

MIDTERM #1
 CHM 2120 3X
 Prof: Mark Dornan

Last name: _____

First name: _____

Student #: _____

Date: June 16th 2015

Notes:

- Approximate total number of points: 60
- There are 10 pages in this exam
- Molecular models are allowed
- Re-grade requests for exams written in pencil will not be considered

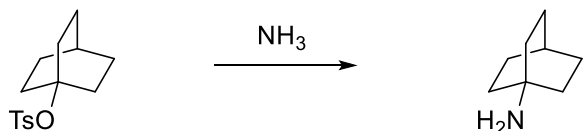
	1a	2a	3b	4b	5b	6b	7b		8		1b	2b	3a	4a	5a	6a	7a	0					
1																			2				
H																			He				
3	4																	5	6	7	8	9	10
Li	Be																	B	C	N	O	F	Ne
11	12																	13	14	15	16	17	18
Na	Mg																	Al	Si	P	S	Cl	Ar
19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36						
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr						
37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54						
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe						
55	56	57	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86						
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn						
87	88	89	104	105	106																		
Fr	Ra	Ac	Rf	Ha	106																		

pK_a table

Acid	pK _a
HBr	-9
ROH ₂ ⁺	-2
H ₃ O ⁺	-1.75
RCO ₂ H	5
R ₃ NH ⁺	10-11
H ₂ O	15.75
ROH	16-18
RC(O)CH ₃	20
HC≡CH	25
H ₂	36
R ₂ NH	35-40
CH ₂ =CH ₂	44
RCH ₃	55

1. Provide the reaction type of the major product (S_N1, S_N2, E1 or E2) and predict how the given change in reaction conditions would affect the rate of this reaction (Faster, Slower or No change). **8 marks**

a.



Reaction type:

S_N1

1

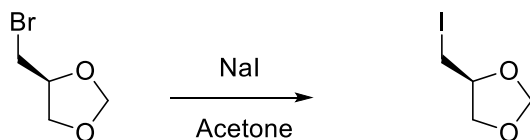
Affect on rate:

No change

1

Decrease ammonia concentration.

b.



Reaction type:

S_N2

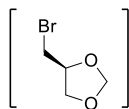
1

Affect on rate:

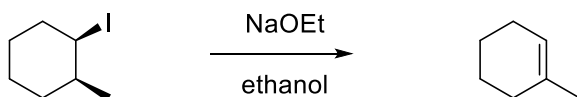
Increase

1

Increase



c.



Reaction type:

E2

1

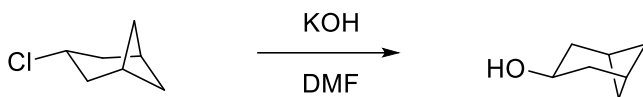
Affect on rate:

Increase

1

Increase base concentration.

d.



Reaction type:

S_N2

1

Affect on rate:

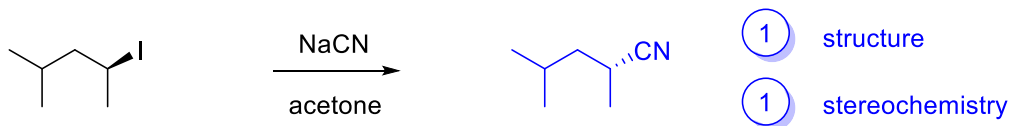
Decrease

1

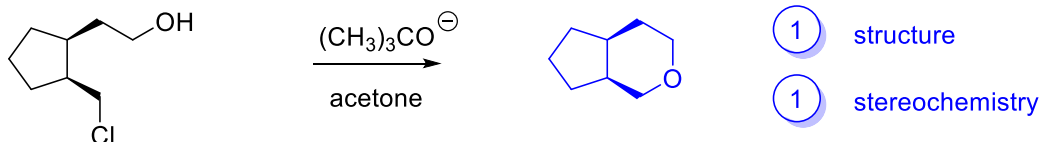
Change solvent to H₂O

2. Provide the products for the following reactions. **12 marks**

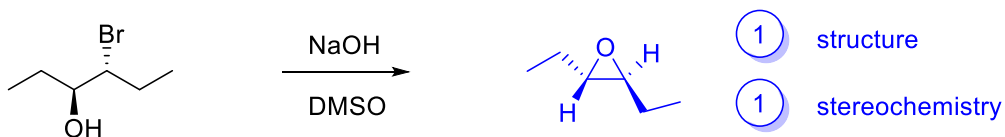
a.



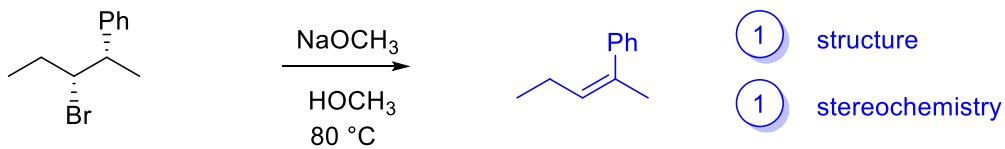
b.



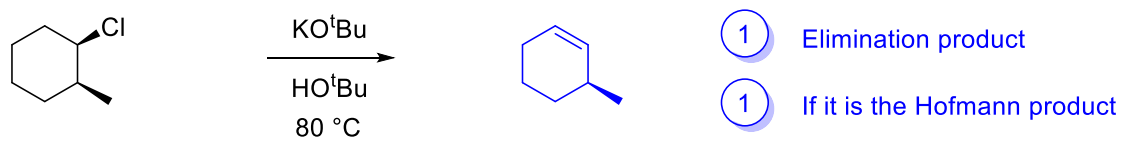
c.



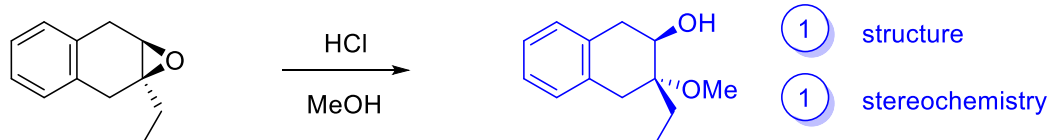
d.



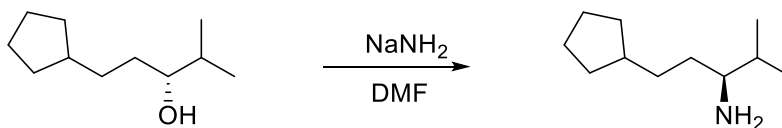
e.



f.

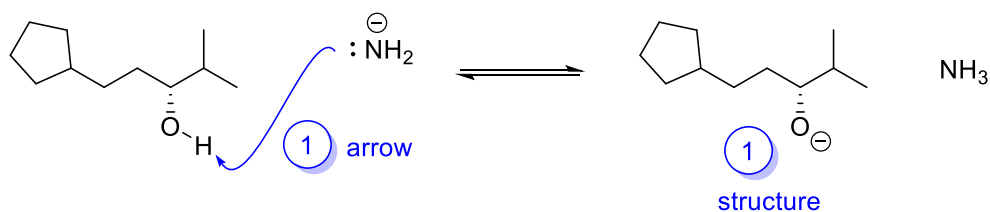
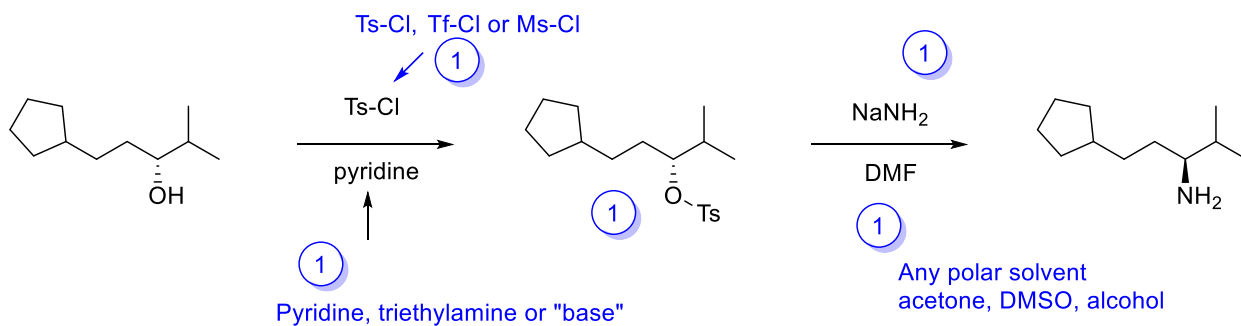


3.

a. Explain why the following reaction will not work as shown. **1 mark**b. Provide the product and mechanism of the reaction that would occur instead. **2 marks**

\ominus OH is a bad leaving group, or;
Acid/base chemistry will happen first

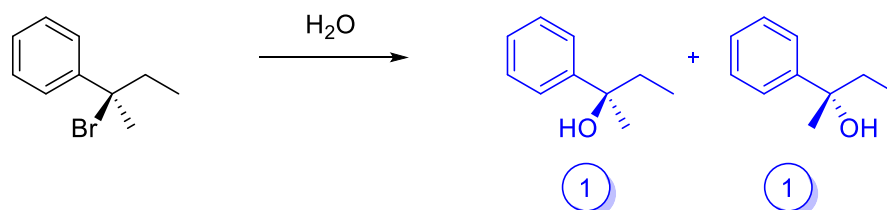
(1)

c. How would you make the product shown starting from the same reactant? Provide reagents, and reaction conditions (no mechanisms needed). **5 marks**

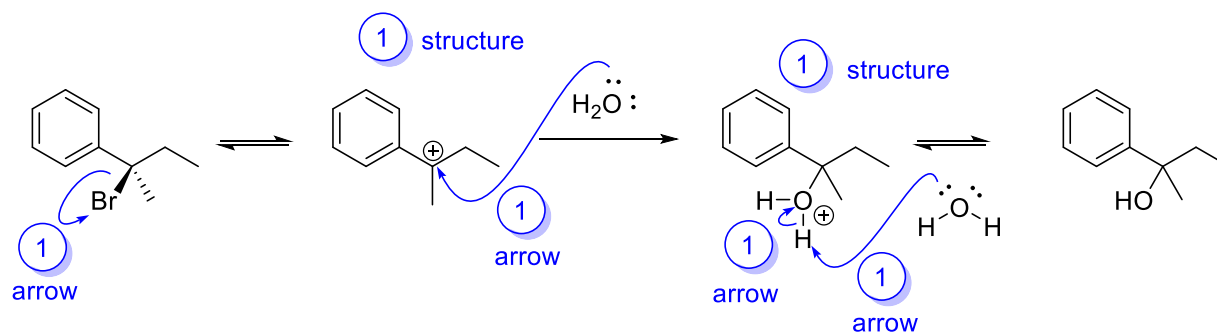
If acidified the OH to make a H_2O LG and then introduced the nucleophile, 2 marks.

4.

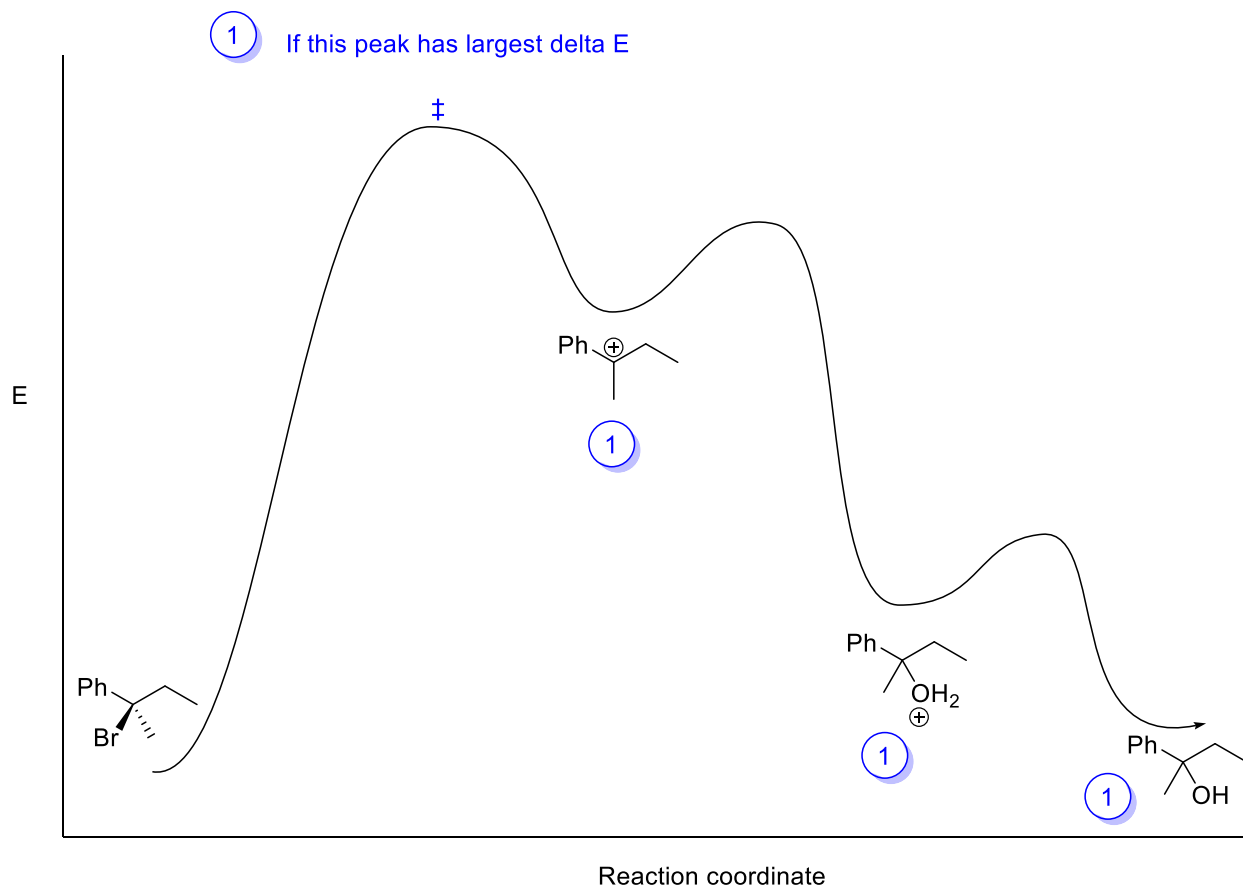
a. Predict the major neutral product(s) for the following substitution reaction and provide the mechanism. **8 marks**



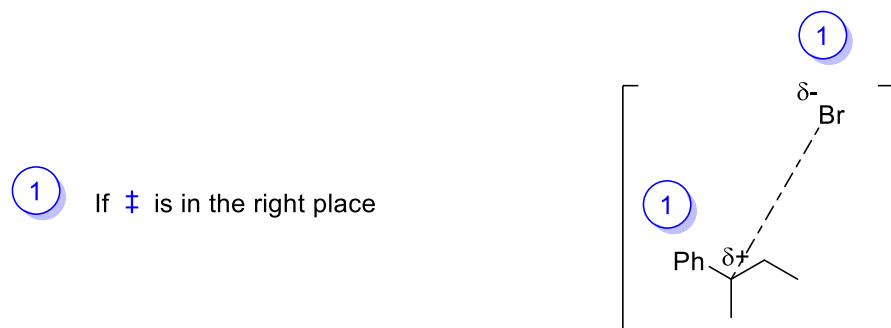
Note: only 1 mark if they got the right product but didn't note the 2 enantiomers.



b. Complete the reaction coordinate diagram that describes this reaction. Include intermediate structures. **4 marks**

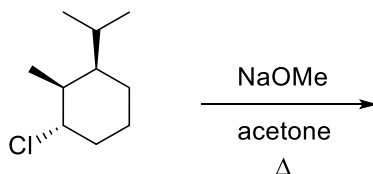


c. Indicate the transition state of the rate determining step on the diagram with the symbol (\ddagger) and draw the structure of the transition state below. **3 marks**



Both Br and substrate should be present
 delta + and delta - not needed but it should be clear
 that TS looks more like the carbocation than the substrate
 1 mark if only carbocation structure is drawn, 2 if LG is present

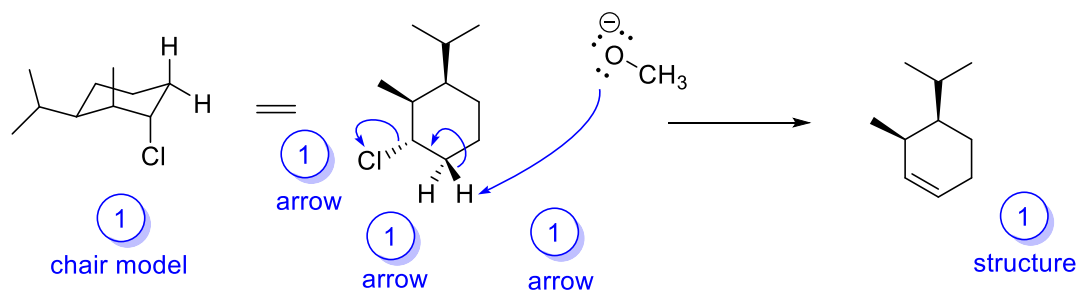
5. Consider the reaction below.



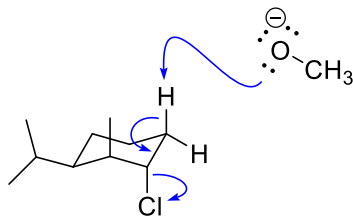
a. What type of reaction (S_N1 , S_N2 , E1 or E2) do these conditions favour? **1 mark**

E2 (1)

b. Write the expected product and the mechanism by which it forms. Include a chair model of the reactive conformation. **5 marks**



ok to show mechanism on 3d chair too:

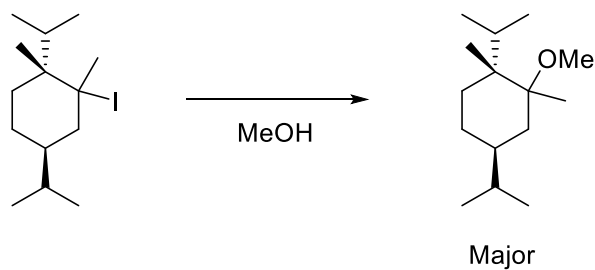


note: If everything else is right, but they made the most substituted alkene, 3 marks

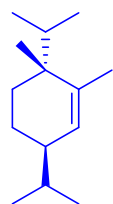
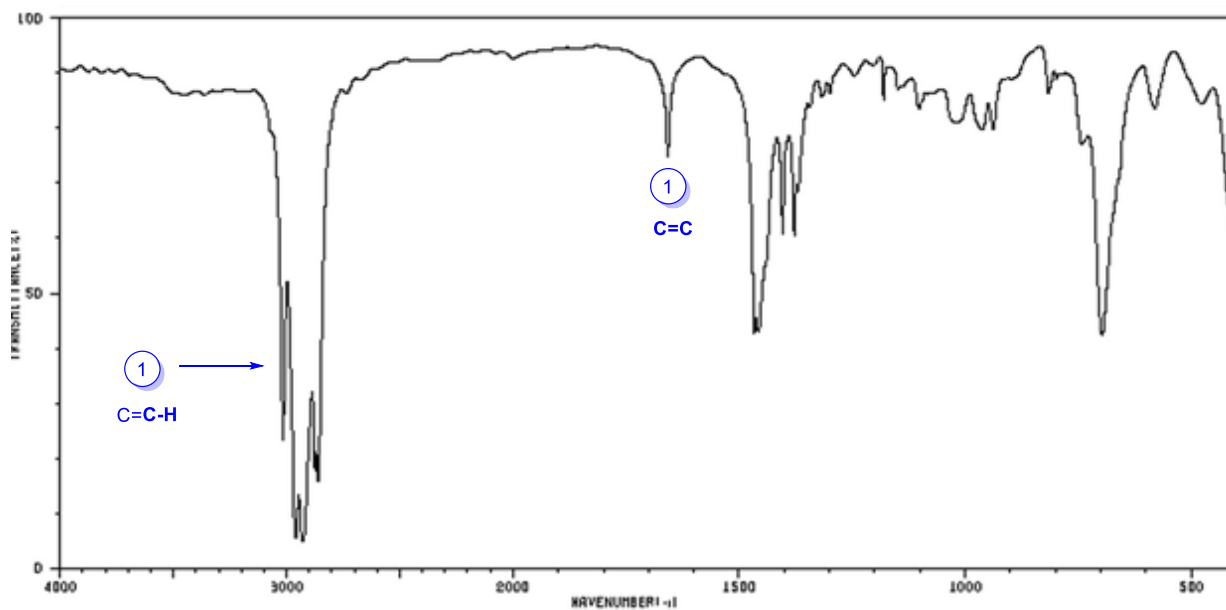
c. What are the implications on the reaction's regiochemistry by using LDA as a base instead? **2 marks**

No implications (1 mark), you will get the same product. Small base cannot make the most stable alkene as the beta-hydrogen is not APP. A large base will still select from the least hindered b-hydrogen. (1 mark)

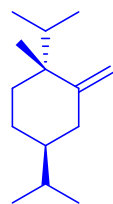
7. The following reaction was completed and the major product shown was obtained.



The most prominent minor product was isolated and an IR spectrum was acquired as shown below. Provide the most likely structure (**2 marks**) and highlight key peaks on the IR spectrum that support your answer. **2 marks**



②
correct structure



← If wrong E2 product selected, 1 mark

8. Bonus question:

What is your favourite reaction (**1 mark**) and why? (**2 marks**)

+ 3 marks for everyone