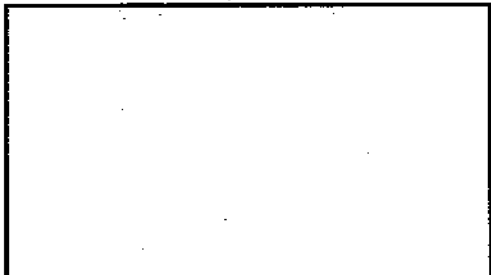
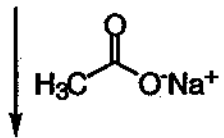
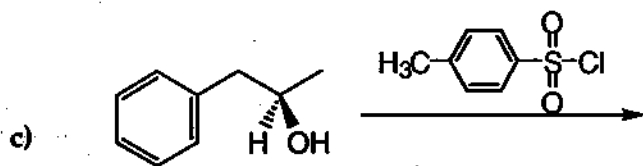
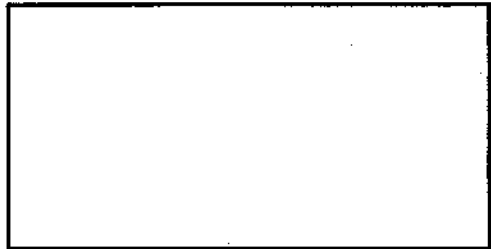
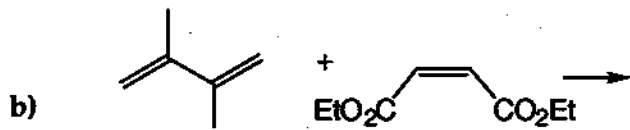
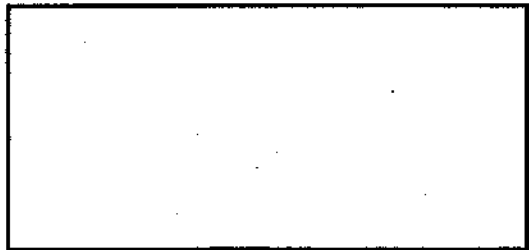
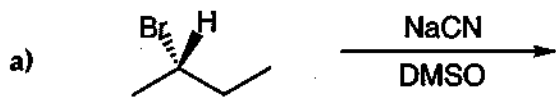
a) (7 pts) Circle the molecules below that are aromatic.



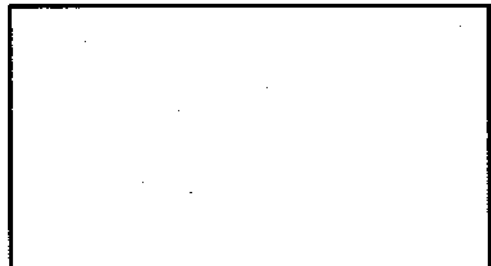
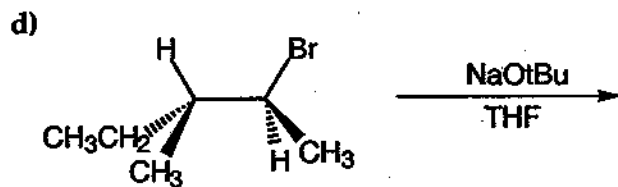
b) (8 pts) Elaborate on your answer for molecules A and E by clearly drawing the orbitals that contain lone pairs or are involved in π -bonding. Indicate the number of electrons in each orbital. Below the drawing list two factors that lead to aromaticity or lack thereof.

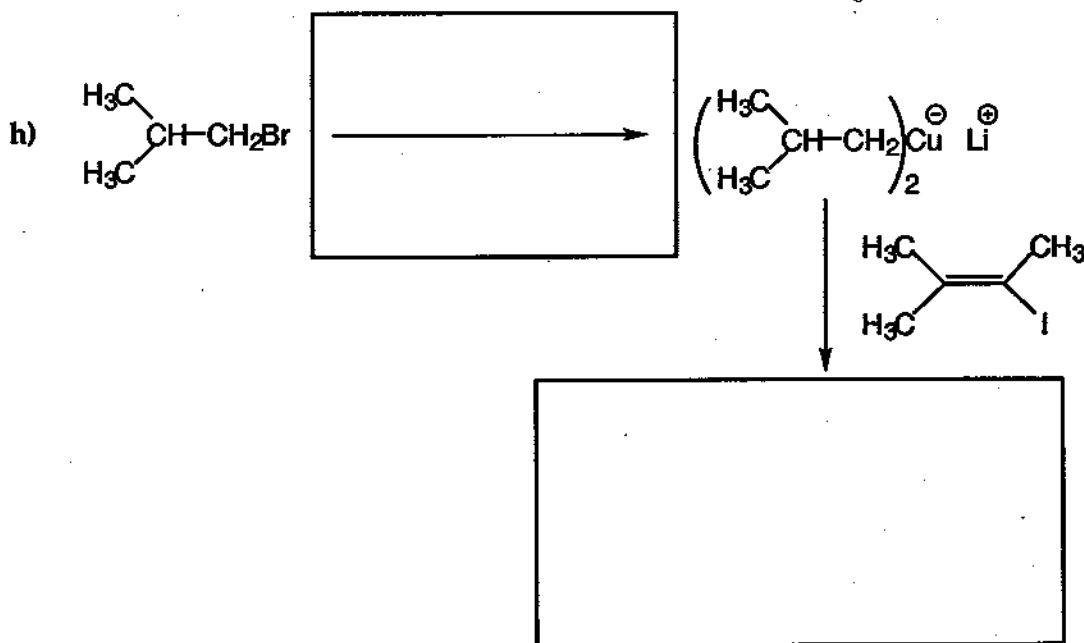
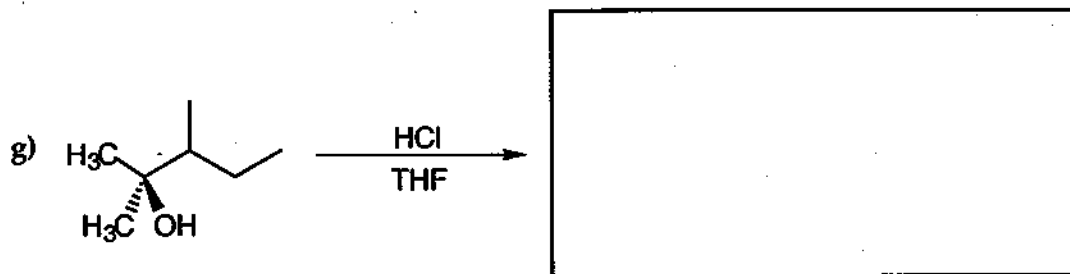
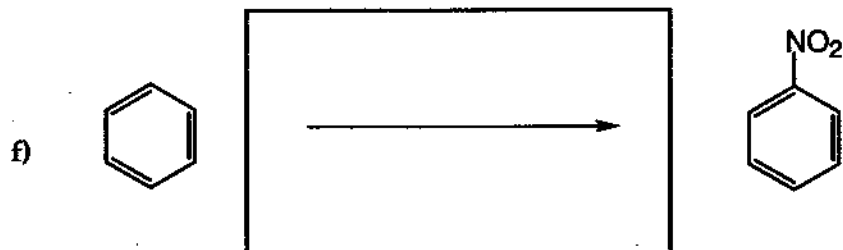
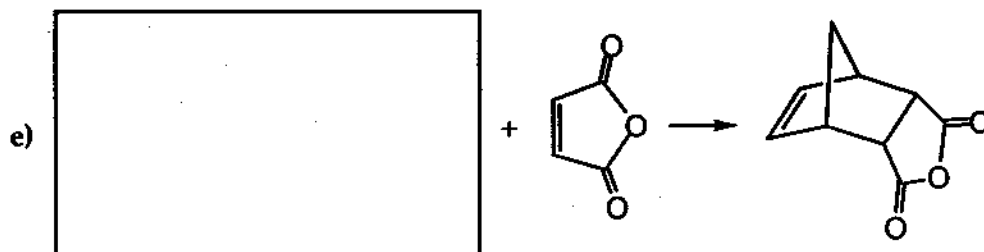


2. [32 pts] For each reaction provide the reagent and/ or major product(s). Clearly indicate stereochemistry where appropriate.



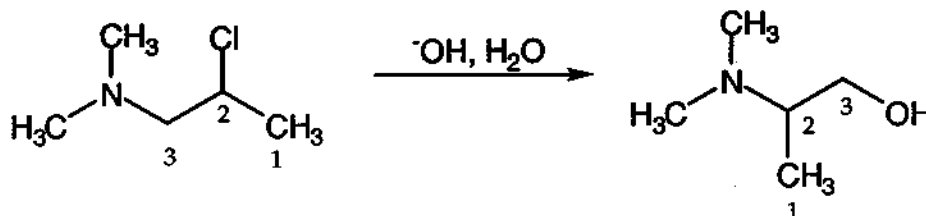
(single stereoisomer)





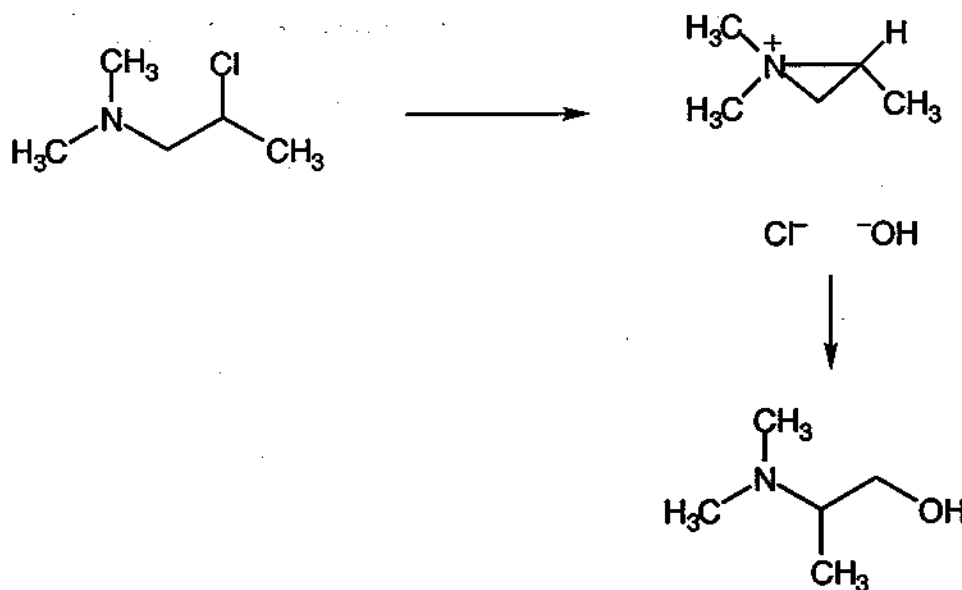
(show only non-metallic product(s))

3. [17 pts] Consider the following reaction. The numbers track the changes in position of individual atoms in the reaction.



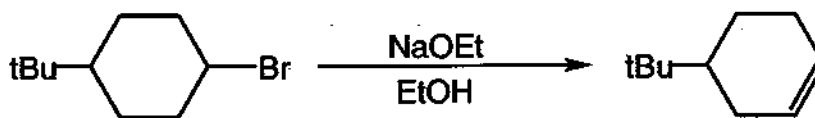
a) (3 pts) List all stereogenic centers in the two molecules.

b) (10 pts) As indicated by the carbon numbers, during the course of this reaction the bond between the nitrogen atom and carbon #3 is broken and a bond between the nitrogen atom and carbon #2 is formed. Provide an arrow pushing mechanism for this reaction using the structures provided below.



c) (4 pts) If the absolute configuration of the starting material is *R*, what is the configuration of the product? Justify your answer.

4. [18 pts] A tertiary butyl substituent on a cyclohexane ring strongly prefers the equatorial position. The molecule shown below can exist as a *cis*- or *trans*- isomer. If this molecule is added to a solution of sodium ethoxide in ethanol, it undergoes an elimination reaction to generate an olefin.



a) (4 pts) Clearly draw the most stable three-dimensional conformations of the *cis*- and *trans*- isomers of the starting material.

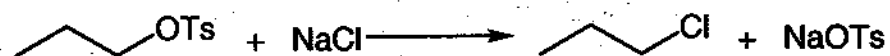
b) (2 pts) Which isomer will be more reactive under the reaction conditions?

c) (6 pts) Justify your answer in part b. Draw the *transition state* for the more reactive isomer.

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d) (8 pts) The reaction rate of the less reactive isomer is sufficiently slow to suggest that it may proceed by an E1 mechanism. Suggest two experiments that will allow you to determine the mechanism of the reaction. Explain.

5. [11 pts] Consider the S_N2 reaction shown below.



a) (6 pts) Which solvent, CH₃OH or DMSO, will lead to a faster rate? Explain your answer. Include pictures, if possible.

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b) (8 pts) Draw an energy diagram that clearly reflects the energy differences between reactions in CH_3OH and DMSO.

1	1 H 1.008																	2 He 4.003						
2	3 Li 6.940	4 Be 9.012																	5 B 10.82	6 C 12.011	7 N 14.008	8 O 15.999	9 F 19.00	10 Ne 20.183
3	11 Na 22.991	12 Mg 24.32																	13 Al 26.98	14 Si 28.09	15 P 30.975	16 S 32.06	17 Cl 35.453	18 Ar 39.944
4	19 K 39.100	20 Ca 40.08	21 Sc 44.96	22 Ti 47.90	23 V 50.95	24 Cr 52.01	25 Mn 54.94	26 Fe 55.85	27 Co 58.94	28 Ni 58.71	29 Cu 63.54	30 Zn 65.38	31 Ga 69.72	32 Ge 72.60	33 As 74.91	34 Se 78.96	35 Br 79.916	36 Kr 83.80						
5	37 Rb 85.48	38 Sr 87.63	39 Y 88.92	40 Zr 91.22	41 Nb 92.91	42 Mo 95.95	43 Tc (99)	44 Ru 101.1	45 Rh 102.91	46 Pd 106.4	47 Ag 107.87	48 Cd 112.4	49 In 114.82	50 Sn 118.70	51 Sb 121.76	52 Te 127.61	53 I 126.91	54 Xe 131.30						
6	55 Cs 132.91	56 Ba 137.36	57 La 138.92	72 Hf 178.50	73 Ta 180.95	74 W 183.86	75 Re 186.22	76 Os 190.2	77 Ir 192.2	78 Pt 195.09	79 Au 197.0	80 Hg 200.6	81 Tl 204.39	82 Pb 207.2	83 Bi 208.9	84 Po (209)	85 At (210)	86 Rn (222)						
7	87 Fr (223)	88 Ra 226.03	89 Ac 227.0	104 Rf (261)	105 Ha (262)	106 -- (263)													Halogens ↑		Noble Gases ↑			
Alkali Metals			58 Ce 140.12	59 Pr 140.92	60 Nd 144.27	61 Pm (145)	62 Sm 150.35	63 Eu 152.35	64 Gd 157.26	65 Tb 158.93	66 Dy 162.51	67 Ho 164.94	68 Er 167.2	69 Tm 168.94	70 Yb 173.04	71 Lu 174.99								
Click Here For Conversion Factors			90 Th 232.04	91 Pa (231)	92 U 238.07	93 Np (237)	94 Pu (242)	95 Am (243)	96 Cm (245)	97 Bk (249)	98 Cf (251)	99 Es (254)	100 Fm (255)	101 Md (256)	102 No (259)	103 Lr (260)								

Radioactive → **84** **Po** (209) ← METALLOID (elements to left of metalloids are metals; to right, non-metals)

ATOMIC NO. → **84** ← CHEMICAL SYMBOL

ATOMIC WEIGHT → **(209)** ← Parentheses indicate element is artificially produced & mass number of longest-lived isotope.