



UNIVERSITY OF  
**TORONTO**  
SCARBOROUGH

**IF THERE IS NO NAME ON THE EXAM, IT WILL NOT BE MARKED**

## Fall 2015 Final Exam Candidate Form

Before you begin your examination, please fill out this form and leave it at the side of your desk along with your student I.D. Please sign at time of collection.

Date: December 9, 2015 Start time: 2pm Duration of Exam: 3 hours

Seat# \_\_\_\_\_ Location: GYM

Name: \_\_\_\_\_  
(please print) Surname Given Names

Student Number:

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Course: CHMB41H  
eg. (CHMA10H)

Lecture#: 1

Instructor's Name: Dr. Shadi Dalili

**I verify that the above information is true and fully accurate.**

The University of Toronto's *Code of Behaviour* on Academic Matters applies to all University of Toronto Scarborough students. The *Code* prohibits all forms of academic dishonesty including, but not limited to, cheating, plagiarism, and the use of unauthorized aids. Students violating the *Code* may be subject to penalties up to and including suspension or expulsion from the University.

Signature: \_\_\_\_\_  
(sign only at time form is collected)

**NOTE TO INSTRUCTOR:** The completed form is to be sent to the Registrar's Office with the Final Examination

**PRINT FULL Name:** \_\_\_\_\_ **Student Number** \_\_\_\_\_

**IF THERE IS NO NAME ON THE EXAM, IT WILL NOT BE MARKED**

**CHMB41H3**

**ORGANIC CHEMISTRY I**

**FINAL EXAM-FALL 2015**

**Dec 9<sup>th</sup>, 2015                      2-5pm**

**TIME ALLOWED: 180 minutes**

**NO CALCULATORS ALLOWED.**

**NO PAGERS OR MOBILE PHONES ALLOWED**

**Write in non-erasable pen. Do not use white-out. No re-marking claims will be accepted if these rules are broken.**

**WRITE YOUR ANSWERS FOR ALL QUESTIONS IN THE SPACES PROVIDED  
MARKS WILL BE DEDUCTED IF INSTRUCTIONS ARE NOT FOLLOWED.  
NO OTHER PAPER MAY BE USED IN THIS EXAM. A PERIODIC TABLE AND  
ROUGH PAPER ARE PROVIDED AT THE END OF THE EXAM BOOKLET.**

**The exam booklet contains 16 pages and 2 blank pages.**

**Part A. \_\_\_\_\_ (20)**

**Part B. \_\_\_\_\_ (38)**

**Part C. \_\_\_\_\_ (32)**

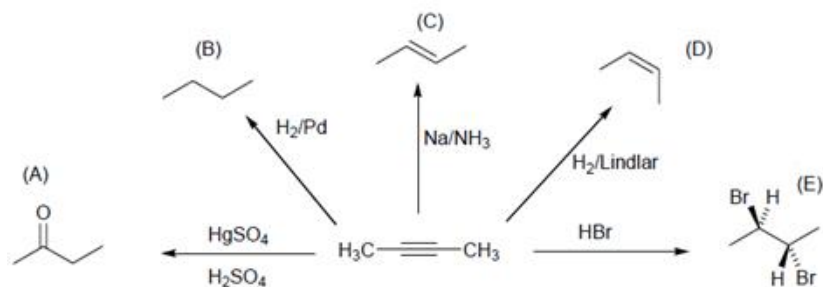
**Part D. \_\_\_\_\_ (30)**

**Part E. \_\_\_\_\_ (30)**

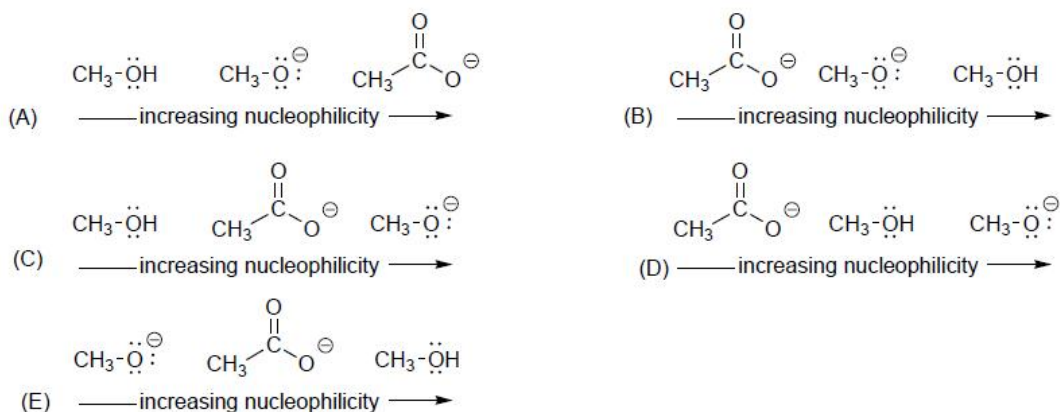
**TOTAL: \_\_\_\_\_ (150)**

**PART A: Multiple Choice Questions. (20 marks-2 mark each). Place your answers in the boxes on Page 6.**

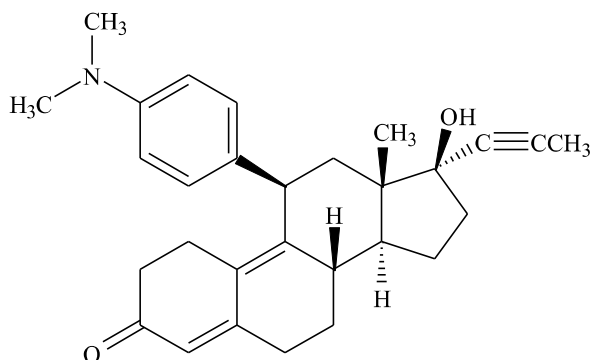
1. Choose the incorrect reaction:



2. Choose the answer that has the following nucleophiles correctly arranged with respect to increasing reactivity:

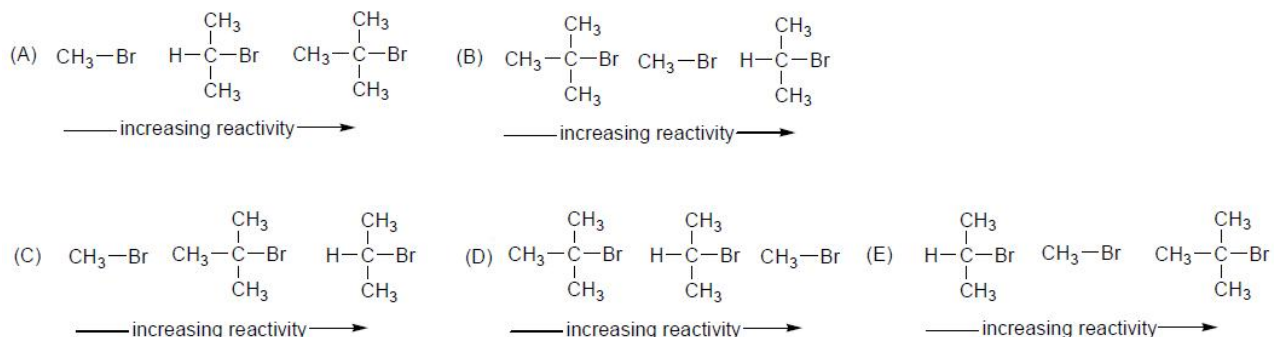


3. The synthetic steroid RU-486 (the “morning after” pill) is shown below. How many asymmetric centers are contained in the molecule..

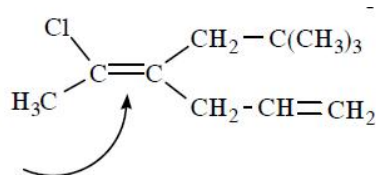


- a. 1  
b. 2  
c. 5  
d. 7  
e. 8

4. Choose the order that has the following alkyl bromides correctly arranged with respect to increased reactivity in an  $S_N2$  reaction:



5. What is the best way to describe the stereochemistry of the double bond indicated in the compound below?

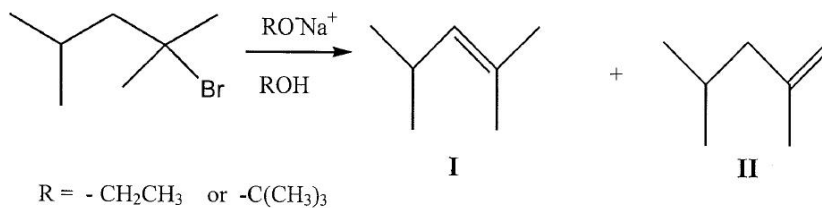


- cis*
- trans*
- E
- Z
- anti

6. Which alkyl halide is expected to react the fastest in an  $S_N1$  reaction?

- a)  $(\text{CH}_3)_3\text{CI}$   
b)  $(\text{CH}_3)_3\text{CBr}$   
c)  $(\text{CH}_3)_3\text{CCl}$   
d)  $(\text{CH}_3)_3\text{CF}$   
e) They would all react at the same rate.

7. Consider the following reaction:

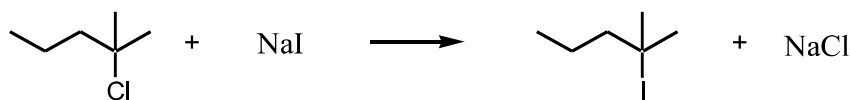


Which statement(s) below is(are) correct?

- A. I is the major product based on Zaitsev's rule
- B. The II:I ratio is greater when R = -ethyl than when R = -*tert*-butyl
- C. The II:I ratio is greater when R = -*tert*-butyl than when R = -ethyl

- a) A only
- b) B only
- c) C only
- d) A and B
- e) A and C

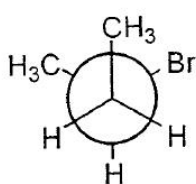
8. Consider the reaction of 2-chloro-2-methylpentane with sodium iodide.



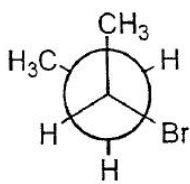
Assuming no other changes, how would it affect the rate if the concentration of 2-chloro-2-methylpentane and sodium iodide were simultaneously doubled?

- (a) No effect
- (b) It would double the rate.
- (c) It would triple the rate.
- (d) It would quadruple the rate.
- (e) It would increase the rate five times.

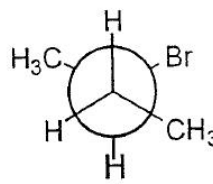
9. In the E2 elimination of 2-bromobutane, which conformation below leads directly to the formation of *cis*-2-butene?



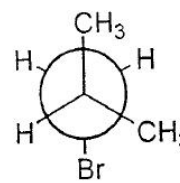
a)



b)

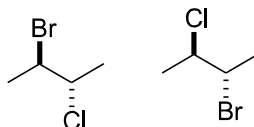


c)



d)

10. What is the relationship between the two molecules shown below?



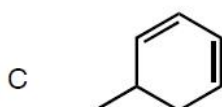
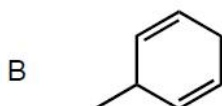
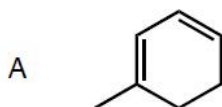
- (a) Identical
- (b) constitutional isomers
- (c) diastereomers
- (d) enantiomers
- (e) cis/trans isomers

## Part A. Multiple Choice Questions

Question	1	2	3	4	5	6	7	8	9	10
Answer										

## Part B: Short answer questions (36 Marks)

1) Rank the following dienes in order of INCREASING stability. Give a BRIEF explanation. (6 marks)

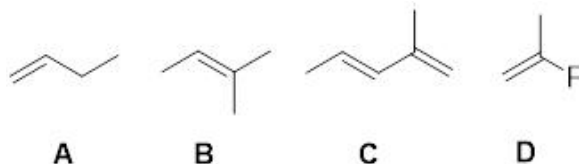


ORDER:

\_\_\_\_\_→  
*Least stable* *Most stable*

Explanation:

- 2) Rank the following alkenes in terms of their relative rates of reaction with HBr. BRIEFLY state the reasoning on which your prediction is based. **For each ranking 1 sentence explanation.** (8 marks)

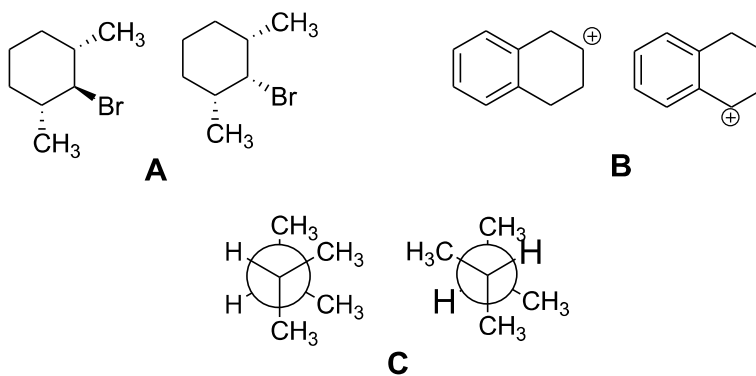


ORDER:

→
  
*Least reactive* *Most reactive*

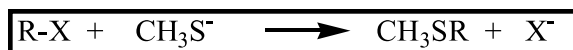
Explanation:

3. Circle the most stable molecule in each pair below and give a brief explanation for your choice in each case. (12 marks)



Explanation:

- 3) Rank the following compounds in order of *increasing* reactivity in the reaction shown below. State the name of the reaction. BRIEFLY state the reasoning on which your prediction is based. **For each ranking 1 sentence explanation.** (12 marks)



R-X:

(CH<sub>3</sub>)<sub>2</sub>CHI  
CH<sub>3</sub>Cl  
CH<sub>3</sub>CH=CHBr  
CH<sub>3</sub>CH<sub>2</sub>Br  
CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>I

ORDER:

\_\_\_\_\_→  
*Least reactive* *Most reactive*

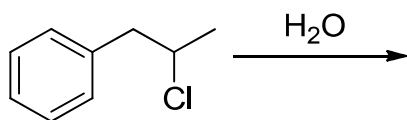
Explanation:



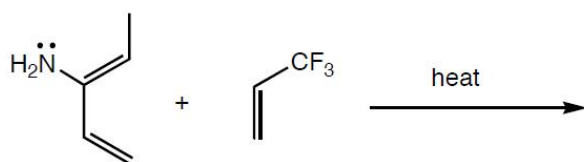
### Part C: Structure and Reagent Questions

- 1) Predict the **MAJOR** products of the following reactions. Indicate, clearly, regiochemistry and stereochemistry where necessary. There is NO case of no reaction. (32 marks)

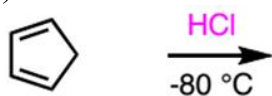
a)



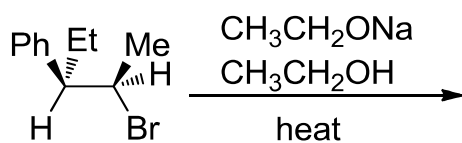
b)



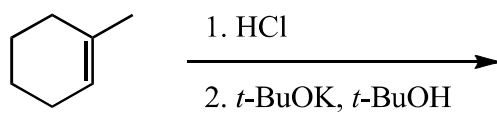
c)



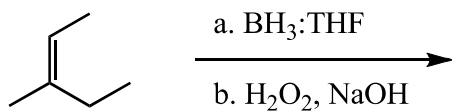
d)



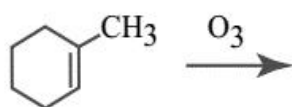
e)



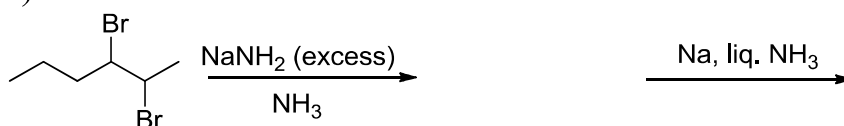
f)



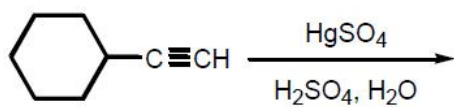
g)



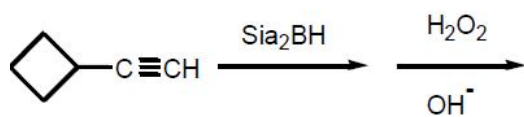
h)



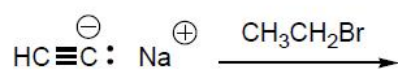
i)

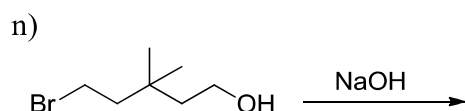
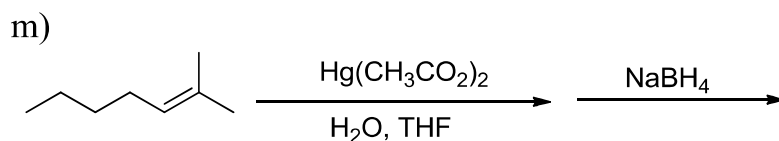
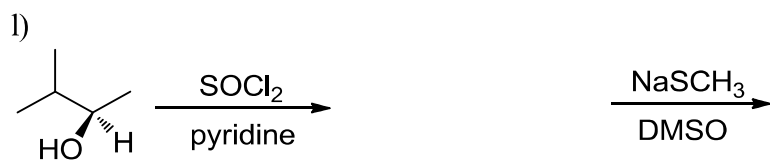


j)  $\text{Sia}_2\text{BH}$  = disiamyl borane =  $\left( \begin{array}{c} \text{CH}_3 \quad \text{CH}_3 \\ | \quad | \\ \text{CH}_3\text{CH} - \text{CH} - \end{array} \right)_2\text{BH}$



k)





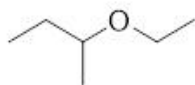
### Part D: Synthesis (30 marks)

Synthesize the following compounds from the starting materials stated, using any other organic and/or inorganic reagents. Show structure of all compounds for each step of your synthesis (you do NOT need to show any mechanisms). If there is not any starting material, suggest a proper one which leads to the desired product in as few steps as possible.

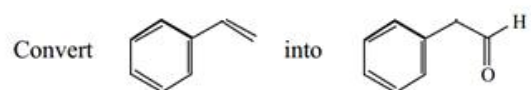
a) Prepare the following epoxide starting from acetylene: (10 marks)



b) Synthesize the ether shown using a proper substitution and alkyl bromide as starting material. (4 marks)



c) 10 marks

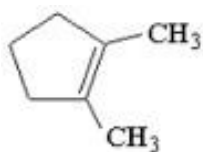


d) 6 marks

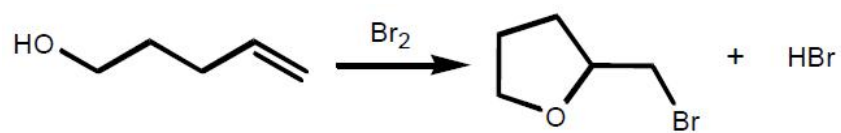


### Part E: Mechanisms (30 marks)

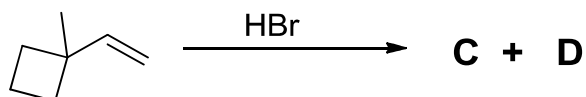
- a) When 1-bromo-2,2-dimethylcyclopentane is heated in ethanol, one of the products which results is shown below. Provide a detailed, stepwise mechanism for the production of this compound, and give the name of the mechanism by which it is produced. (8 marks)



b) Provide a detailed, step by step mechanism for the reaction below. (10 marks)

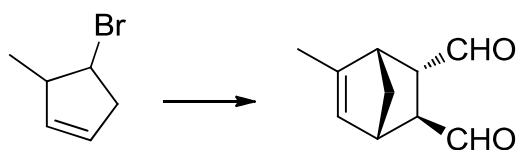


(c) Show the mechanism of reaction, complete with arrows showing electron movements, and all intermediates and the possible products for the following reaction. Label which is(are) the major and which is(are) the minor product. (12 marks)



**BONUS QUESTION:**

Synthesize the final product starting from the compound shown, using any other organic and inorganic reagents. State the type of reaction used. (5 marks)



1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1A	2A					7B	8B	1B	2B			3A	4A	5A	6A	7A	8A
1 H 1.00794	2 He 4.00260											5 B 10.811	6 C 12.011	7 N 14.0067	8 O 15.9994	9 F 18.9984	10 Ne 20.1797
3 Li 6.941	4 Be 9.01218											13 Al 26.9815	14 Si 28.0855	15 P 30.9738	16 S 32.066	17 Cl 35.4527	18 Ar 39.948
11 Na 22.9898	12 Mg 24.3050	3 Sc 44.9559	4 Ti 47.88	5 V 50.9415	6 Cr 51.9961	7 Mn 54.9381	8 Fe 55.847	9 Co 58.9332	10 Ni 58.693	11 Cu 63.546	12 Zn 65.39	31 Ga 69.723	32 Ge 72.61	33 As 74.9216	34 Se 78.96	35 Br 79.904	36 Kr 83.80
37 Rb 85.4678	38 Sr 87.62	39 Y 88.9059	40 Zr 91.224	41 Nb 92.9064	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.906	46 Pd 106.42	47 Ag 107.868	48 Cd 112.411	49 In 114.818	50 Sn 118.710	51 Sb 121.757	52 Te 127.60	53 I 126.904	54 Xe 131.29
55 Cs 132.905	56 Ba 137.327	57 *La 138.906	72 Hf 178.49	73 Ta 180.948	74 W 183.84	75 Re 186.207	76 Os 190.23	77 Ir 192.22	78 Pt 195.08	79 Au 196.967	80 Hg 200.59	81 Tl 204.383	82 Pb 207.2	83 Bi 208.980	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra 226.025	89 †Ac 227.028															
*Lanthanide series		58 Ce 140.115	59 Pr 140.908	60 Nd 144.24	61 Pm (145)	62 Sm 150.36	63 Eu 151.965	64 Gd 157.25	65 Tb 158.925	66 Dy 162.50	67 Ho 164.930	68 Er 167.26	69 Tm 168.934	70 Yb 173.04	71 Lu 174.967		
†Actinide series		90 Th 232.038	91 Pa 231.036	92 U 238.029	93 Np 237.048	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (262)		

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Rough Paper

