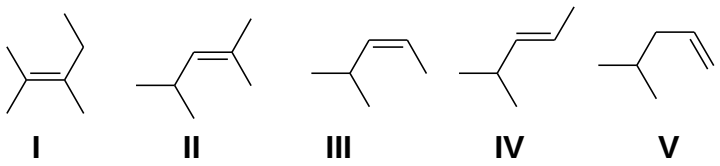
Part I (*10 marks*) - Multiple Choice (*1 mark each)* Place your answers in the boxes on the answer sheet.

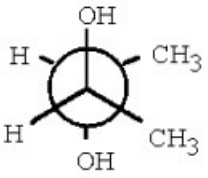
1. Rank the following alkenes in order of their stability (least stable on left to most stable on right).

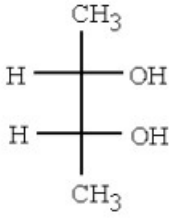


I **II** **III** **IV** **V**

(a) V < III < IV < II < I
(b) I < II < IV < III < V
(c) III < IV < II < V < I
(d) V < IV < II < III < I
(e) I <IV < II < III < V

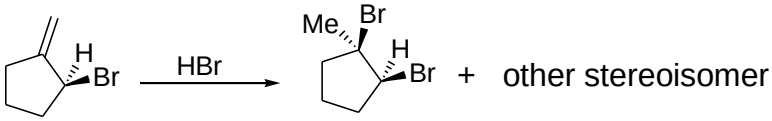
2. Which of the following terms best describes the pair of compounds shown:





A) enantiomers
B) constitutional isomers
C) the same molecule
D) diastereomers
E) E/Z isomers

3. Which of the following statements is <u>TRUE</u> regarding the reaction below?

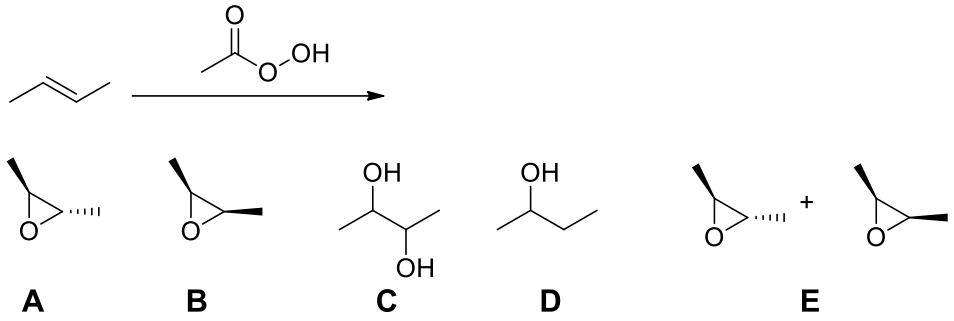


single enantiomer

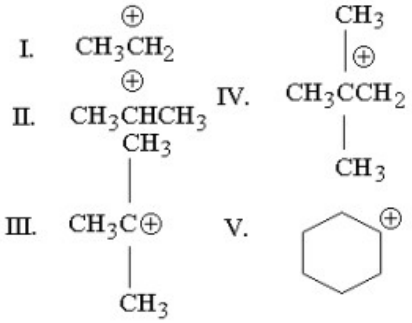
I- The mixture of products formed is optically active.
II-The stereoisomer *shown* is a meso compound.
III- The stereoisomer *shown* has a (1R, 2S) configuration.
IV-The stereoisomers formed are diastereomers relative to each other.
V-The stereoisomers are formed in a 50:50 ratio.

(a) I and IV only
(b) II, IV and V
(c) III, IV and V
(d) I, II, and IV
(e) I, III and IV

4. What is the major product of the following reaction:

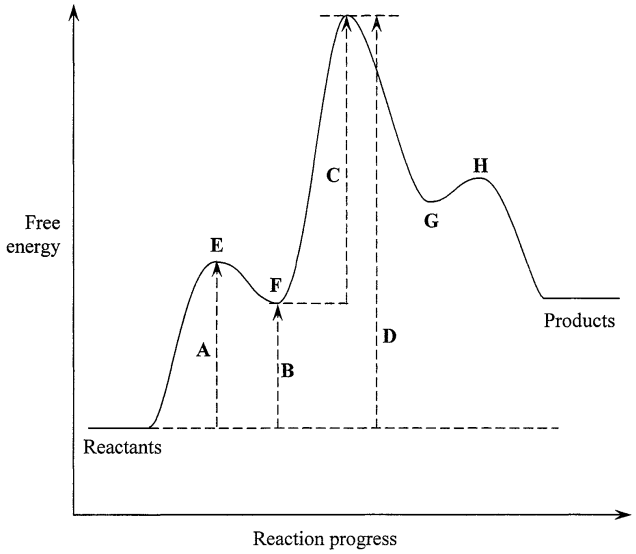


5**.** Which of the following carbocations is the <u>least</u> stable?



A) I
B) II
C) III
D) IV
E) V

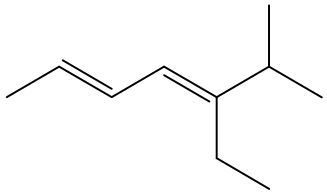
B. Answer questions 6 to 7 using the energy diagram provided below.



6. What is the activation energy for the rate-determining step of the forward reaction?
(a) **A**
(b) **B**
(c) **C**
(d) **D**
(e) None of the above

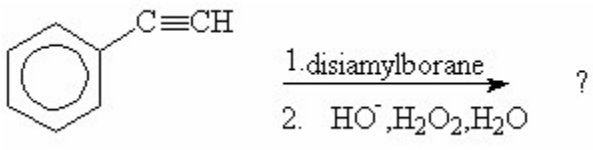
7. Which of the following statements is **true**?
(a) The reverse reaction is endergonic.
(b) There are two transition states in the forward reaction.
(c) Intermediate **F** is less stable than the second transition state.
(d The rate determing step is from **F** to **G**.
(e) The forward reaction is exergonic

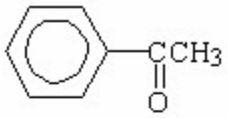
8. Which is the correct IUPAC name for the structure shown below?
a) (*2Z, 4Z*)-5-isopropyl-2,4-heptadiene
b) (*2E, 4E*)-5-ethyl-6-methyl-2,4-heptadiene
c) (*2E, 4Z*)-5-ethyl-6-methyl-2,4-heptadiene
d) (*2E, 4Z*)-5-methylethyl-2,4-heptadiene
e) (*2Z, 4E*)-5-ethyl-6-methyl2,4-heptadiene

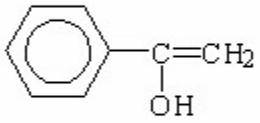


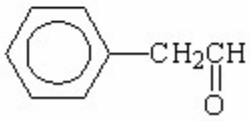
9. Which of the following compounds is the major product when 1-hexyne is treated with excess HBr?
A) 1,1-dibromohexane
B) 1,1-dibromohexene
C) 1,2-dibromohexene
D) 1,2-dibromohexane
E) 2,2-dibromohexane

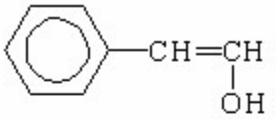
10. Which of the following is the final and major product of this reaction?

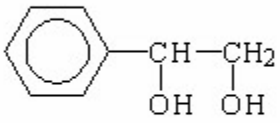


I. 

II. 

III. 

IV. 

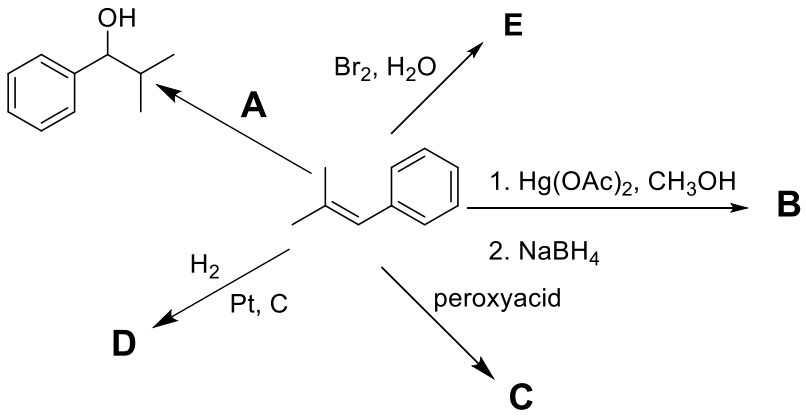
V. 

A) I
B) II
C) III
D) IV
E) V

Part II: Short Answers

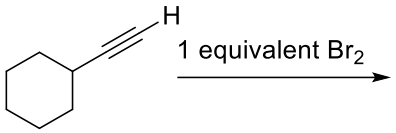
1. (*10 marks*)
Fumaric acid (*trans*-$HO_2CCH=CHCO_2H$) is reacted with bromine. Show the intermediate formed and draw all the stereoisomers formed in Fischer projection. Indicate all chirality centers with an asterisk (*). What is the chemical term used for the isomers formed? Is the product mixture optically active? (Check appropriate box on answer sheet) Explain your answer (yes or no) in fewer than 10 words.

2. (*10 marks*) Fill in the boxes on the answer sheet with the appropriate reactants, reagents, or products for the following reactions (show all stereochemistry where necessary):

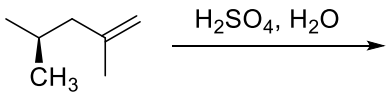


3. (10 marks) Draw the major organic product generated in the reactions below. Indicate any stereochemistry, if applicable.

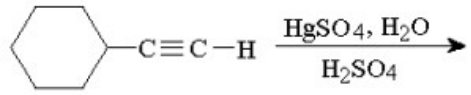
a)



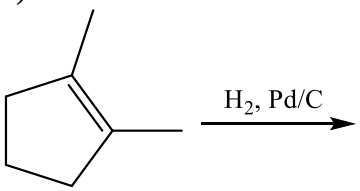
b)



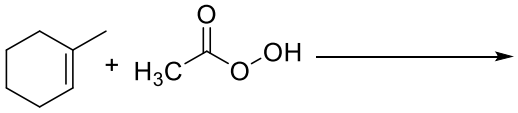
c)



d)

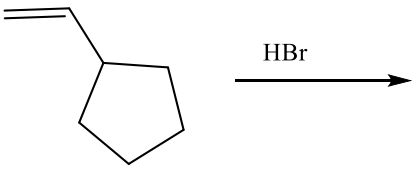


e)

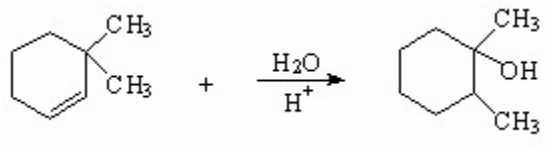


Part III: Mechanisms

1. Using curved arrows, draw the mechanism for formation of the product in the following reaction. (10 marks)



2. Propose a mechanism for the following reaction: (10 marks)



END of TEST

Name: _____

ANSWER SHEET

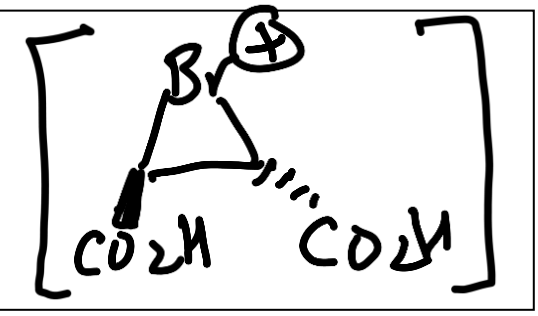
Part I. Multiple Choice:

Question	1	2	3	4	5	6	7	8	9	10
Answer	A	D	E	A	A	C	D	B	E	C

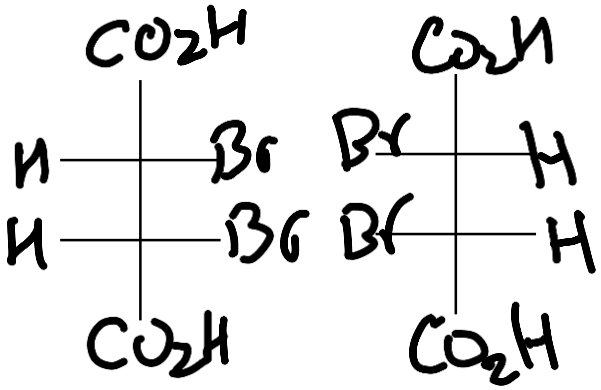
Part II. Short answers:

1. (10 marks)

trans-$HO_2CCH{=}CHCO_2H$ + Br_2 ⟶



intermediate



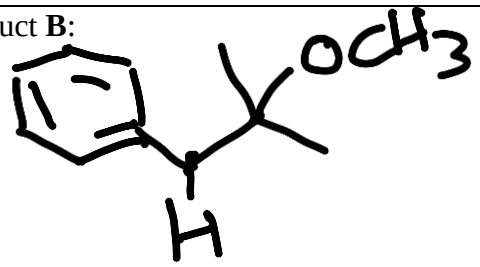
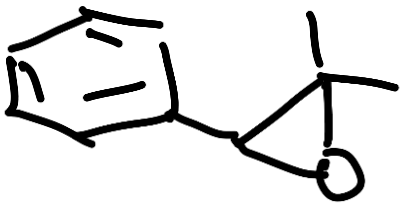
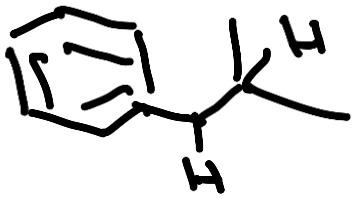
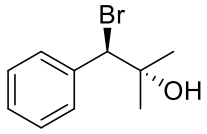
Optically active? Yes ☐ ☒ No

- meso
- line of symmetry
- ∴ no optical activity

2. (*10 marks*)

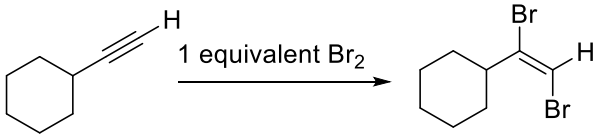
Reagents **A**:

1) BH3,THF ; 2) H2O2, H2O, HO^-

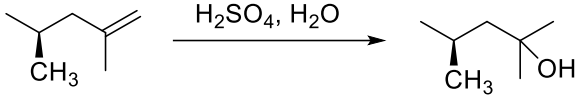
Product **B**: 	Product **C**: 
Product **D**: 	Product **E:**  + enantiomer

3. (10 marks)

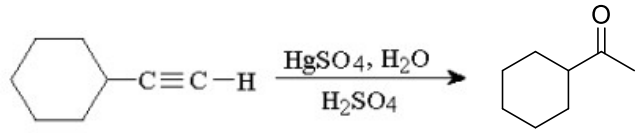
a)



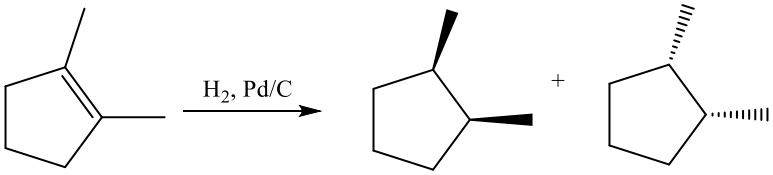
b)



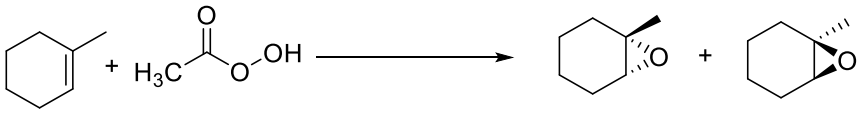
c)



d)

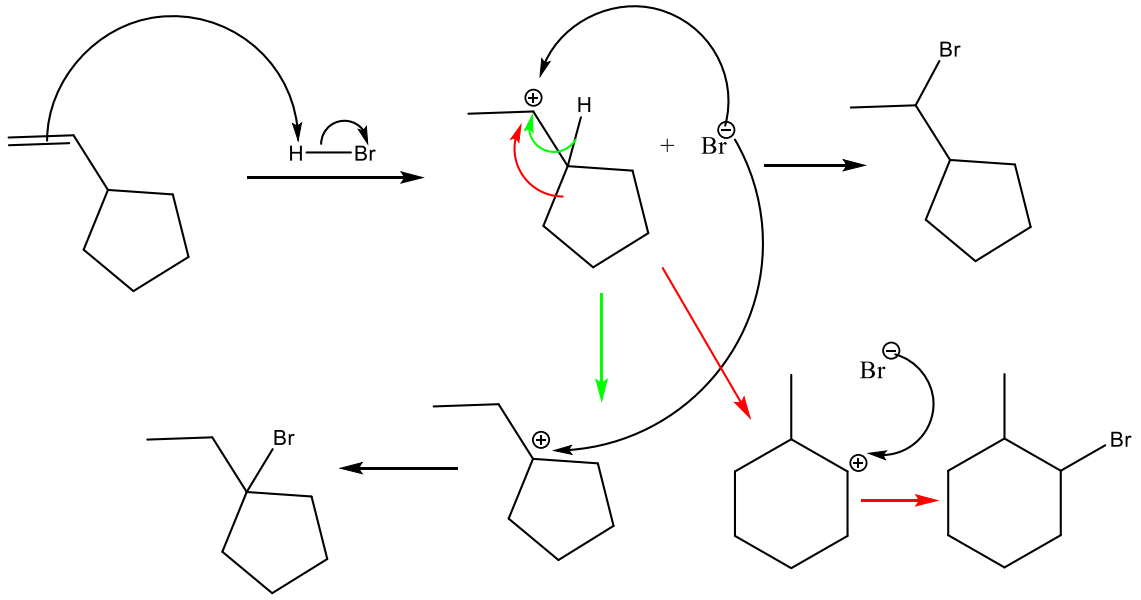


e)



Part III: Mechanisms

1.



2.