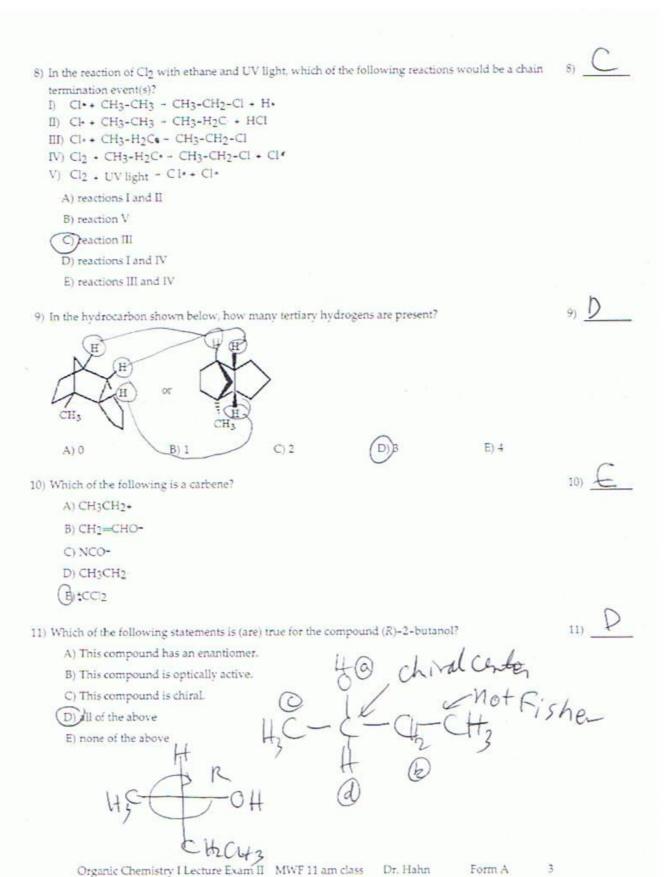
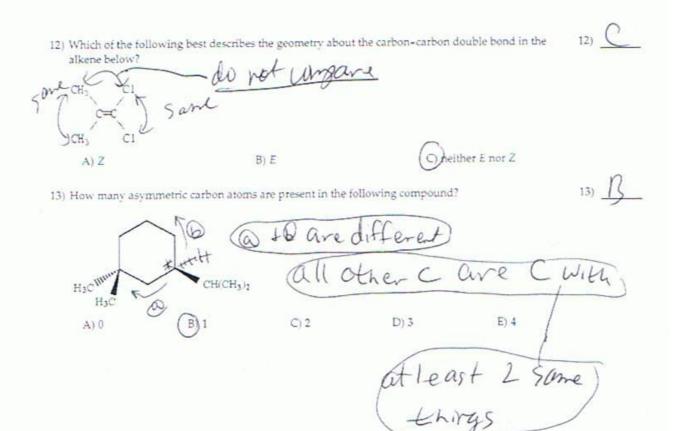
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not specify work. Only answers which intended space without clear indication going to spend 3 hours looking for you what they meant to write if I can't clear visible. No points for errors going from	partial and full credit (except multiple of are clearly readable will be graded. If you of where, I will not grade it. (I am grade it answer somewhere on the exam and I rly read what you wrote. No Points for on the exam to the scantron. No Points for formation to answer the question. (2 pt	you write the answer other that ding 250 x 10 page exams, by am not going to contact 250 p erased answers which are still or anything other than norma	myself I am not eople to tell me somewhat
(total number of pages of the exam = 9 pages, it is your own responsibility for	pages • periodic table • scantron Che not completing the exam.)	ck number of pages. If you to	urn in less than 1
Part I Multiple Choice (2 pts each, 26 in case you erased so much that there is	pts total) Fill in your answer on the har is a computer error in grading.	rdcopy of the exam as backup	for your scantron
MULTIPLE CHOICE. Choose the one	e alternative that best completes the sta	tement or answers the questi	on.
1) A radical reaction mechanis	mis NA= not attemp	A)	1) B
A) done so as to produce	the more stable pair of ions W	= howork	1
(B) homolytic	BA = bad attempt		
C) via hydrogenation		#	
D) heterolytic	(RBA = real bad	allingt)	
E) none of the above	(RRBA = realre	cal BA)	
2) What synthetic goal is achie sequence?	ved by subjecting an alkene to an oxyme	ercuration-demercuration	2)
A Markovníkov additior	of H <sub>2</sub> O wherein skeletal rearrangemen	it is prevented	
B) Markovnikov addition	of H2O wherein skeletal rearrangemen	it is promoted	
C) syn-hydroxylation			
D) anti-Markovnikov ad-	dition of H2O wherein skeletal rearrang	ement is prevented	
E) anti-Markovnikov ad	dition of H2O wherein skeletal rearrang	ement is promoted	1-
3) Which of the following state	ements correctly pertains to a pair of ena	intiomers?	3) <u>D</u>
A) The have different me	lting points.		
B) They rotate the plane	of polarized light by differing amounts a	and in opposite directions.	
C) They have the same m	elting point, but they have different boil	ling points.	
They rotate the plane directions.	of polarized light by exactly the same an	nount and in opposite	
E) They rotate the plane	of polarized light by differing amounts a	and in the same direction.	

<ol> <li>Consider</li> <li>D shown</li> </ol>	the three-step mechanism below.	for the reaction of A	through intermediate	s B and C to produce	4)
A - B	E <sub>a</sub> = 15 kcal/mol				
B-C	E <sub>a</sub> = 10 kcal/mol				
C - D	$E_a = 2 \text{ kcal/mol}$				
Which of	the three steps is rate-limit	ting slowest step?			
A) The	reaction of A to B.				
	reaction of B to C.				
C) The	reaction of C to D.				
D) All	three steps occur at the san	ne rate; there is no ra	te-limiting step.		
	a can't tell from the informa				
	the following intermediate in the presence of acid?	es is thought to occur	r in the mechanism by	which alkenes are	5)
A) car	bocation				
B) car	banion				
C) free	e radical				
D) car	bene				
E) alk	yne				
6) For a giv	en reaction, if 4G° is greate	r than zero (positive	e), then:		6)
A) Th	e reaction is going downhill	in energy and will	go to product.		
B) Th	e reaction is going really fas	st.			
C) Th	e reaction is going uphill in	energy and will not	go to product.		
	statements are true.				
E) All	statements are false.				Λ
	ny distinct monochlorinate hlorination?	d products can resu	It when cyclopentane	is subjected to free	7 <u>A</u>
radical c				E) 5	

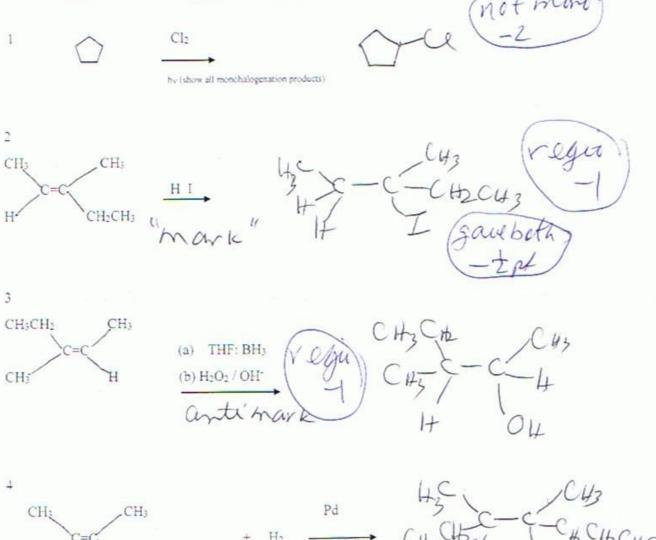


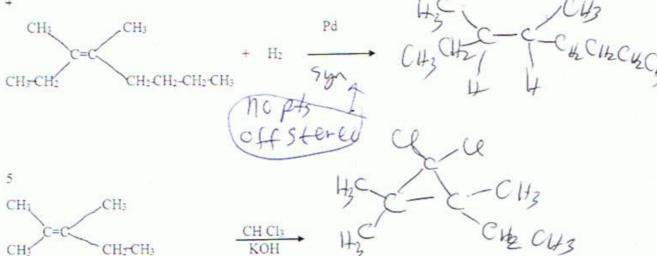


Part II. Short Answers (40 pts)
A. Nomenclature: (2 pts each, 8 pts)
Given the structural formula shown below, give the IUPAC name of the molecule.
a. name 1-brono - 3-ethyl-2-methyl
Any cyclopentare Cyclopentane
by 2 Total ethyl bromo (Fp)
Grow of methyl (Ext)
b. name 6-2,5-dimethyl hex-3-ene
120 + ene (Fer)
2 - methyl 3 (#-tet)
5-methyl
<ol> <li>Given the following IUPAC name, draw a structural formula of the molecule (skeletal formula acceptable, condensed structure, Lewis Dot structure acceptable, molecular formula not acceptable don't forget to show the hydrogens in your formula unless you are using the skeletal structure.)</li> </ol>
a. 2,4-dimethyl-1-pentene Ept CH3 CH3 Ept # tpt
rent too HE = C-CH-C-CH (Free)
OS H
b. E-3-methyl-2-hexene
E OF # CH3 (29)
1 12 -173
Organic Chemistry I Lecture Fall 2015 Dr. Hahn Exam II MWF 11 Form A
Organic Chemistry I Lecture Fan 2015—Dr. Haini Exami ii Stat 11 Total A

Please show work on all questions for partial credit even on questions which do not specify. Please write legibly. If I cannot read your answer, I cannot grade your answer. (use back of exam for scratch paper)

B. Reactions: Show the Organic Product in the following reactions by giving the structural formula of the product. (skeletal formula, condensed structure, Lewis Dot structure are all acceptable. Molecular Formula is <u>not</u> acceptable.) DO <u>NOT</u> SHOW MECHANISMS. (2 pts each, 10 pts)



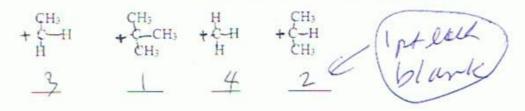


## C. Short Answers (22 pts)

1. Given the following groups attached to a chiral carbon, put in order of (a) highest priority to (d) lowest priority. Show all "ghost" atoms. (2 pts each, 8 pts)

2.

 Given the following carbocations, label from most stable to least stable by filling in the blank below the molecule with the number (1) for most stable to (4) for least stable (1 pt each, 4 pts)



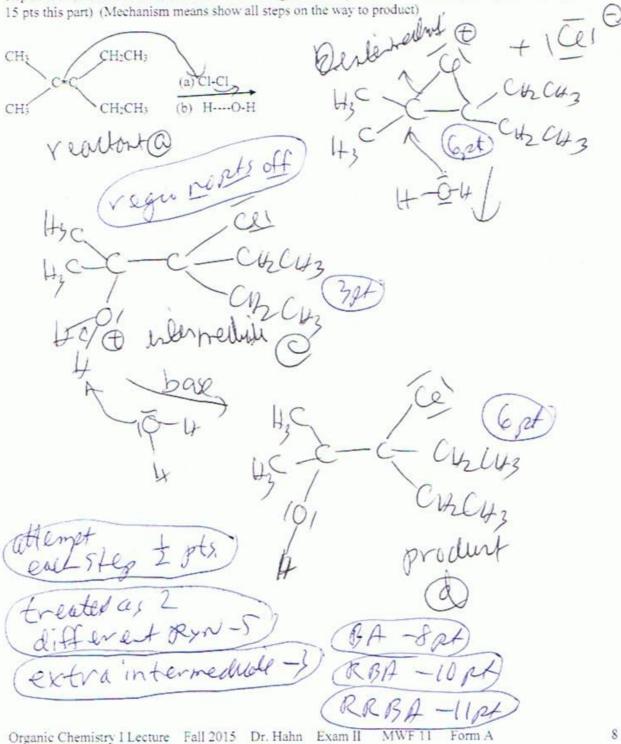
4 Given the following energy diagram, (2 pt each, total 10 pts)

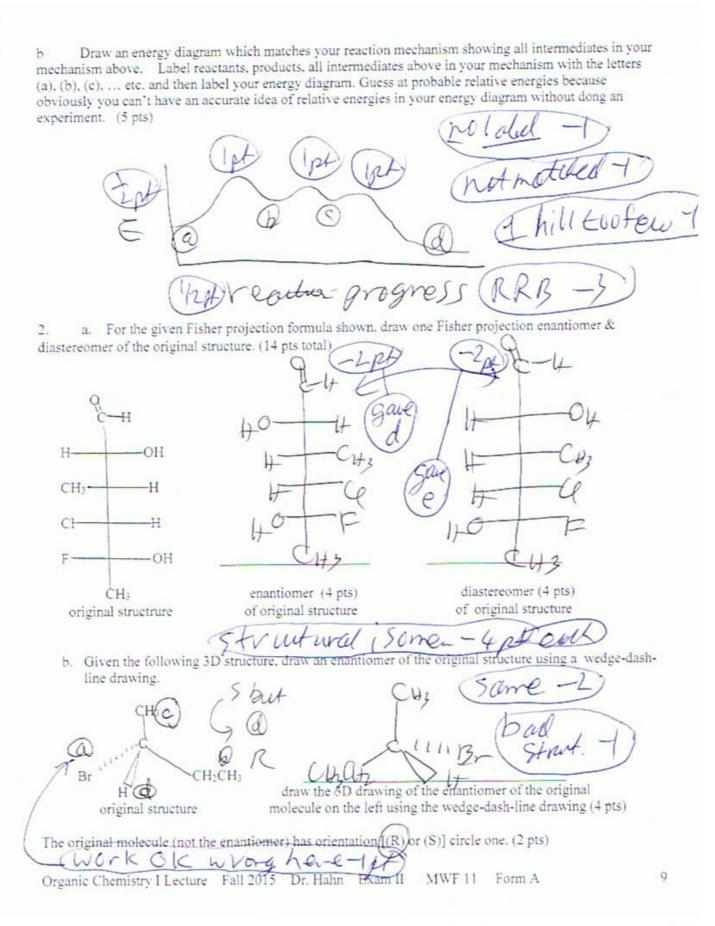


Reaction Progress

- a) How many steps is in the reaction mechanism shown [(1), (2)(3)(4)] (circle one)
- b) Which of the steps is the slowest step [(1<sup>st</sup> step) (2<sup>nd</sup> step)] (circle one) (note: just because I gave 3 potential steps does not necessarily mean that there are actually 3 steps it could be less)
- c) How many intermediates ? [(1)(2)(3)(4)] (circle one)
- d) How many transition states [(1),(2)(3)] (circle one)
- e) Is the reaction energetically favored to go forward to product? [(yes) no) (circle one)

a. Complete the following reaction mechanism. Show all intermediates but not the transition state structures. Show electron pushing arrows and completely drawn Lewis Dot (or Kekule) structures for each step of the reaction mechanism and the correct regiochemistry and stereochemistry if required. (20 pts total,





Organic C	hemistry I Le	cture Fall 2015 Dr. H	ahn Exam II 10/26/1	5 Monday M	WF II Form B Exam	#
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not specifintended going to swhat they	y work. Only space without pend 3 hours meant to with ly points for e	Il questions for partial answers which are cle clear indication of wh looking for your answite if I can't clearly read rrors going from the expension enough informat	arly readable will be g ore, i will not grade it er somewhere on the e I what you wrote. No l sam to the scantron. In	raded, 11 you {I am gradin xam and I am Points for crai Io Points for	write the answer one y 250 x 10 page exam not going to contact 2 sed answers which are anything other than no	s, by myself I am not 50 people to tell me estill somewhat
(total nun pages, it i	nber of pages s your own r	of the exam = 9 pages esponsibility for not co	+ periodic table + scan empleting the exam.)	fron Check	number of pages. If y	on turn in less than R
Part I M in case ye	ultiple Choice on crased so π	(2 pls each, 26 pts tota usch that there is a con	d) Fill in your answer aputer error in grading	on the hardo	opy of the exam as bac	kup for your scantron .
MULTIP	LE CHOICE	Choose the one altern	ative that best comple	tes the stater	nent or answers the q	uestion.
· i i	What synthe	tic goal is achieved by	subjecting an alkene to	an oxymero	aration-demercuration	n 1) <u>H</u>
	sequence?	vnikov addition of H2				
	( '') · ·	vnikov addition of H20				
		rdroxylation				
		[arkovnikov addition c	of H2O wherein skelet	il rearrangem	ent is prevented	
		Γατκοντικόν addition c				
			7	وود آمانا السابوب	ontano is subjected to f	100 2) A-
2	How many o radical chlor	distinct monochlorinat ination?	ed producis can restut	when cyclops	marie is subjected to 1	7 1
	(A)1	B) 2	C)3	. 10) 4	E) 5	
	· •		المراب والمرابع		naund2	3) (
3	) How many :	asymmetric carbon ato	70 > 0 for	1 210	2/2	
		$\sim$ $\checkmark$	1 - 100	CVV(V)	Jet /	
		1	TW= NO	WOV	>	
	T. Allinia	сацен,	00			
	H3C II₃C					
	A) 0	(B)1	C) 2	D) 3	E) 4	
		B	A = bao	alte	mpl	
		R	BA= r	en	bad atten	
		(RRBA	= rea	1/0	N BA	)
	Ó	rganic Chemistry I Lec	ture Exam H Dr. 1	Hahm MWI	Thatsi Torm B	1 1
				•	•	



- 4) In the reaction of Cl2 with other and UV light, which of the following reactions would be a chain termination event(s)?
  - i) Cl\*+ CH3+CH3 CH3+CH2+Cl\*+ H\*
  - II) Cle+ CH3-CH3 CH3-H2C+ HCI
  - трСl++ СН3-Н2С• СН3-СН2-СL
  - IV) Cl<sub>2</sub> + CH<sub>3</sub>-H<sub>2</sub>C+ CH<sub>3</sub>-CH<sub>2</sub>-Cl + Cl\*
  - V) Cl<sub>2 + UV light + Cl\* + Cl\*</sub>
    - A) reactions I and II
    - B) reaction V
  - T) reaction III
  - D) reactions I and IV.
  - E) reactions UI and IV
- 5) Which of the following statements is (are) true for the compound (R)-2-butanol?

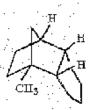


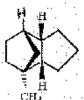
- A) This compound has an enantiomer.
  - B) This compound is optically active.
  - C) This compound is chiral.
- D) all of the above
  - F) none of the above
- 6) For a given reaction, if ΔG° is greater than zero (positive), then:

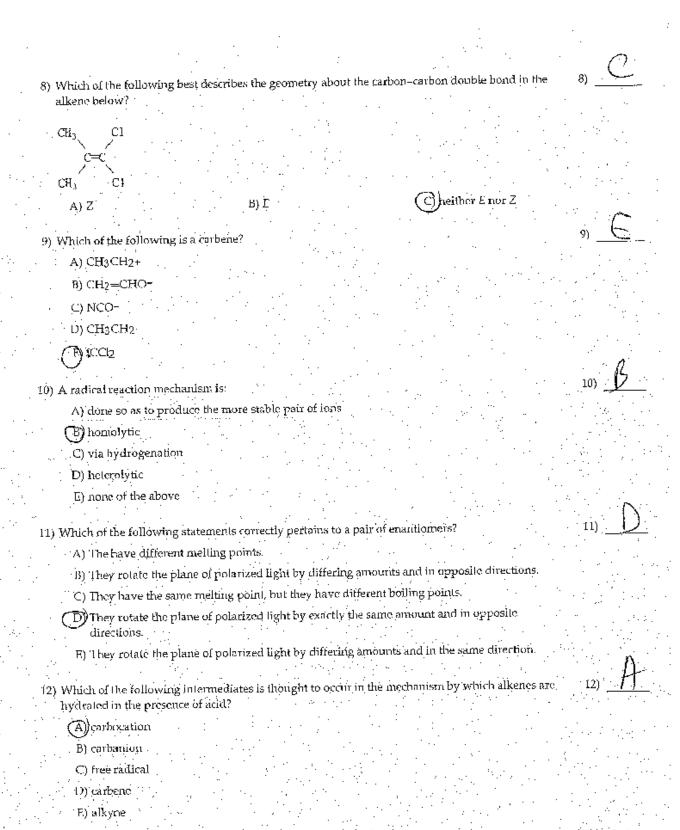


- A) The reaction is going downbill in energy and will go to product.
- B) The reaction is going really fast:
- (C) The reaction is going uphill in energy and will not go to product.
- D) All statements are true.
- E) All statements are false.
- 7) In the hydrocarbon shown below, how many tertiary hydrogens are present?





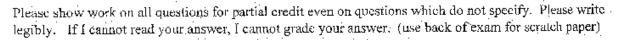


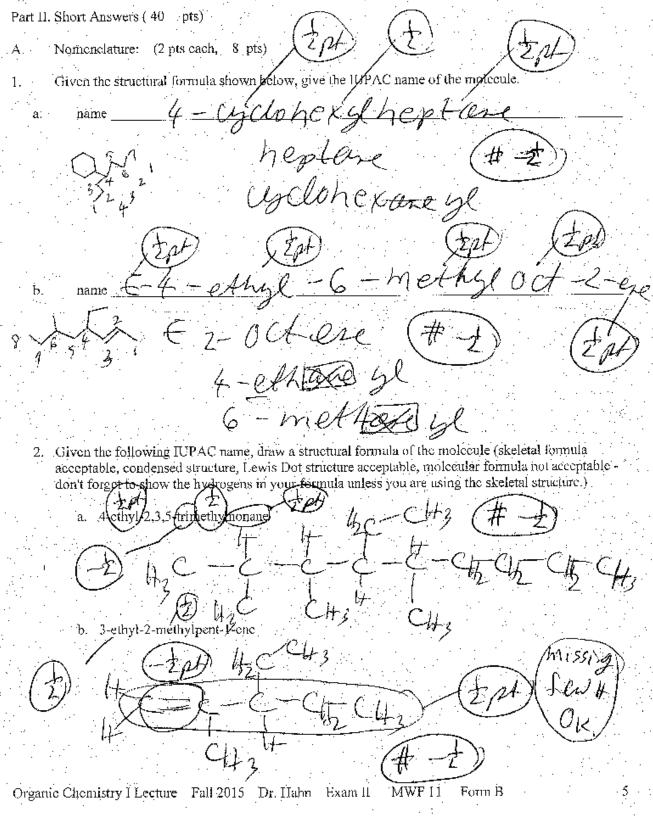


- - A B  $E_a = 15 \text{ kcal/mol}$ B - C  $E_a = 10 \text{ kcal/mol}$
  - $C = D \qquad \qquad E_a = 2 \; kcal/mol$

Which of the three steps is rate-limiting slowest step?

- (A) The reaction of A to B.
  - B) The reaction of B to C.
  - C) The reaction of C to D.
  - D) All three steps occur at the same rate; there is no rate-limiting slep.
  - E) You can't tell from the information given.

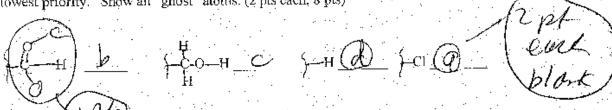




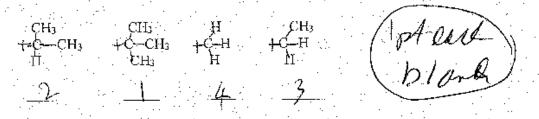
Reactions: Show the Organic Product in the following reactions by giving the structural formula of the product. (skeletal formula, condensed structure, Lewis Dot structure are all acceptable. Molecular Formula is not acceptable.) DO NOT SHOW MECHANISMS. (2 pts each, 10 pts) 1 .  $CH_3\text{--}CH_2\text{--}CH_3\text{--}CH_3$ Cbhy (give all munchalogonation products) 2  $CH_{3}$ CU3CH2  $CH_2CH_3$  $\widetilde{CH_3}$ THF: BIL (b) H<sub>2</sub>O<sub>2</sub> / OH CH3  $CH_{3}$  $CIJ_3$  $CH_3$  $CH_3$   $CH_2$ CH2 CH3  $CH_3$ CH Cl<sub>3</sub> KOH  $CH_3$ CH<sub>2</sub> CH<sub>3</sub>

## C. Short Answers (22 pts)

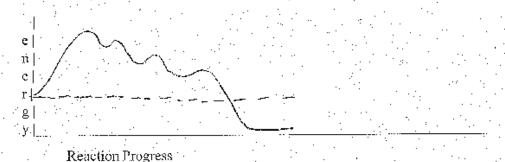
1. Given the following groups attached to a chiral carbon, put in order of (a) highest priority to (d) lowest priority. Show all "ghost" atoms. (2 pis each, 8 pts)



2. Given the following carbocations, label from most stable to least stable by filling in the blank below the molecule with the number (1) for most stable to (4) for least stable (1 pt each, 4 pts)

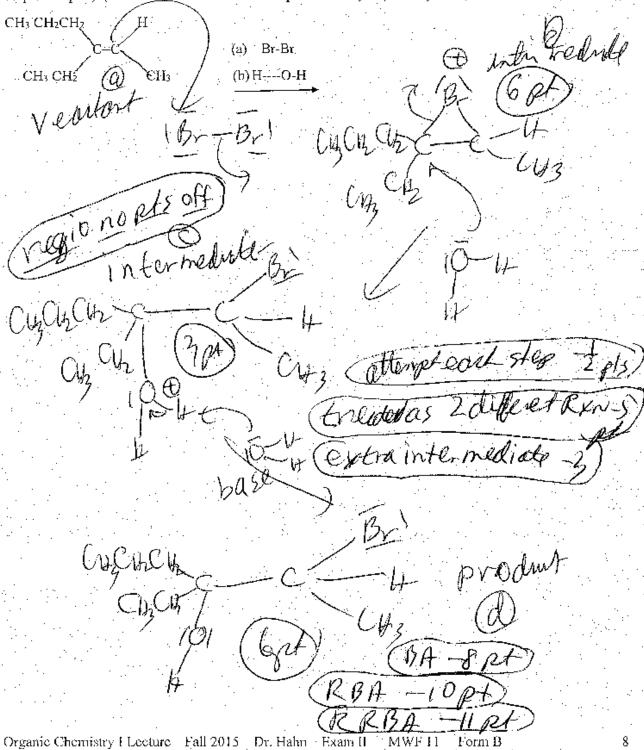


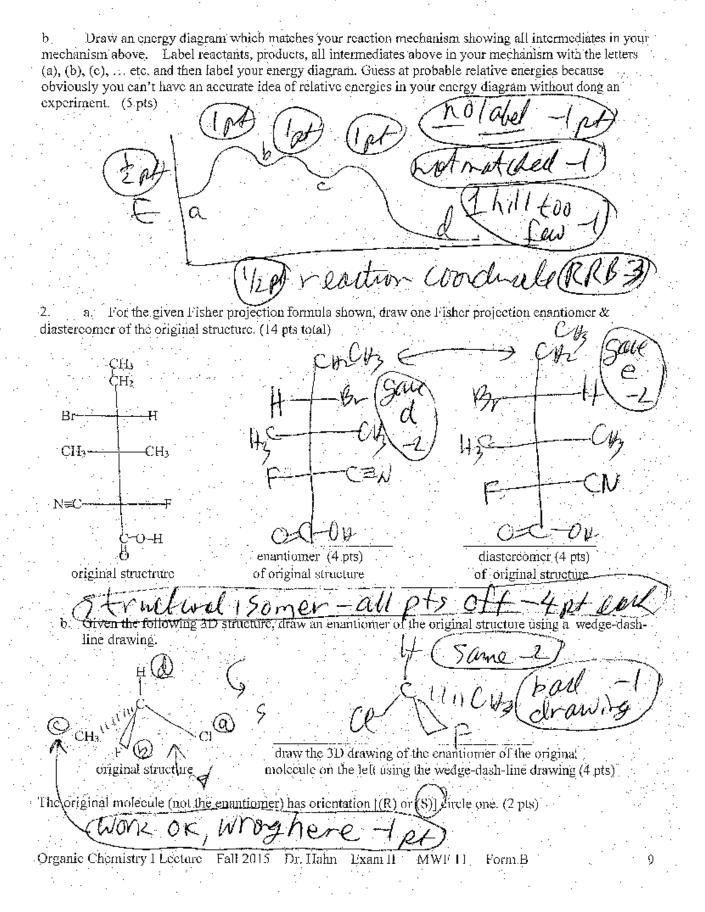
3 Given the following energy diagram, (2 pt each, total 10 pts)



- How many steps is in the reaction mechanism shown [(1), (2),(3),(4)] (circle one)
- b) Which of the steps is the slowest step (1<sup>st</sup> step) (2<sup>nd</sup> step) (3<sup>nl</sup> step) (circle one) (note: just because I gave 3 potential steps does not necessarily mean that there are actually 3 steps it could be less)
- c) How many intermediates ? [(1),(2)(3)(4)(5)] (circle one)
- d) How many transition states [(1),(2),(3)(4)(5)] (circle one).
- e) Is the reaction energetically favored to go forward to product? [(yes) (no)] (circle one)

a. Complete the following reaction mechanism. Show all intermediates but not the transition state [. structures. Show electron pushing arrows and completely drawn Lewis Dot (or Kekule) structures for each step of the reaction mechanism and the correct regiochemistry and stereochemistry if required. (20 pts total, 15 pts this part) (Mechanism means show all steps on the way to product)





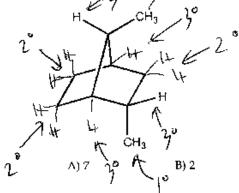
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Sign Name		Print Nam	<b>c</b>	Key	_	
Please show work for all questions for partial and full credit (except multiple choice questions) even on questions which do not specify work. Only answers which are clearly readable will be graded. If you write the answer other than in the intended space without clear indication of where, I will not grade it. (I am grading 250 x 10 page exams, by myself I am not going to spend 3 hours looking for your answer somewhere on the exam and I am not going to contact 250 people to tell me what they meant to write if I can't clearly read what you wrote. No Points for erased answers which are still somewhat visible. No points for errors going from the exam to the scantron. No Points for anything other than normal organic chemistry formulas showing enough information to answer the question. (2 pts print & sign name)						
(total number of pages of the pages, it is your own respons	exam = 9 pages + pe siblity for not compl	riodic table + scan eting the exam.)	tron - Check numb	per of pages. If you tun	n in less than 10	
Part 1 Multiple Choice (2 pts in case you crased so much th	each, 26 pts total) First there is a compute	ill in your answer er error in grading	on the hardcopy o	f the exam as backup fo	r your scantron	
MULTIPLE CHOICE. Choose	se the one alternativ	e that best comple	etes the statement	or answers the question	ı. ^	
Thow many distinct radical chlorination		roducts can result	when cyclopentane	c is subjected to free	1)	
(A) 1	B) 2	C) 3	D) 4	E) 5	•	
What synthetic goz sequence?					2)	
$\sim$	vaddition of H2O wl					
·	v addition of H2O wl	herein skeletal rea:	rrangement is prot	noted		
C) syn=hydroxy	uation nikov addition of H <sub>2</sub>	οΩ wherein skelets	d rearrangement is	s prevented		
•	nikov addition of H2				•	
3) Which of the follow hydrated in the pro	wing intermediates is esence of acid?	s thought to occur	in the mechanism		3)	
A) carbocation B) carbanion	(VA=	no+ a	ttompt)			
C) free radical			-			
D) carbene	(NW=	no wo	v (S)			
E) alkyne	BA=	bad	attempo	9		
	RBA:	= red	bado	attempt)		
	RRB	A = YQ	al real	bad atter	Jest)	

4) A mixture of equal amounts of two chantiomers \_\_\_\_\_\_



- A) is optically inactive
- B) is called a racemic mixture
- C) implies that the enantiomers are meso forms
- (D) both A and B
- E) none of the above
- 5) How many secondary hydrogens are present in the hydrocarbon below?





6) Which of the following is <u>not</u> a possible termination step in the free radical chlorination of methane?

C) 16



E) 8

- A) «CH3 + «CH3 · · CH3CH3
- B) •C113 + Cl• · CH3Cl

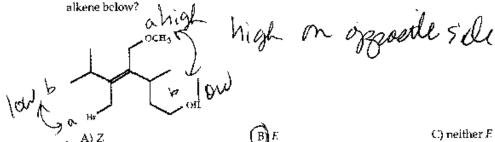
- D) None are termination steps.
- E) All shown steps are termination steps.
- 7) A radical reaction mechanism is:



- A) done so as to produce the more stable pair of ions
- (B) homolytic
- C) via hydrogenation
- D) heterolytic
- E) none of the above







(B)E

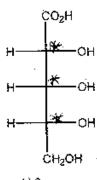
C) neither Enor Z

9) Which of the following is a carbene?

- A) CH3CH2+
- B) CH2~CHO-
- C) NCO=
- D) CH3CH2:
- (1)\$CCl2

10) How many diastereomers are there of the molecule shown below?

B) 2



A) 3

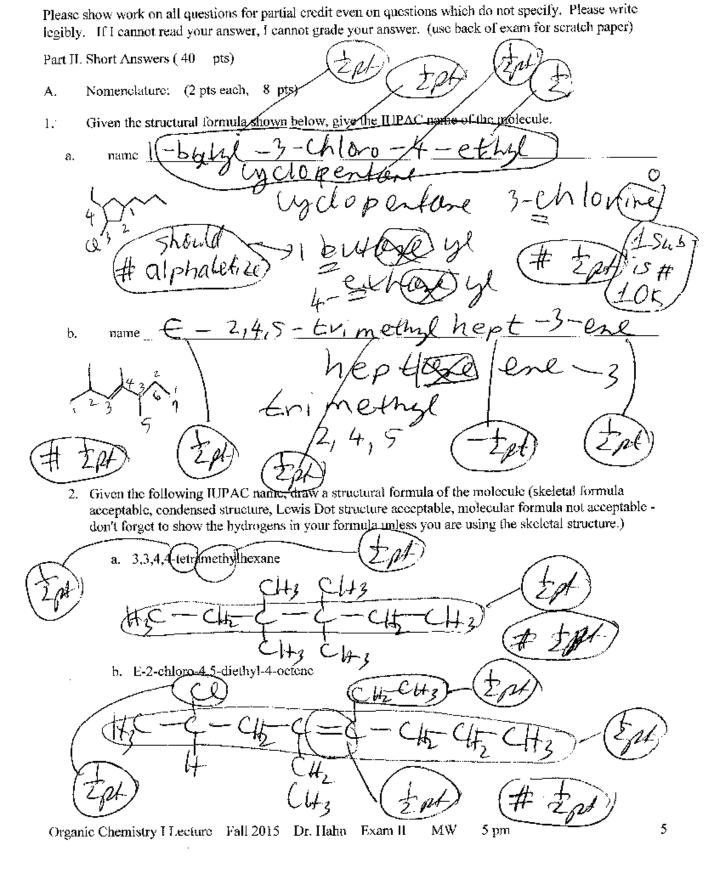
# Chiral Centers = 3 (marked with \*)

C) 0

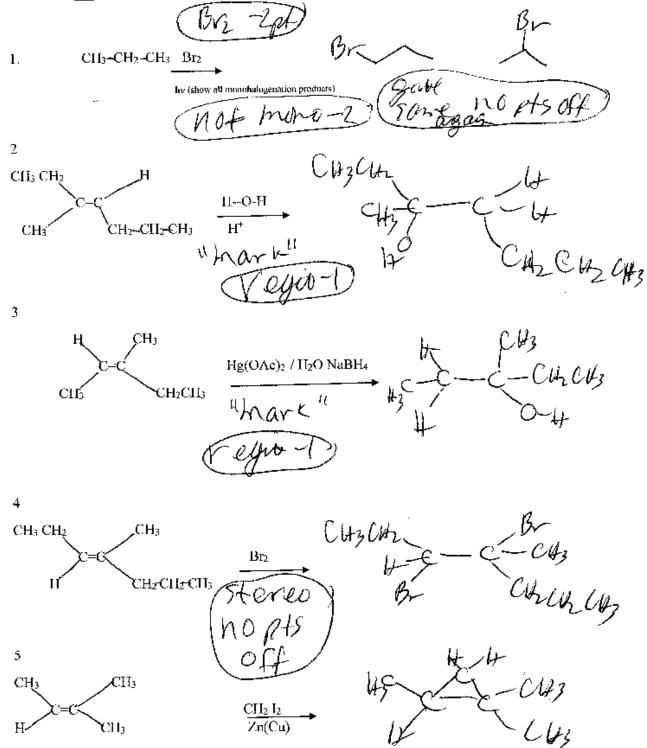
D) 1

Lypes in test banks question

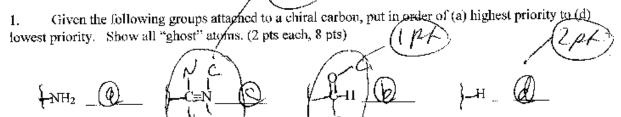
11) Consider t D shown b	he three-slep mechanism for the reaction of $\Lambda$ through intermediates B and C to produce below.	11)
A → B	$\mathbf{E_{a}} = 15 \text{ kcal/mol}$	
$B \rightarrow C$	$E_{tt} = 10 \text{ kcal/mol}$	
C - D	$E_a = 2 \text{ kcal/mol}$	
Which of	the three steps is rate-fimiting slowest step?	
A) The	reaction of A to B.	
B) The	reaction of B to C.	
C) The	reaction of C to D.	
Đ) All t	hree steps occur at the same rate; there is no rate-limiting step.	
E) You	can't tell from the information given.	_
	the following statements is (are) true for the compound (R)-2-butanol? compound has an enantiomer.	12)
	compound is optically active.	
•	compound is chiral.	
D) all c	f the above	
E) non	e of the above	
ŕ	en reaction, if $\triangle G^{\circ}$ is greater than zero (positive), then:	13)
A) The	reaction is going downhill in energy and will go to product.	
B) The	reaction is going really fast.	
C) The	reaction is going uphill in energy and will not go to product.	
D) All	statements are true.	
E) Aft	statements are false.	



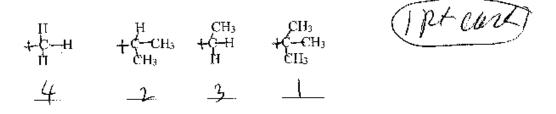
B. Reactions: Show the Organic Product in the following reactions by giving the structural formula of the product. (skeletal formula, condensed structure, Lewis Dot structure are all acceptable. Molecular Formula is <u>not</u> acceptable.) DO <u>NOT</u> SHOW MECHANISMS. (2 pts each, 10 pts)



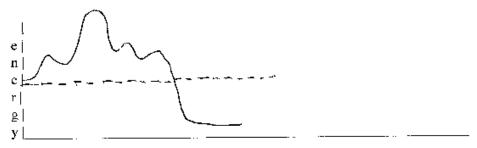




2. Given the following carbocations, label from most stable to least stable by filling in the blank below the molecule with the number (1) for most stable to (4) for least stable (1 pt cach, 4 pts)



3 Given the following energy diagram, (2 pt each, total 10 pts)



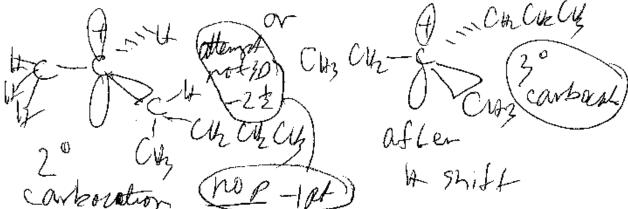
Reaction Progress

- a) How many steps is in the reaction mechanism shown [(1), (2),(3) 4) (circle one)
- b) Which of the steps is the slowest step [(1<sup>st</sup> step) (2<sup>nd</sup> step) (3<sup>rd</sup> step)] (circle one) (note: just because I gave 3 potential steps does not necessarily mean that there are actually 3 steps—it could be less)
- c) How many intermediates ?  $\{(1),(2),(3),(4)\}$  (circle one)
- d) How many transition states |(1),(2),(3)(4)])(circle one)
- e) Is the reaction energetically favored to go forward to product? (ves) (no)] (circle one)

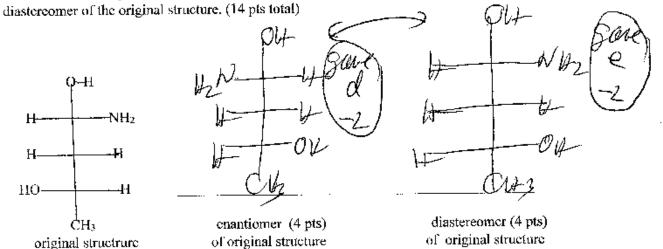
Show all work for partial and full credit. Long Answers (34 pts) Part III. a. Complete the following reaction mechanism. Show all intermediates but not the transition state L structures. Show electron pushing arrows and completely drawn Lewis Dot (or Kekule) structures for each step of the reaction mechanism and the correct regiochemistry and stereochemistry if required. (20 pts total, 15 pts this part) (Mechanism means show all steps on the way to product) 11 **><sub>Н' / Н----О-**Н</sub> СН-СН2-СП2-СН3  $\tilde{C}H_3$ Please check for the possibility of rearrangement.

Organic Chemistry I Lecture Fall 2015 Dr. Hahn Exam II MW

Draw a 3D structure of the <u>first intermediate</u> above showing the + charge localized on the empty p orbital. (3D structure need only be on the carbocation) (5 pts)



a. For the given Fisher projection formula shown, draw one Fisher projection enantiomer &



b. Given the following 3D structure, draw an enantiomer of the original structure using a wedge-dashline drawing.

draw the 3D drawing of the enantiomer of the original molecule on the left using the wedge-dash-line drawing (4 pts) Voriginal structure

Sign NamePrint Name	'
Please show work for all questions for partial and full credit (except multiple choice questions) even on que not specify work. Only answers which are clearly readable will be graded. If you write the answer other thintended space without clear indication of where, I will not grade it. (I am grading 250 x 10) page exams, by going to spend 3 hours looking for your answer somewhere on the exam and I am not going to contact 250 what they meant to write if I can't clearly read what you wrote. No Points for erased answers which are still visible. No points for errors going from the exam to the scantron. No Points for anything other than norm chemistry formulas showing enough information to answer the question. (2 pts print & sign name)	nan in the y myself I am not people to tell me Il somewhat int organic
(total number of pages of the exam = 9 pages + periodic table + scantron   Check number of pages. If you pages, it is your own responsibility (or not completing the exam.)	turn in less than 10
Part I Multiple Choice (2 pts each, 26 pts total). Fill in your answer on the hardcopy of the exam as backup in case you erased so much that there is a computer error in grading.	o for your scantron
MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the quest	tion.
1) A radical reaction mechanism is:	1)
A) done so as to produce the more stable pair of ions	
B) homolytic	
C) via hydrogenation	
D) heterolytic	
E) none of the above	
2) What synthetic goal is achieved by subjecting an alkene to an oxymercuration—demorcuration sequence?	2)
A) Markovnikov addition of H2O wherein skeletal rearrangement is prevented	
B) Markovníkov addition of H2O wherein skeletal rearrangement is promoted	
C) syn-hydroxylation	
D) anti-Markovnikov addition of H2O wherein skeletal rearrangement is prevented	
E) an(i-Markovnikov addition of H2O wherein skeletal rearrangement is promoted	
3) Which of the following statements correctly pertains to a pair of enantiomers?	3)
A) The have different melting points.	
B) They rotate the plane of polarized light by differing amounts and in opposite directions.	
C) They have the same melting point, but they have different boiling points.	
<ul> <li>D) They rotate the plane of polarized fight by exactly the same amount and in opposite directions.</li> </ul>	
E) They rotate the plane of potarized light by differing amounts and in the same direction.	

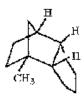
4) Consider D shown	the three-step mechanism tollow.	for the reaction of $\Lambda$ :	through intermediate	s B and C to produce	4)
A - B	F <sub>a</sub> = 15 kcal/mol				
B - C	$E_a = 10 \text{ kcal/mol}$		•		
$C \cdot D$	$E_a = 2 \text{ kcal/mol}$				
Which of	the three steps is rate-limit	ing slowest step?			
A) The	reaction of A to B.				
B) The	ereaction of B to C.				
C) The	reaction of C to D.				
D) All	three steps occur at the sam	e rate; there is no rat	e-limiting step.		
E) You	acan't tell from the informa	tion given.			
	the following intermediate in the presence of acid?	s is thought to occur	in the mechanism by	which alkenes are	5)
A) car	bocation				
B) car	banion				
C) free	e radical				
D) car	bene				
E) alk	yne				
6) For a giv	ren reaction, if ΔG° is greate	r than zero (positive)	, then:		6)
	e reaction is going downhill				
	e reaction is going really fas				
	e reaction is going uphill in		go lo product.		
	statements are true.				
•	statements are false.				
	my distinct monochlorinale hlorination?	d products can result	t when cyclopontane	is subjected to free	カ
A) 1	B) 2	C) 3	D) 4	H) 5	

8) In the teaction of Cl<sub>2</sub> with ethane and UV light, which of the following reactions would be a chain — 8) \_\_\_\_\_ termination event(s)?

- f) Cl\*+ CH3-CH3 CH3-CH2-Ct + H\*
- II)  $Cl_2 + CH_3 + CH_3 + CH_3 + H_2C_2 + HC1$
- III) Cla + CH3-H2Cl CH3-CH2-Cl
- IV)  $Cl_2 + CH_3-H_2C_2 + CH_3-CH_2-C_1 + Ch^*$
- V) Cl2 + UV light Cl\* + Cl\*
  - A) reactions I and II
  - B) reaction V
  - C) reaction III
  - D) reactions I and IV
  - E) reactions III and IV

9) In the hydrocarbon shown below, how many tertiary hydrogens are present?





Oi



- A) 0
- B) 1
- C) 2
- D) 3
- F) 4

10) Which of the following is a carbone?

10} \_\_\_\_\_

- A) CH3CH2+
- B) CH2=CHO=
- C) NCO-
- D) CH3CH2-
- F) CCl<sub>2</sub>

11) Which of the following statements is (are) true for the compound (R)-2-butanol?

11) \_\_\_\_\_

- A) This compound has an enantiomer.
- B) This compound is optically active.
- C) This compound is chiral.
- D) all of the above
- E) none of the above

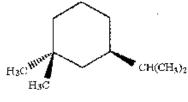
- 12) Which of the following best describes the geometry about the carbon-carbon double bond in the alkene below?
- 12) \_\_\_\_\_

 $\Lambda$ ) Z

B) E

- C) neither E nor Z
- 13) How many asymmetric carbon atoms are present in the following compound?

13) \_\_\_\_



- A) 0
- B) I
- C) 2
- D) 3
- E) 4

Please show work on all questions for partial credit even on questions which do not specify. Please write legibly. If I cannot read your answer, I cannot grade your answer. (use back of exam for scratch paper)

Part II. Short Answers (40 pts)

A. Nomenclature: (2 pts each, 8 pts)

Given the structural formula shown below, give the IUPAC name of the molecule.

a. name \_\_\_\_\_\_

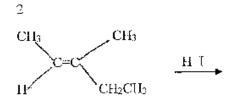
b. name\_\_\_\_\_\_

- 2. Given the following IUPAC name, draw a structural formula of the molecule (skeletal formula acceptable, condensed structure, Lewis Dot structure acceptable, molecular formula not acceptable don't forget to show the hydrogens in your formula unless you are using the skeletal structure.)
- a. 2,4-dimethyl-1-pentene

b. E-3-mothyl-2-hexene

B. Reactions: Show the Organic Product in the following reactions by giving the structural formula of the product. (skeletal formula, condensed structure, Lewis Dot structure are all acceptable. Molecular Formula is **not** acceptable.) DO **NOT** SHOW MECHANISMS. (2 pts each, 10 pts)





3  $CH_3CH_2 \qquad CH_3 \qquad \qquad \\ C+C \qquad \qquad (a) \quad THF; BH_3 \qquad \\ CH_3 \qquad \qquad (b) H_2O_2 \, / \, OH \qquad \\ \\ CH_3 \qquad \qquad (b) H_2O_2 \, / \, OH \qquad \\ \\ CH_3 \qquad \qquad (b) H_3O_2 \, / \, OH \qquad \\ \\ CH_3 \qquad \qquad (b) H_3O_2 \, / \, OH \qquad \\ \\ CH_3 \qquad \qquad (c) H_3O_2 \, / \, OH \qquad \\ \\ CH_3 \qquad \qquad (d) H_3O_2 \, / \, OH \qquad \\ \\ CH_3 \qquad \qquad (d) H_3O_2 \, / \, OH \qquad \\ \\ CH_3 \qquad \qquad (d) H_3O_2 \, / \, OH \qquad \\ \\ CH_3 \qquad \qquad (d) H_3O_2 \, / \, OH \qquad \\ \\ CH_3 \qquad \qquad (d) H_3O_2 \, / \, OH \qquad \\ \\ CH_3 \qquad \qquad (d) H_3O_2 \, / \, OH \qquad \\ \\ CH_3 \qquad \qquad (d) H_3O_2 \, / \, OH \qquad \\ \\ CH_3 \qquad \qquad (d) H_3O_2 \, / \, OH \qquad \\ \\ CH_3 \qquad \qquad (d) H_3O_3 \, / \, OH \qquad \\$ 

4
$$CH_{1} CH_{2} CH_{2} CH_{2} CH_{2} CH_{2} CH_{2} CH_{3}$$

$$CH_{3} CH_{2} CH_{2} CH_{2} CH_{2} CH_{3}$$

CH<sub>3</sub> CH<sub>3</sub> CH<sub>2</sub> CH<sub>3</sub> CH<sub>2</sub> CH<sub>3</sub> KOH

## C. Short Answers (22 pts)

1. Given the following groups attached to a chiral carbon, put in order of (a) highest priority to (d) lowest priority. Show all "ghost" atoms. (2 pts each, 8 pts)

3. Given the following carbocations, label from most stable to least stable by filling in the blank below the molecule with the number (1) for most stable to (4) for least stable (1 pt each, 4 pts)

4 Given the following energy diagram, (2 pt each, total 10 pts)



## Reaction Progress

- a) How many steps is in the reaction mechanism shown [(1), (2),(3)(4)] (circle one)
- b) Which of the steps is the slowest step  $[(1^{st} \text{ step}) (2^{nd} \text{ step}) (3^{id} \text{ step})]$  (circle one) (note: just because I gave 3 potential steps does not necessarily mean that there are actually 3 steps it could be less)
- c) How many intermediates ? [(1),(2),(3)(4)] (circle one)
- d) How many transition states [(1),(2),(3)] (circle one)
- e) Is the reaction energetically favored to go forward to product? [(yes) (no)] (circle one)

Part III. Long Answers (34 pts) Show all work for partial and full credit.

1. a. Complete the following reaction mechanism. Show all intermediates but not the transition state structures. Show electron pushing arrows and completely drawn Lewis Dot (or Kekule) structures for each step of the reaction mechanism and the correct regiochemistry and stereochemistry if required. (20 pts total, 15 pts this part) (Mechanism means show all steps on the way to product)

b Draw an energy diagram which matches your reaction mechanism showing all intermediates in your mechanism above. Label reactants, products, all intermediates above in your mechanism with the letters (a), (b), (c), ... etc. and then label your energy diagram. Guess at probable relative energies because obviously you can't have an accurate idea of relative energies in your energy diagram without dong an experiment. (5 pts)

2. a. For the given Fisher projection formula shown, draw one Fisher projection enantiomer & diastereomer of the original structure. (14 pts total)

b. Given the following 3D structure, draw an enantiomer of the original structure using a wedge-dash-line drawing.

The original molecule (not the enantiomer) has orientation [(R) or (S)] circle one. (2 pts)

Organic Chemistry I Lecture	Fall 2015 Dr. J	Hahn Exam II 10/26	/15 Monday MWF	II Form B Exam #	· · · · · · · · ·
Sign Name		Print Na	ame		-cola_
Please show work for all quest not specify work. Only answer space without clear indication spend 3 hours looking for you meant to write if I can't clearly points for errors going from the showing enough information	ers which are cl of where, I wi r answer some read what you ne exam to the s	learly readable will be Il not grade it . (I am g where on the exam an p wrote. No Points for scantron. No Points f	graded. If you writ grading 250 x 10 pag d I am not going to cerased answers wh or anything other th	e the answer other than be exams, by myself I are contact 250 people to to tich are still somewhat	tions which do in the intended in not going to all me what they visible. No
(total number of pages of the e pages, it is your own responsi			ntron Check num	ber of pages. If you tu	rn in less than 10
Part I Multiple Choice (2 pts in case you erased so much th				of the exam as backup fo	or your scantror
MULTIPLE CHOICE, Choos	e the one alter	native that best comp	letes the statement	or answers the question	on.
<ol> <li>What synthetic goal sequence?</li> </ol>	is achieved by	/ subjecting an alkene i	to an oxymercuralic	n-demercuration	1)
۸) Markovnikov	addition of H <sub>2</sub>	O wherein skeletal rea	urangement is prev	ented	
B) Markovnikov	addition of H2	O wherein skeletal rea	ırrangement is pron	noted	
C) syn-hydroxyl:	ation		-		
D) anti-Markovn	ikov addition o	of H2O wherein skelet	al rearrangement is	prevented	
E) anti-Markovn	ikov addition o	of 1300 wherein skellet	al rearrangement is	promoted	
<ol><li>How many distinct radical chlorination</li></ol>		ted products can resul	l when cyclopentana	e is subjected to free	2)
A) 1	B) 2	C) 3	D) 4	E) 5	
3) How many asymmetric carbon atoms are present in the following compound?					3)
H <sub>3</sub> C H <sub>3</sub> C	снен	)1			
A) 0	<b>B</b> ) 1	C) 2	D) 3	E) 4	

- 4) In the reaction of Cl2 with ethane and UV light, which of the following reactions would be a chain termination event(s)?
- 4)

- l) Cls + CH3-CH3 CH3-CH2-Cl + H4
- II) Clo + CH<sub>3</sub>-CH<sub>3</sub> ·· CH<sub>3</sub>-H<sub>2</sub>Co + HCl
- III) Cla+ CH3-H2Ca CH3-CH2-CI
- IV) Cl2 + CH3-H2C. CH3-CH2-Cl + Cl+
- V) Cl<sub>2 + UV light</sub> C le + Cl<sub>2</sub>
  - A) reactions I and II
  - B) reaction V
  - C) reaction III
  - D) reactions I and IV
  - E) reactions III and IV
- 5) Which of the following statements is (are) true for the compound (R)-2-butanol?

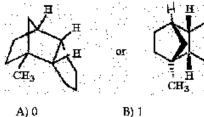


- A) This compound has an enantiomer.
- B) This compound is optically active.
- C) This compound is chiral.
- D) all of the above
- E) none of the above
- 6) For a given reaction, if  $\Delta G^{o}$  is greater than zero (positive), then:



- A) The reaction is going downhill in energy and will go to product.
- B) The reaction is going really fast.
- C) The reaction is going uphill in energy and will not go to product.
- D) All statements are true.
- E) All statements are false.
- 7) In the hydrocarbon shown below, how many tertiary hydrogens are present?





- A)0
- C) 2
- D) 3
- E) 4

8) Which of the follow alkene below?	ving best describes the geometry abo	out the carbon-carbon double bond in the	8)	
CH <sub>3</sub> CI C=C CH <sub>3</sub> CI				
A) Z	B) £	C) neither $E$ nor $Z$		
9) Which of the follow	ring is a carbene?		9)	
A) CH3CH2+				
B) CH2=CHO-				
C) NCO-				
D) CH3CH2·				
E);CCl2				
10) A radical reaction p	nechanism is:		10)	
A) done so as to g	produce the more stable pair of ions		-	
B) homolytic				
<ul><li>C) via hydrogena</li></ul>	ation			
D) heterolytic				
E) none of the ab	ove			
11) Which of the follow	ing statements correctly pertains to	a pair of enantiomers?	11)	
A) The have diffe	erent melting points.			
B) They rotate th	e plane of polarized light by differin	g amounts and in opposite directions.		
C) They have the	same melting point, but they have d	lifferent boiling points.		
<ul><li>D) They rotate the directions.</li></ul>	e plane of polarized light by exactly	the same amount and in opposite		
E) They rotate the	e plane of polarizod light by differin	g amounts and in the same direction.		
12) Which of the follow hydrated in the pres	ing intermediates is thought to occusionce of acid?	r in the mechanism by which alkenes are	12)	
A) carbocation				
B) carbanion				
C) free radical				
D) carbene				
E) alkyne				

- 13) Consider the three-step mechanism for the reaction of A through intermediates B and C to produce 13) D shown below.
  - A B  $E_{a}=15\;\mathrm{kcal/mol}$  $\mathbf{B} \to \mathbf{C}$  $E_a = 10 \; kcal/mol$  $C \dashv D$  $E_0 = 2 \text{ kcal/mof}$

- Which of the three steps is rate-limiting slowest step?
  - A) The reaction of A to B.
  - B) The reaction of B to C.
  - C) The reaction of C to D.
  - D) All three steps occur at the same rate; there is no rate-limiting step.
  - E) You can't tell from the information given.

Please show work on all questions for partial credit even on questions which do not specify. Please write legibly. If I cannot read your answer, I cannot grade your answer. (use back of exam for scratch paper)

Part II. Short Answers (40 pts)

A. Nomenclature: (2 pts each, 8 pts)

1. Given the structural formula shown below, give the IUPAC name of the molecule.

a. name



b. name\_\_\_\_

- 2. Given the following lUPAC name, draw a structural formula of the molecule (skeletal formula acceptable, condensed structure, Lewis Dot structure acceptable, molecular formula not acceptable don't forget to show the hydrogens in your formula unless you are using the skeletal structure.)
  - a. 4-ethyl-2,3,5-trimethylnonane
  - b. 3-ethyl-2-methylpent-1-ene

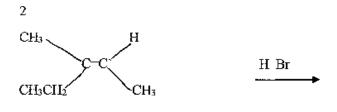
B. Reactions: Show the Organic Product in the following reactions by giving the structural formula of the product. (skeletal formula, condensed structure, Lewis Dot structure are all acceptable. Molecular Formula is <u>not</u> acceptable.) DO <u>NOT</u> SHOW MECHANISMS. (2 pts each, 10 pts)

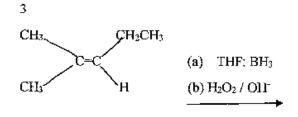
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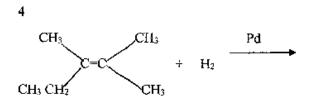
CH3-CH2-CH2-CH3

Cl2

hv (grvc all monohalogenation products)





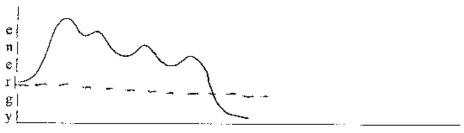


## C. Short Answers (22 pts)

1. Given the following groups attached to a chiral carbon, put in order of (a) highest priority to (d) lowest priority. Show all "ghost" atoms. (2 pts each, 8 pts)

2. Given the following carbocations, label from most stable to least stable by filling in the blank below the molecule with the number (1) for most stable to (4) for least stable (1 pt each, 4 pts)

Given the following energy diagram, (2 pt each, total 10 pts)

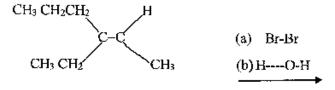


Reaction Progress

- a) How many steps is in the reaction mechanism shown [(1), (2), (3)(4)] (circle one)
- b) Which of the steps is the slowest step [(1st step) (2nd step) (3rd step)] (circle one) (note: just because I gave 3 potential steps does not necessarily mean that there are actually 3 steps it could be less)
- c) How many intermediates ?[(1),(2),(3)(4)(5)] (circle one)
- d) How many transition states [(1),(2),(3)(4)(5)] (circle one)
- e) Is the reaction energetically favored to go forward to product? {(yes) (no)} (circle one)

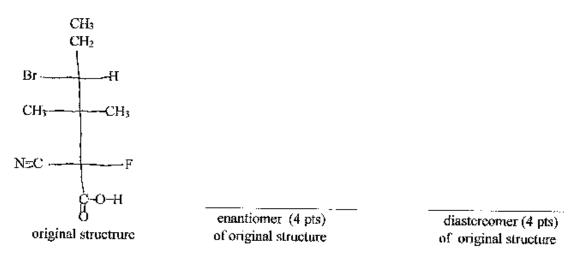
Part III. Long Answers (34 pts) Show all work for partial and full credit.

1. a. Complete the following reaction mechanism. Show all intermediates but not the transition state structures. Show electron pushing arrows and completely drawn Lewis Dot (or Kekule) structures for each step of the reaction mechanism and the correct regiochemistry and stereochemistry if required. (20 pts total, 15 pts this part) (Mechanism means show all steps on the way to product)

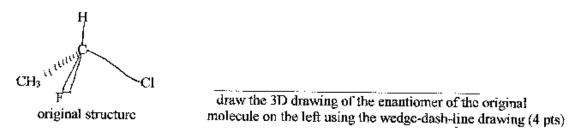


b Draw an energy diagram which matches your reaction mechanism showing all intermediates in your mechanism above. Label reactants, products, all intermediates above in your mechanism with the letters (a), (b), (c), ... etc. and then label your energy diagram. Guess at probable relative energies because obviously you can't have an accurate idea of relative energies in your energy diagram without dong an experiment. (5 pts)

2. a. For the given Fisher projection formula shown, draw one Fisher projection enantiomer & diastercomer of the original structure. (14 pts total)



 Given the following 3D structure, draw an enantiomer of the original structure using a wedge-dashline drawing.



The original molecule (not the enantiomer) has orientation [(R) or (S)] circle one. (2 pts)

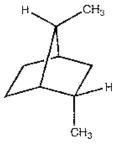
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nolis inter goin wha visil	se show work for all q specify work. Only an ided space without clo g to spend 3 hours loc t they meant to write in the No points for erro histry formulas showi	swers which are clear ear indication of whe sking for your answe if I can't clearly road as going from the ex-	orly readable will be ere, I will not grade it er somewhere on the what you wrote. No am to the scantron.	graded. If you write . (Lam grading 250 a exam and Lam not go Points for erased ans No Points for lanythin	the answer other than a 10 page exams, by m oing to contact 250 peo owers which are still so ng other than normal o	in the yself I am not pte to tell me omewhat
(tota page	l number of pages of es, it is your own resp	the exam = 9 pages to consiblity for not con	<ul> <li>periodic table + scar impleting the exam.)</li> </ul>	itron - Check numbe	r of pages. If you tur	n in less than 10
Part in ca	1 Multiple Choice (2 se you crased so mud	pts each, 26 pts total h that there is a comp	) fill in your answe puter error in gradin	r on the hardcopy of t g.	the exam as backup (o	r your scantron
MU	TIPLE CHOICE. C	ioose the one alterna	ative that best compl	etes the statement or	answers the question	ı.
	<ol> <li>How many dist radical chlorina</li> </ol>		d products can result	when cyclopentane i	is subjected to free	1)
	A) 1	B) 2	C) 3	D) 4	E) 5	
	sequence?			to an oxymercuration		2)
	A) Markovni	kov addition of H <sub>2</sub> C	) wherein skeletat rea	nrangement is prove	nted	
	B) M <b>ar</b> kovni	kov addition of FI2C	) wherein skeletai rea	irrangement is promo	oted	
	C) syn-hydr	oxylation				
	D) anti-Mar	kovnikov addition of	f H2O wherein skelet	al rearrangement is p	revented	
	F) anti-Marl	kovnikov addition of	f 1120 wherein skelet	al rearrangement is p	romated	
		llowing intermediate presence of acid?	es is thought to occur	in the mechanism by	which alkenes are	3)
	A) carbocation	on				
	B) carbanion	1				
	error de la la	al				
	C) free radio					
	C) free radio D) carbene					
	·					

4) A mixfu	re of equal a	mounts of two	i enantiomers	

4) \_\_\_\_\_

- A) is optically inactive
- B) is called a racemic mixture
- C) implies that the countiomers are meso forms
- D) both A and B
- E) none of the above
- 5) How many secondary hydrogens are present in the hydrocarbon below?

5) \_\_\_\_\_\_



- A) 7
- B) 2
- C) 16
- D) 6
- F.) 8

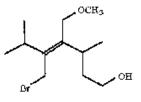
6) Which of the following is <u>not</u> a possible termination step in the free radical chlorination of methane? 6)

- A) -CH3 + -CH3 → CH3CH3
- B) -CH3 + CF CFt3Cf
- C) CH3 + Cl2 CH3Cl + Cl
- D) None are termination steps.
- E) All shown steps are termination steps.
- 7) A radical reaction mechanism is:

?)

- A) done so as to produce the more stable pair of ions
- B) homolytic
- C) via hydrogenation
- D) heterolytic
- E) none of the above

- 8) Which of the following best describes the geometry about the carbon-carbon double bond in the alkene below?
- 8) .\_\_\_\_\_



A) Z

B) I

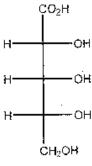
C) neither  $\Gamma$  nor Z

9) Which of the following is a carbone?

9) .....

- A) CH3CH2+
- B) CH2=CHO=
- C) NCO-
- D) CII3CH2:
- E) gCCl<sub>2</sub>
- 10) How many diastereomers are these of the molecule shown below?

10)



- A) 3
- B) 2
- C) 0
- D) 1
- E) 6

11) Consider Dishown	the three–step mechanism for the reaction of $A$ through intermediates $B$ and $C$ to produce below.	1i)
A – B	$E_0 = 15 \text{ kcal/mol}$	
B - C	$E_0 = 10 \text{ kcal/mol}$	
$C \dashv D$	E <sub>d</sub> = 2 kcal/mol	
Which of	the three steps is rate-limiting slowest step?	
A) The	reaction of A to B.	
B) The	reaction of B to C.	
C) The	reaction of C to D.	
D) All	three steps occur at the same rate; there is no rate-limiting step.	
E) You	can't tell from the information given.	
12) Which of	the following statements is (are) true for the compound (R)-2-butanol?	12)
	s compound has an enantiomer.	
B) Thi	s compound is optically active.	
	s compound is chiral.	
D) áll (	of the above	
E) nor	e of the above	
13) For a giv	on reaction, if △G° is greater than zero (positive), then:	13)
	reaction is going downhill in energy and will go to product.	
	maction is going really tast.	
C) The	reaction is going uphill in energy and will not go to product.	
	statements are true.	
	statements are false.	
ŕ		

Please show work on all questions for partial credit even on questions which do not specify. Please write legibly. If I cannot read your answer, I cannot grade your answer. (use back of exam for scratch paper)

Part II. Short Answers (40 pts)

A. Nomenclature: (2 pts each, 8 pts)

Given the structural formula shown below, give the IUPAC name of the molecule.

- Given the following IUPAC name, draw a structural formula of the molecule (skeletal formula
  acceptable, condensed structure, Lewis Dot structure acceptable, molecular formula not acceptable don't forget to show the hydrogens in your formula unless you are using the skeletal structure.)
  - a. 3,3,4,4-tetramethylhexanc
  - b. E-2-chloτο-4,5-diethyl-4-octene

B. Reactions: Show the Organic Product in the following reactions by giving the structural formula of the product, (skeletal formula, condensed structure, Lewis Dot structure are all acceptable. Molecular Formula is <u>not</u> acceptable.) DO <u>NOT</u> SHOW MECHANISMS. (2 pts each, 10 pts)

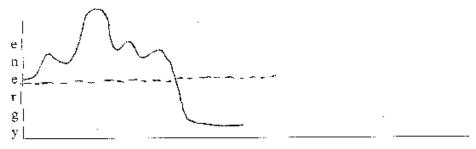
5 CH<sub>3</sub> CU<sub>3</sub> 
$$\frac{\text{CH}_2 \text{ I}_2}{\text{Zn}(\text{Cu})}$$

## C. Short Answers (22 pts)

1. Given the following groups attached to a chiral carbon, put in order of (a) highest priority to (d) lowest priority. Show all "ghost" atoms. (2 pts each, 8 pts)

2. Given the following carbocations, label from most stable to least stable by filling in the blank below the molecule with the number (1) for most stable to (4) for least stable (1 pt each, 4 pts)

3 Given the following energy diagram, (2 pt each, total 10 pts)



## Reaction Progress

- a) How many steps is in the reaction mechanism shown [(1), (2),(3)(4)] (circle one)
- b) Which of the steps is the slowest step [(1<sup>st</sup> step) (2<sup>nd</sup> step) (3<sup>rd</sup> step)] (circle one) (note: just because I gave 3 potential steps does not necessarily mean that there are actually 3 steps it could be less)
- c) How many intermediates ? [(1),(2),(3)(4)] (circle onc)
- d) How many transition states [(1),(2),(3)(4)] (circle one)
- e) Is the reaction energetically favored to go forward to product? [(yes) (no)] (circle one)

Part III. Long Answers (34 pts) Show all work for partial and full credit.

1. a. Complete the following reaction mechanism. Show all intermediates but not the transition state structures. Show electron pushing arrows and completely drawn Lewis Dot (or Kekule) structures for each step of the reaction mechanism and the correct regiochemistry and stereochemistry if required. (20 pts total, 15 pts this part) (Mechanism means show all steps on the way to product)

Please check for the possibility of rearrangement. You may have to do a hydride shift.

b Draw a 3D structure of the **first intermediate** above showing the - charge localized on the empty p orbital. (3D structure need only be on the carbocation) (5 pts)

3. a. For the given Fisher projection formula shown, draw one Fisher projection enantiomer & diastereomer of the original structure. (14 pts total)

b. Given the following 3D structure, draw an enantiomer of the original structure using a wedge-dash-line drawing.

The original molecule (not the enantiomer) has orientation [(R) or (S)] circle one. (2 pts)