

# ANSWERS

CHM 2120  
Midterm #1  
September 29, 2010  
ANSWERS

First Name: \_\_\_\_\_ Last Name: \_\_\_\_\_

Student Number: \_\_\_\_\_

Seat Number: \_\_\_\_\_

**Approximate total number of marks: 72**

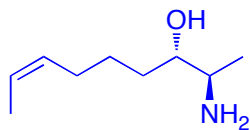
- The marks are given as a guide and are subject to change.
- You can write in pen or in pencil.
- The use of molecular models is permitted but they cannot be shared.
- The use of calculators or other electronic devices is not permitted.

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

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Final mark

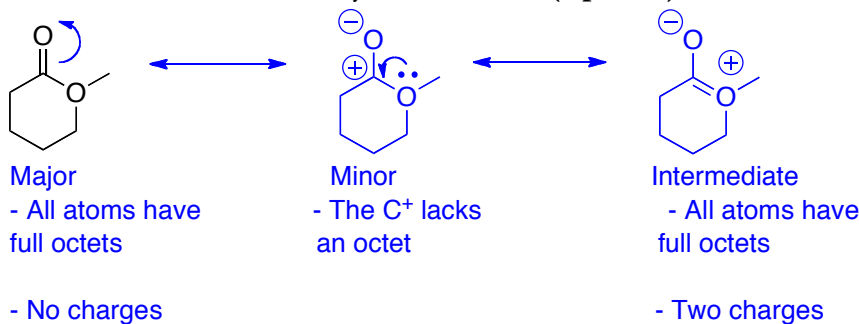
1. Draw the structure of (2R,3S,Z)-2-aminonon-7-en-3-ol. (3 points)



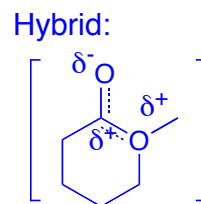
Correct skeleton : 1  
Configurations of stereocentres : 1  
Alkene Z : 1

2.

- Draw all of the resonance structures of the following compound using arrows to show the movement of electrons. (4 points)
- Rank the resonance structures. (2 points)
- Justify your ranking. (5 points)
- Draw the resonance hybrid structure. (2 points)

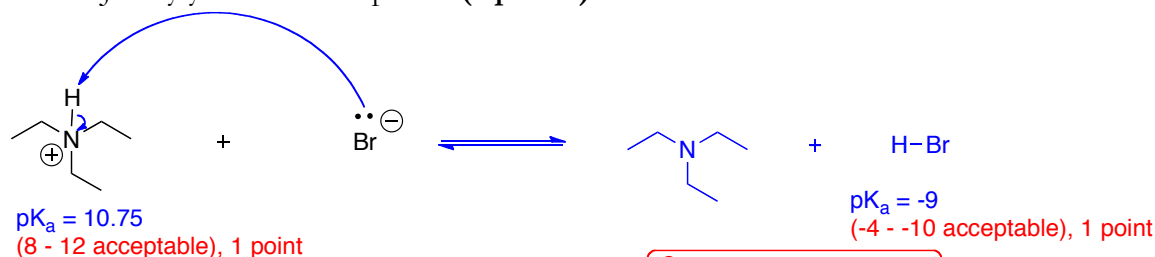


a.  
1 pt per resonance structure drawn  
1-curved arrows  
1-resonance arrow between structures  
b. -1 per error  
c. 1 point per correct statement  
d. -1 per error  
General: -1 per incorrect structure or statement



3.

- Draw the mechanism and products for the following reaction. (5 points)
- Will the reaction favour the starting materials or the products? (1 point)
- Justify your choice in part b. (3 points)



Les reactants are favoured. (1 point)

The reaction favours the side with the weakest acid (the protonated amine).

(1 point) - must make a clear comparison of the acids and demonstrate the understanding that the equilibrium favours the side with the weakest acid

a.  
1 pt per curved arrow (2)  
1 pt equilibrium arrow  
1 pt per final structure (2)

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4. Circle the least basic nitrogen atom in the following compound and justify your choice. (3 points)

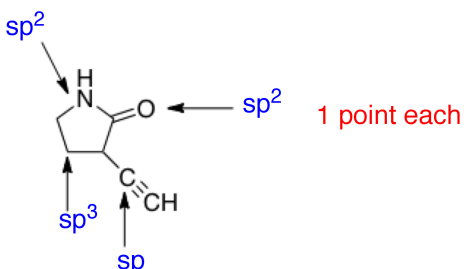


1 point: the circled N

1 point: the electrons in the right hand nitrogen are involved in resonance, they are more stabilized (they are delocalized). Aromaticity would be destroyed if this N was protonated (this would be destabilizing)

1 point: the electrons in the left hand nitrogen are not involved in resonance (they are in an  $sp^2$  orbital). Aromaticity is not destroyed if these electrons are protonated.

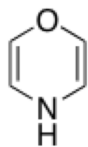
5. Identify the hybridization state for each of the atoms indicated with an arrow. (4 points)



1 point each

6. Decide whether each of the following compounds is aromatic, anti-aromatic, or non-aromatic and justify your choice (please support your answer with a drawing if you are discussing the position of electrons or orbitals in space). (11 points)

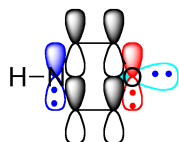
a.



The ring is planar  
All the atoms are  $sp^2$  hybridized  
There are 8  $\pi$  electrons;  $n=2$  by the  $4n$  rule

1 point each

The compound is anti-aromatic



1 point

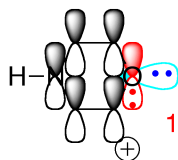
b.



The ring is planar  
All the atoms are  $sp^2$  hybridized  
There are 6  $\pi$  electrons;  $n=1$  by the  $4n+2$  rule

1 point each

The compound is aromatic



1 point

c.



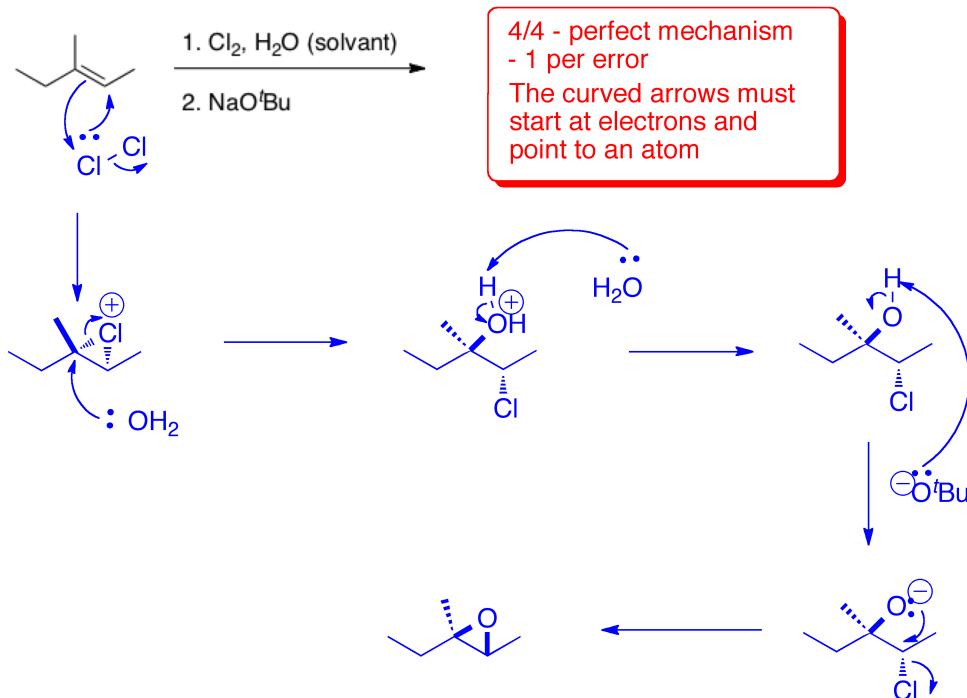
Non-aromatic (1 point). The top C is  $sp^3$  hybridized. (1

point)

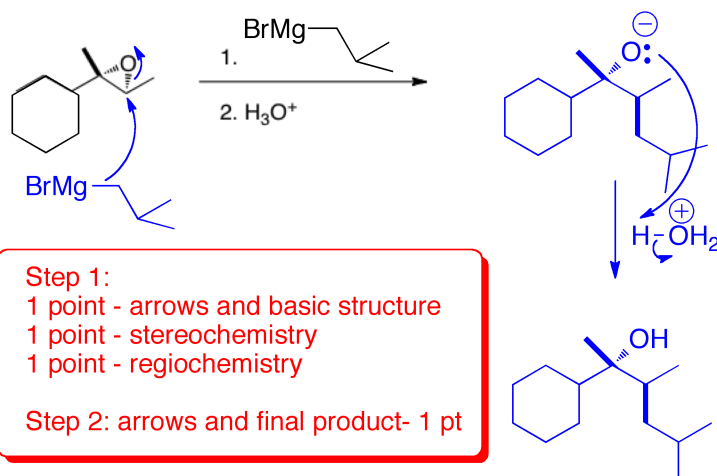
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7. Provide a mechanism and the major organic product of each of the following reactions. (4 points each = 12 points)

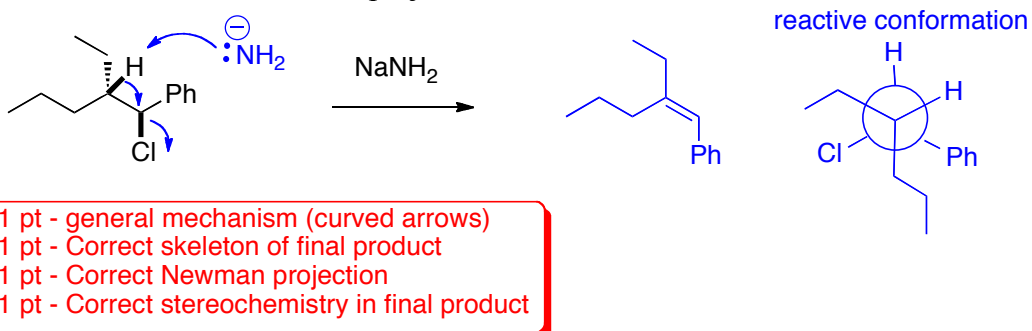
a.



b.

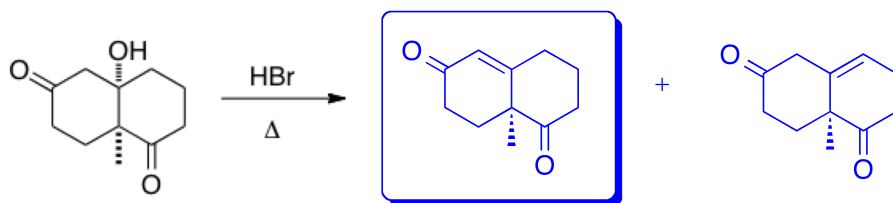


- c. Please include a Newman projection of the reactive conformation.



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- 8.
- Draw the two elimination products for the following reaction. **(2 points)**
  - Circle the major product. **(1 point)**

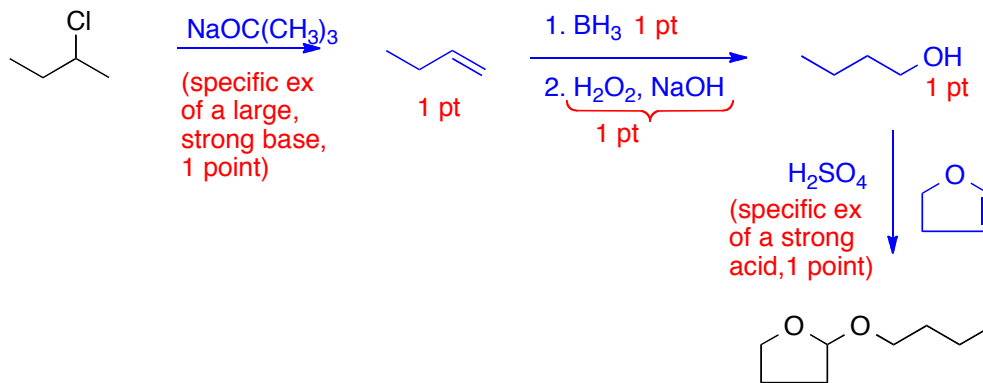


1 point per structure  
1 point for identifying the resonance-stabilized alkene

9. Propose a synthesis of:



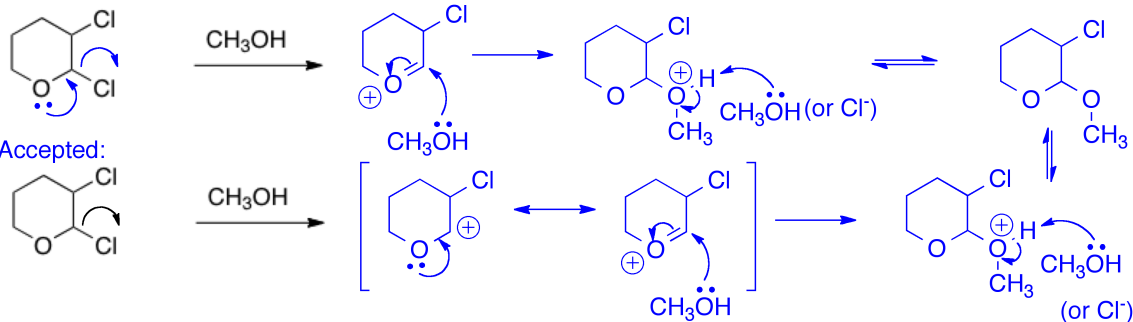
You can add in any other reagents that you require. You do not have to provide a retrosynthesis. **(6 points)**



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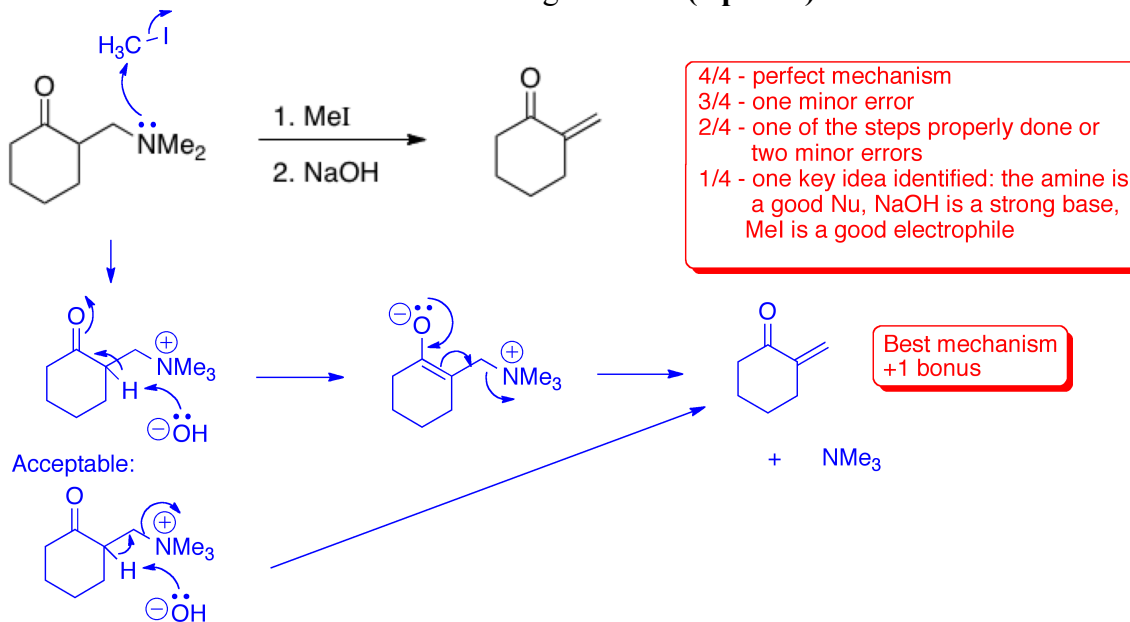
10. Draw a mechanism showing the formation of the major product (only) for the following reaction: (4 points)

Best mechanism:



2 points -  $S_N1$  mechanism well-drawn (1 point - E1)  
 1 point - regiochemistry (0 pts E1)  
 1 point - implication of oxygen lone pair shown

11. Draw a mechanism for the following reaction: (4 points)



Bonus! (3 points)

Explain the following results. Please draw a mechanism in 3D as part of your answer.

