Athabasca University
CANADA'S OPEN UNIVERSITY

**Faculty of Science & Technology**

# Mid-term Grade Report

Please use ink only | REV 6

| CHEMISTRY | CHEM 350 | IMA | A |
|---|---|---|---|
| Course designation and number | | Form no. | Office use only |

## Student to complete *(please print)*

Name _____ Student ID number _____
Last First Middle

Address _____ Tutor Name _____

Postal Code _____

**Student signature** _____ **Date** _____

**Must be signed and dated to validate examination**

## Examination invigilator to complete

**Note:** Please place this form along with the examination and student response(s) in the self-addressed stamped envelope provided. If there is a problem, please call Examination Services at: **1 - 800 - 788 – 9041 ext. 6579**

Name _____ Telephone _____

Date exam received by invigilator _____ E-mail _____

This is to certify that the above student wrote the examination under my supervision between the hours of _____ (am/pm) and _____ (am/pm)

on the specified date at _____

**Name of the examination centre or invigilator's address**

**Invigilator signature** _____ **Date** _____

**Must be signed and dated to validate examination**

## Marker to complete

Examination mark _____

**Comments:**

ANSWER KEY

MIDTERM

CHEM 350

**Marker signature** _____ **Date** _____

Students wishing to appeal an examination result must follow the instructions regarding Appeal regulations provided in the Athabasca University Calendar.

The personal information collected on this form will be used for the purpose of producing a final grade report. The collection of this personal information is necessary for operating and administering the services of Athabasca University and will be protected under the provisions of the Alberta Freedom of Information and Protection of Privacy Act. If you have any questions about the collection and use of this information, Associate Registrar, Operations, Athabasca University, 1 University Drive, Athabasca, AB Canada T9S 3A3 Telephone: 1-800-788-9041

# CHEM 350
# Organic Chemistry I
# Mid-term Examination
# Version A

**Instructions to Examination Invigilator:**

Thank you for taking the time to supervise this examination for an Athabasca University student.

1. A maximum of **two (2) hours** is allowed for this examination.

2. This is a **closed-book examination**. Only materials distributed with this examination may be used by the student to answer examination questions. The student is **NOT** allowed to use textbooks, workbooks, notes, tapes, cell phones, hand-held computers, laptop computers, or other electronic/digital devices or to consult with other people while writing this examination.

3. The use of a calculator, slide rule, and a molecular model kit is permitted; but **palm pilots hand-held computers are not allowed**.

4. Before the examination date, please check that all pages of the examination are present. The examination should contain a Periodic Table, an Infrared Absorption Table, a $^1$H NMR Chemical Shift Table and a Chemistry Data Sheet. If anything is missing, please call Examination Services.

5. Please ensure that you, the Examination Invigilator, and the student fill in the appropriate sections of the **Mid-term Grade Report**. Please indicate the **exact** time taken by the student to complete the examination.

6. All examination materials are to be returned to you, the Examination Invigilator, when the student has finished writing the examination.

7. Before the student writes the examination, consult the Examination Invigilation Procedures document for detailed instructions as well as for information regarding problems/exceptions.

8. If the student has trouble understanding what is required to answer a particular question, please tell him or her to:

   a. note the difficulty beside the question, and

   b. try to answer the question as best as he or she can.

Again, thank you for your cooperation.

**Attach Chemistry Data Sheet, Periodic Table, Infared Absorption Table, $^1$H NMR Chemical Shift Table**

# CHEM 350
# Organic Chemistry I
# Mid-term Examination
# Version A

**Instructions to the Student:**

1. You will be allowed **two (2) hours** to complete the examination.

2. This is a **closed-book examination** to be written without textbooks, workbooks, notes, tapes, cell phones, hand-held computers, laptop computers or other electronic/digital devices and to be supervised by a person authorized by Athabasca University.

3. The use of a calculator, slide rule, and a molecular model kit is permitted; but **palm pilots hand-held computers are not allowed**.

4. Part A 10 Short-Answer Questions
   Part B 5 Long-Answer Questions

5. Before the examination, please check that all pages of the examination are present. The examination should contain a Periodic Table, an Infrared Absorption Table, a $^1$H NMR Chemical Shift Table and a Chemistry Data Sheet. If anything is missing, please tell the examination invigilator.

6. You must achieve at least **45%** to pass this examination.

7. Legibility is important; an examination that cannot be read cannot be graded.

8. Complete the information requested on the **Mid-term Grade Report** included in your examination package.

9. On completion of the examination, hand the entire examination package (examination questions, and mid-term grade report) to your examination supervisor.

**CHEM 350**
**Organic Chemistry I**
**Mid-term Examination**
**Version A**

## Marking Summary

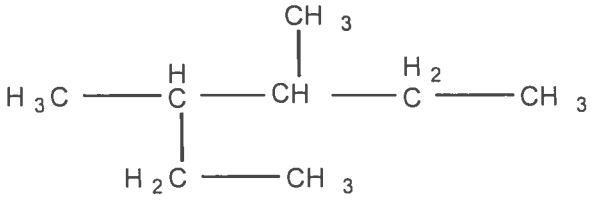
| Question Number | Marks Available | Score |
|---|---|---|
| Part A (Questions 1-10) | 30 | |
| Part B (Longer questions) | | |
| 11 | 10 | |
| 12 | 12 | |
| 13 | 6 | |
| 14 | 10 | |
| 15 | 12 | |
| **TOTAL** | **80** | |

**CHEM 350**
**Organic Chemistry I**
**Mid-term Examination**
**Version A**

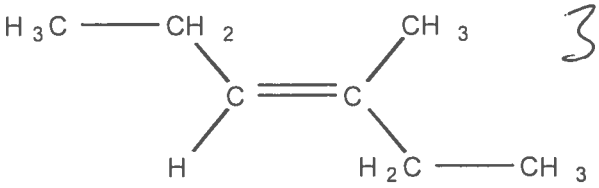
**Part A Short-answer questions**

Each question in this section is worth **3 marks**.

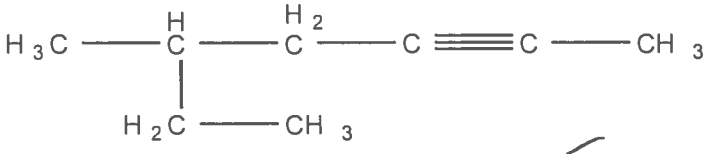
1. Provide the IUPAC name for each of the following compounds.



2,3-dimethylhexane



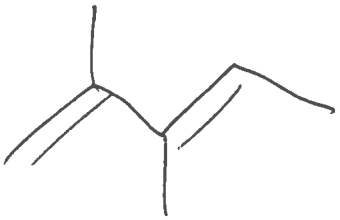
3-methyl-3-hexene



5-methyl-2-heptyne

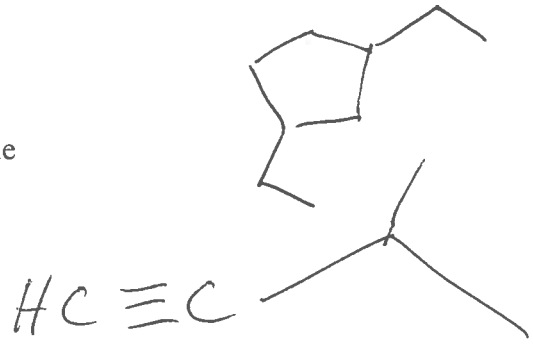
2. Draw structures for the following compounds.

a. 2,3-dimethyl-1,3-pentadiene

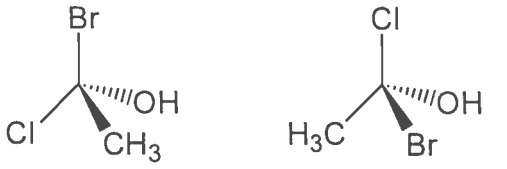


b. 1,3-diethylcyclopentane

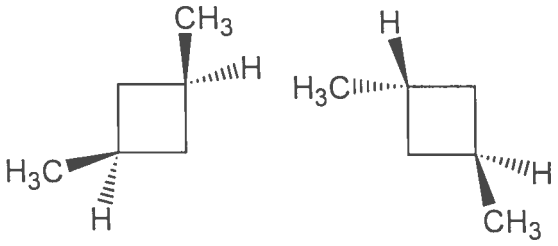
c. 3-methyl-1-butyne



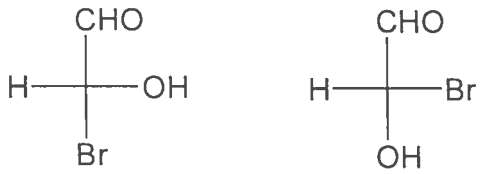

3. In each case label the following pairs of compounds as enantiomers, diastereomers, or identical.




identical

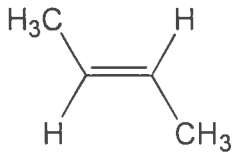



diastereomers

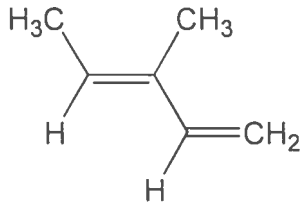



enantiomers

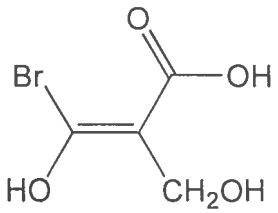
4. Determine whether each of the compounds shown below has *E* or *Z* configuration.




E

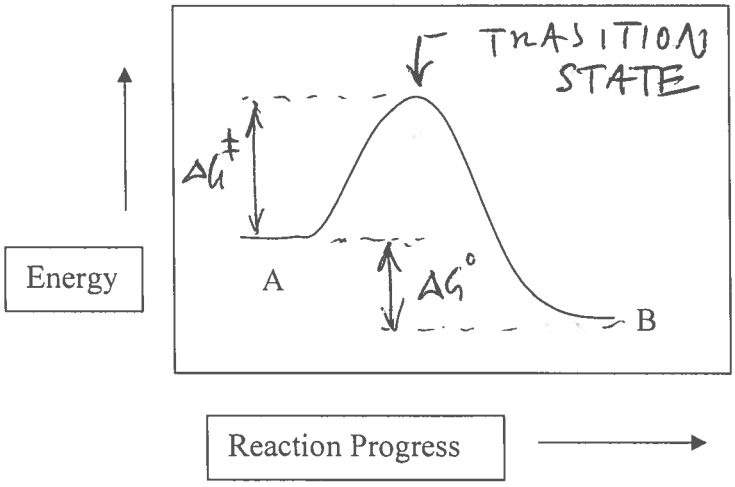



E




Z

5. Consider the following reaction energy diagram.




a. Is the above reaction exothermic or endothermic?

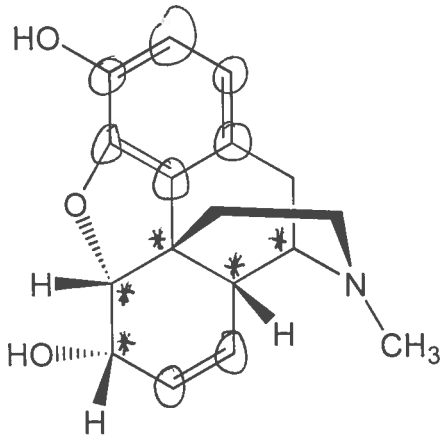
b. Label the transition state on the diagram.

c. Label $\Delta G^{\circ}$ and $\Delta G^{\ddagger}$ on the diagram. Use double-headed arrows to indicate what ranges they represent.

6. Morphine is a powerful analgesic drug. On the structure of morphine below:

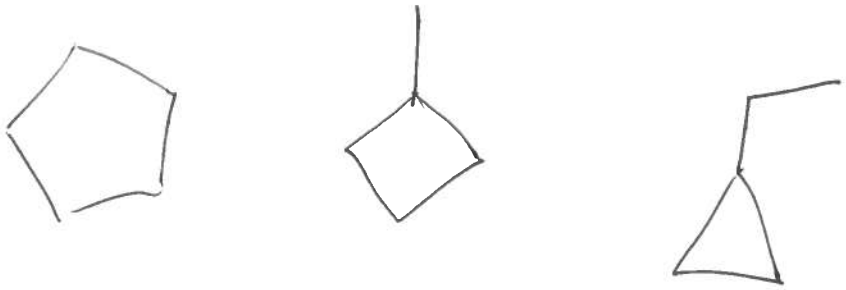
   a. Use asterisks (*) to label each of the stereogenic carbon atoms in this compound.

   b. Circle all $sp^2$ hybridized carbon atoms.

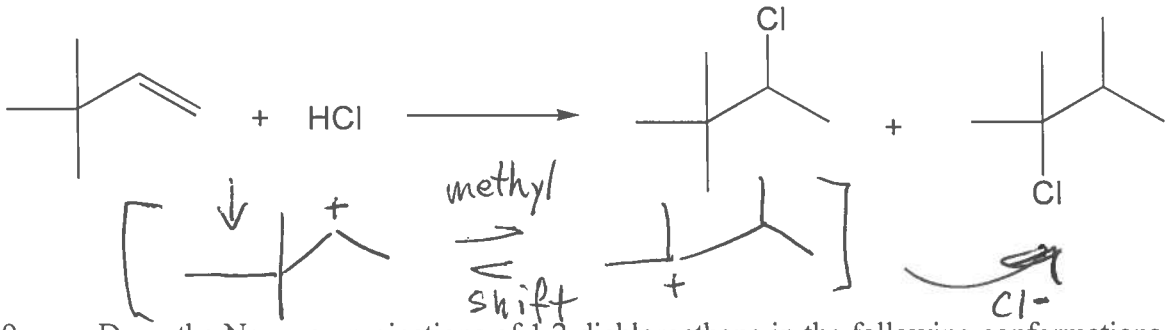



*morphine*

7. There are three (3) constitutional cycloalkane isomers for $C_5H_{10}$. Draw these three isomers containing a cycloalkane.

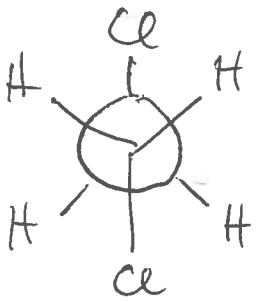


8. Explain why this reaction generates two products and draw the cation intermediate expected for each product shown.

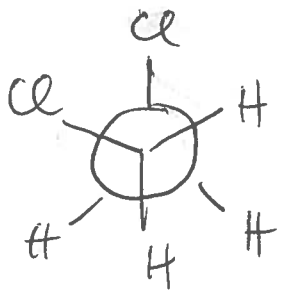



9. Draw the Newman projections of 1,2-dichloroethane in the following conformations. Circle the least stable configuration.

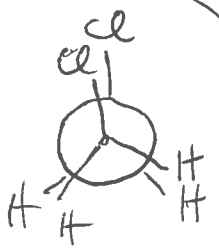
anti




gauche




eclipsed




least stable

10. At 32° C a reaction has an equilibrium constant ($K_{eq}$) of 7.5.

a. Does the equilibrium lie to the products of reacts side?

slightly to products

b. Calculate the value of $\Delta G^\circ$ at this temperature.

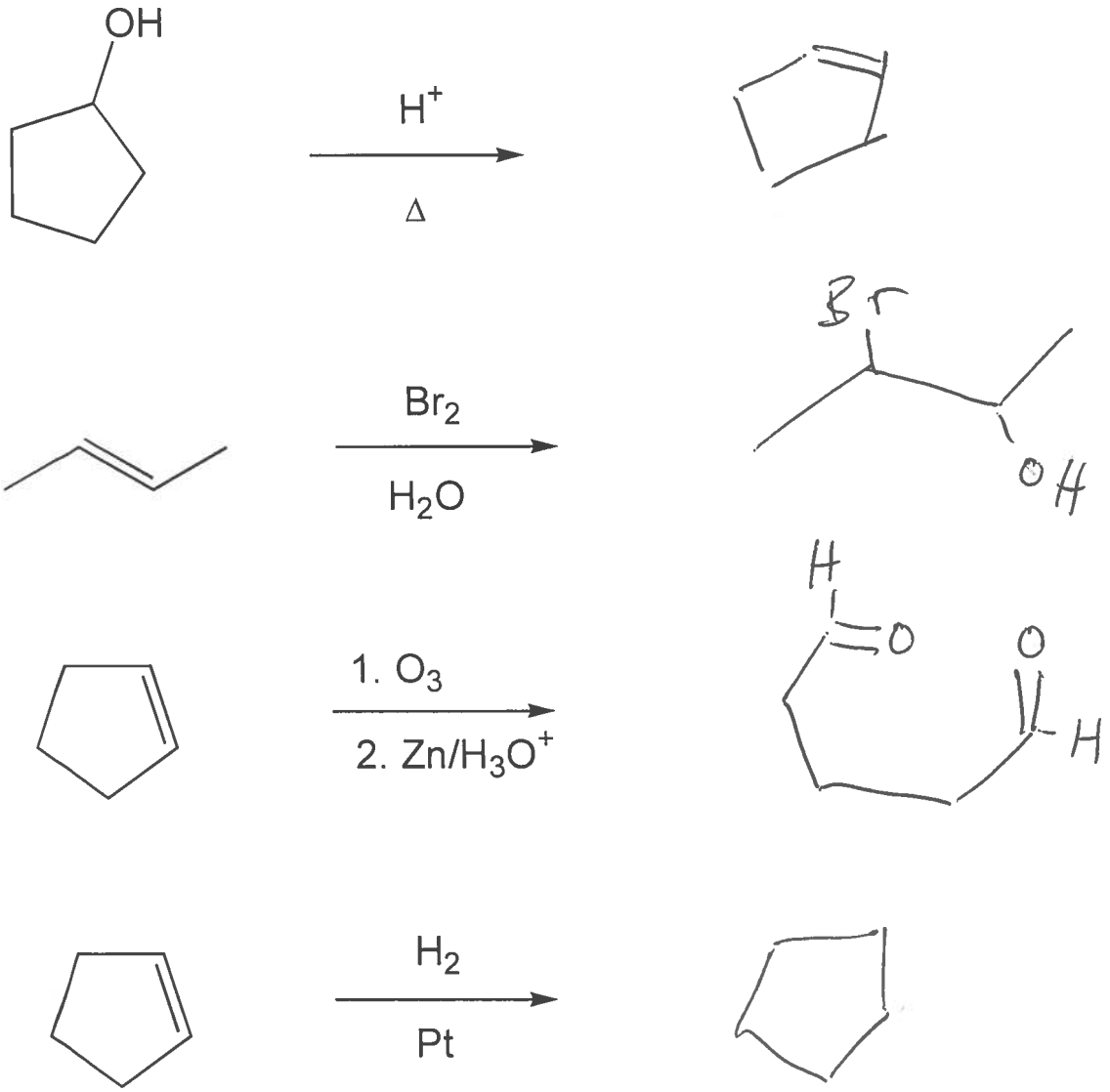
$\Delta G^\circ = -RT \ln K_{eq} = -(8.314)(305) \ln 7.5$

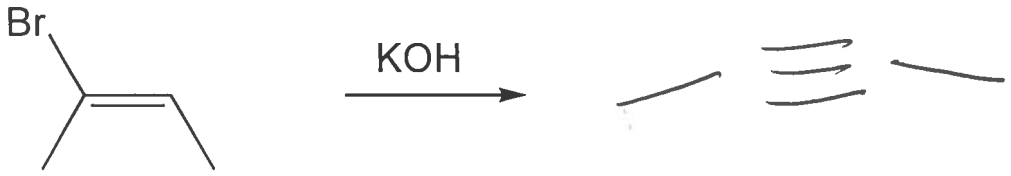
$= -5.1$ kJ/mol

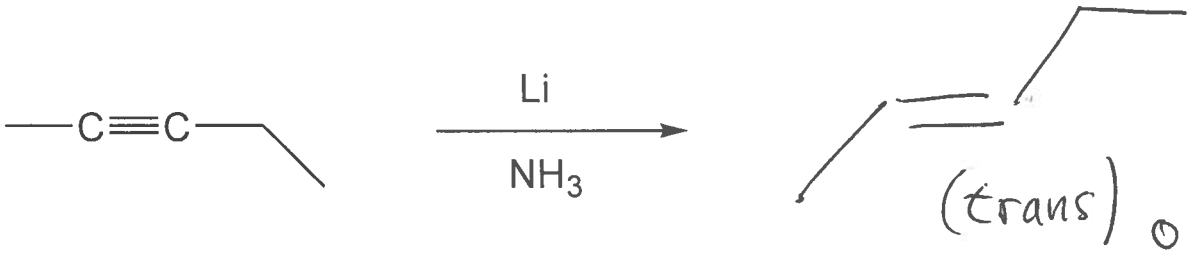
**Part B Long-answer questions**

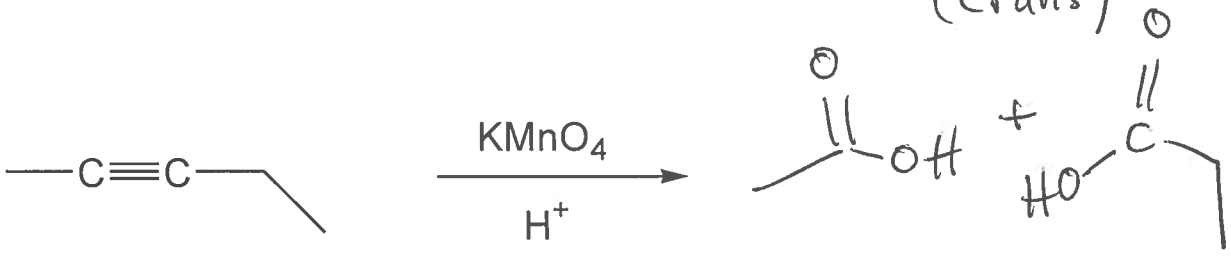
The marks for each question are indicated.

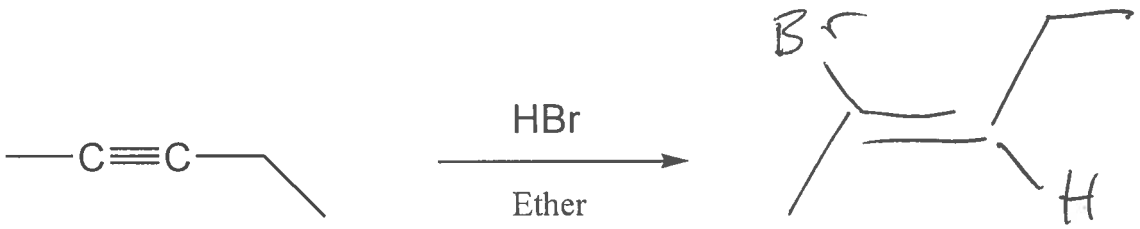
11. Give the major product(s) for FIVE (5) of the following reactions and show stereochemistry where appropriate. (Note: Only the first five questions answered will be marked—so only give answers for the five you want marked.)



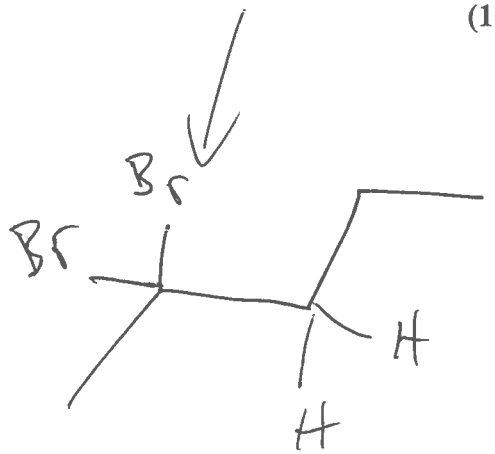


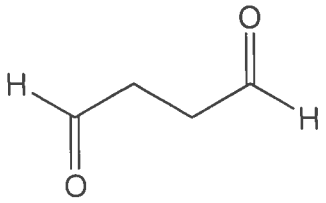



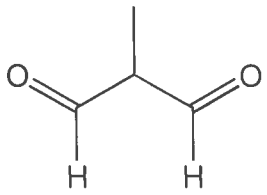

**(10 marks)**



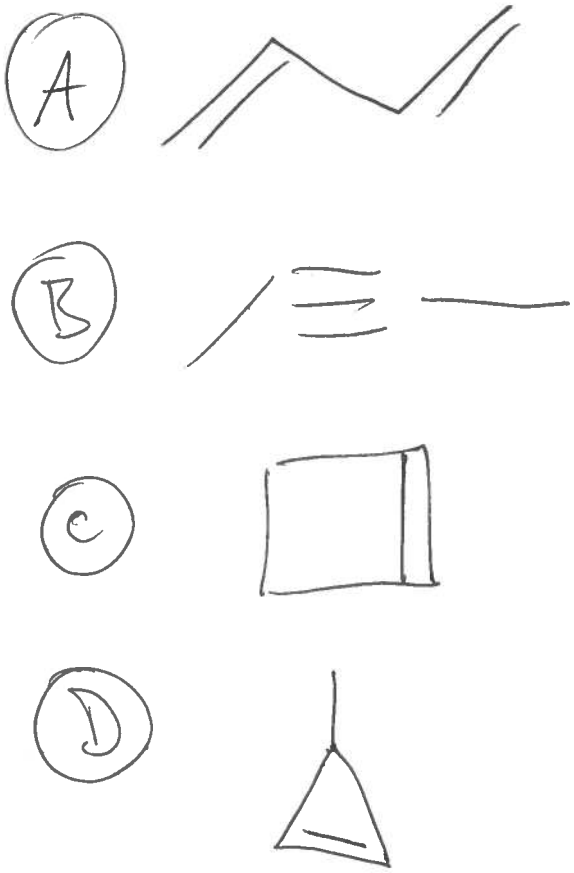
12. You run a chemistry lab and have found that your new lab assistant has labelled four different compounds (A, B, C, and D) with the formula $C_4H_6$. You know these compounds are isomers, but they are also chemically different. All three unknowns decolourize $Br_2$ in $CH_2Cl_2$. A and B form butane and each absorb 2 moles of $H_2$. Compound B reacts with $NaNH_2$ and then $CH_3Br$ to form a five-carbon compound. The other compounds (i.e. A, C, and D) do not react. Treatment of Compound C with $KMnO_4$ affords Compound E, while Compound D forms Compound F under the same conditions (see structures below). Before making your lab assistant write out "I will always label my chemicals properly!", one hundred times on the chalkboard, suggest suitable labels for compounds A, B, C, and D.




E

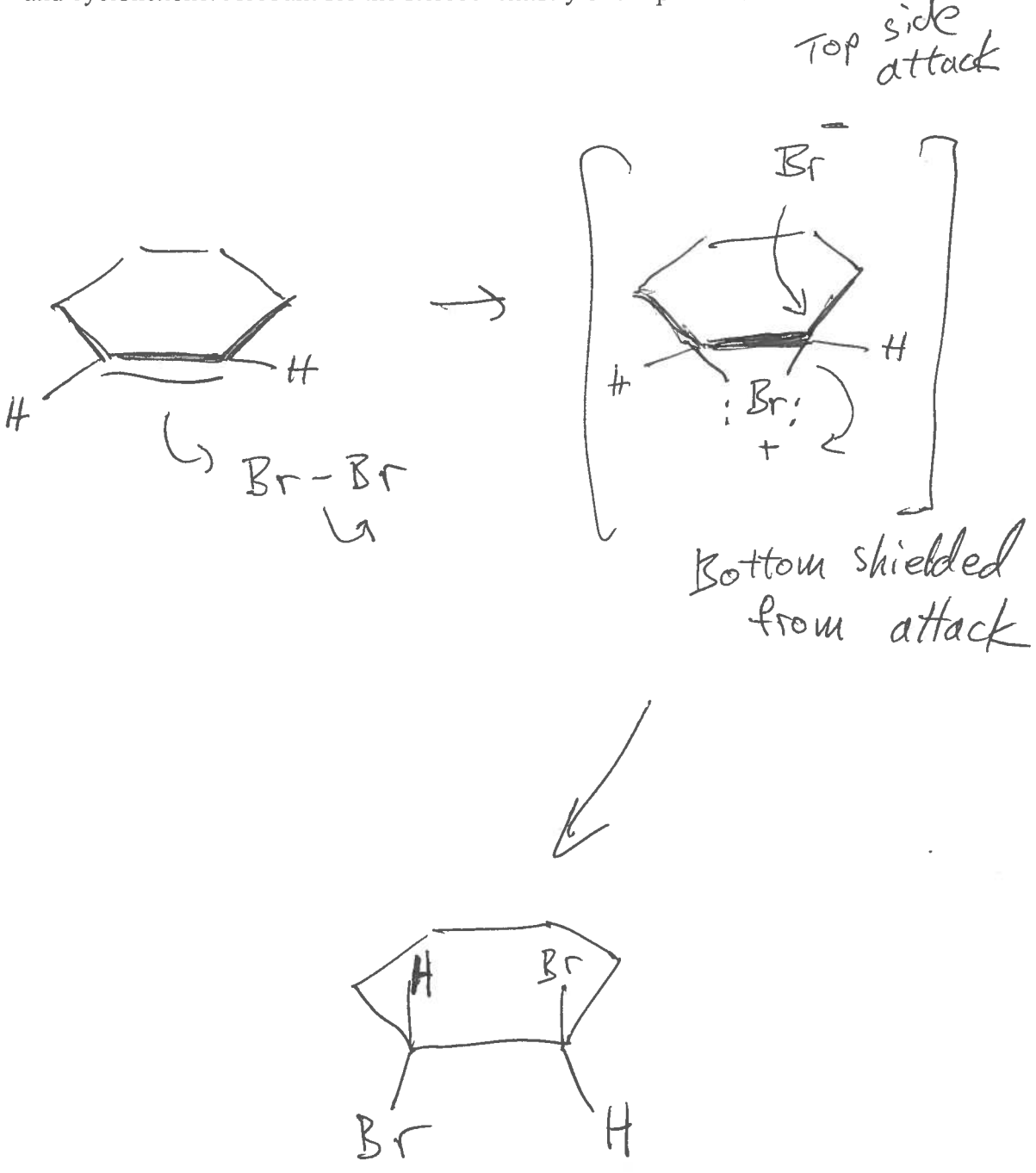



F



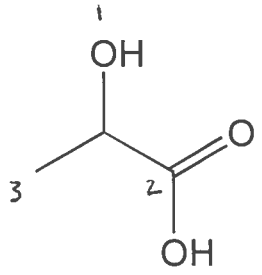

**(12 marks)**

13. Write/draw the detailed mechanism for the addition reaction that occurs between bromine and cyclohexene. Account for the stereochemistry of the product.

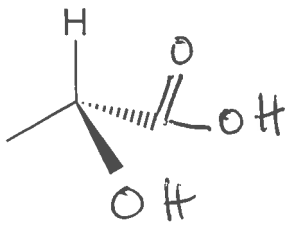



**(6 marks)**

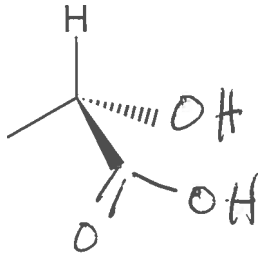
14. The structure of lactic acid is shown below. Lactic acid is optically active with (–) lactic acid (*R* configuration) having $[\alpha]_D = -3.82^o$ and (+) lactic acid (*S* configuration) having $[\alpha]_D = +3.82^o$.




a. Draw both configurations.




*R*




*S*

b. The observed $[\alpha]_D$ of a sample of lactic acid is $+1.23^o$. Calculate the percent mix of *R* and *S* configurations.

Let x = fraction of R; 1-x = fraction S

$1.23 = x(-3.82) + (1-x)(+3.82)$

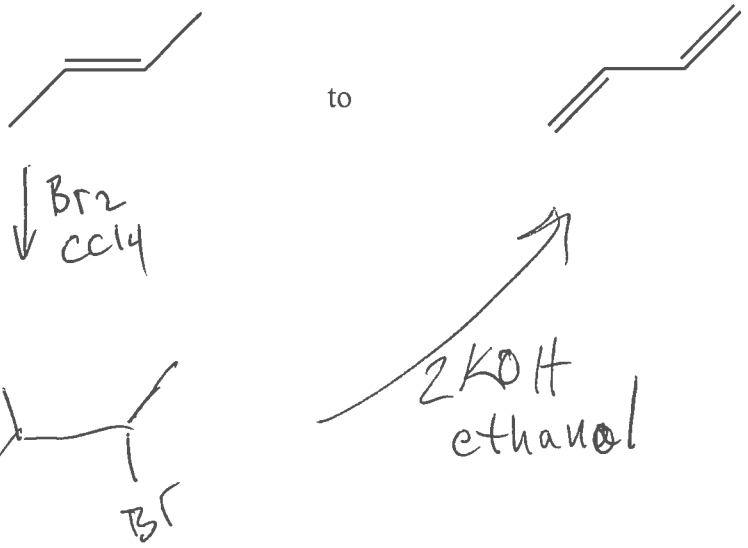
$\frac{1.23}{3.82} = -x + 1 - x = 1 - 2x$

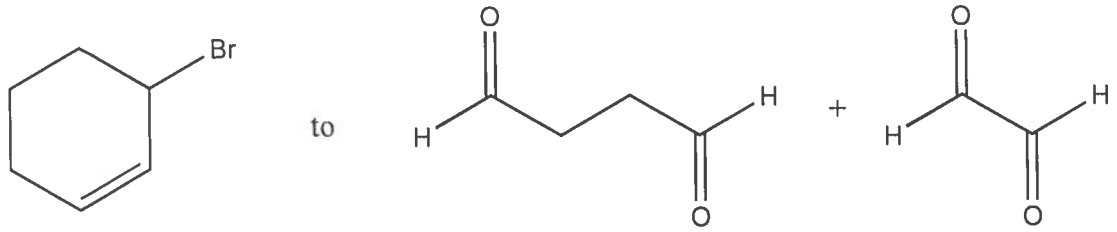
$2x = 1 - \frac{1.23}{3.82}$

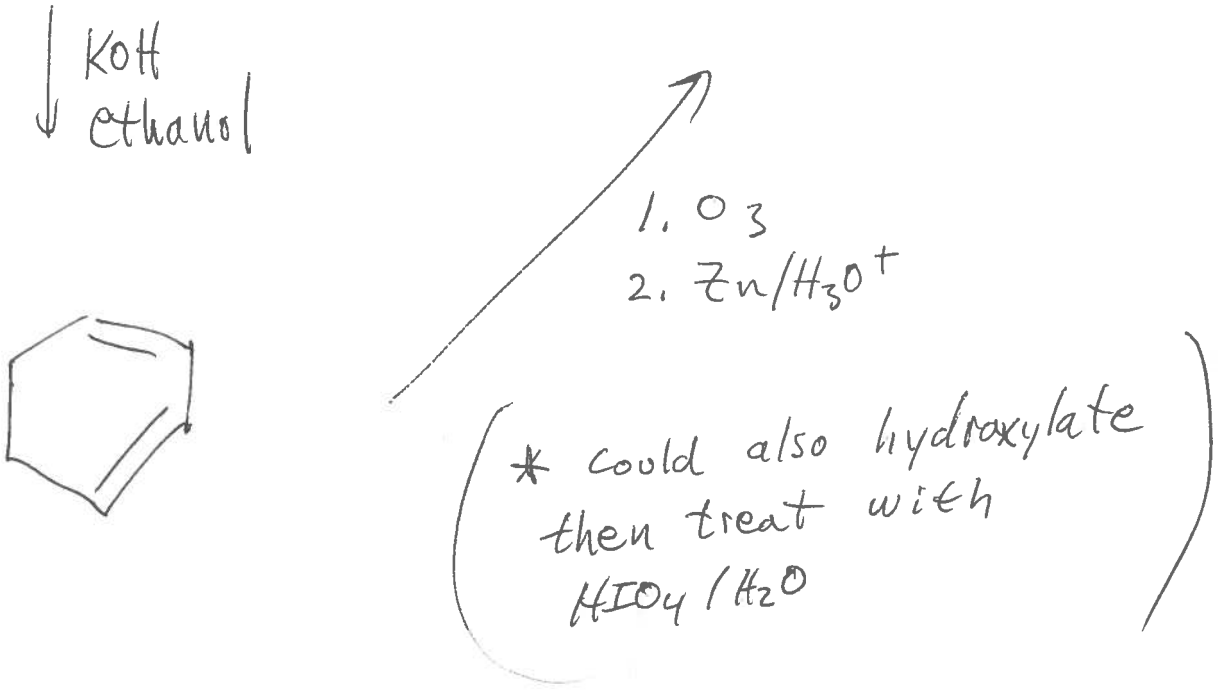
$x = \left(1 - \frac{1.23}{3.82}\right)/2 = 0.34$

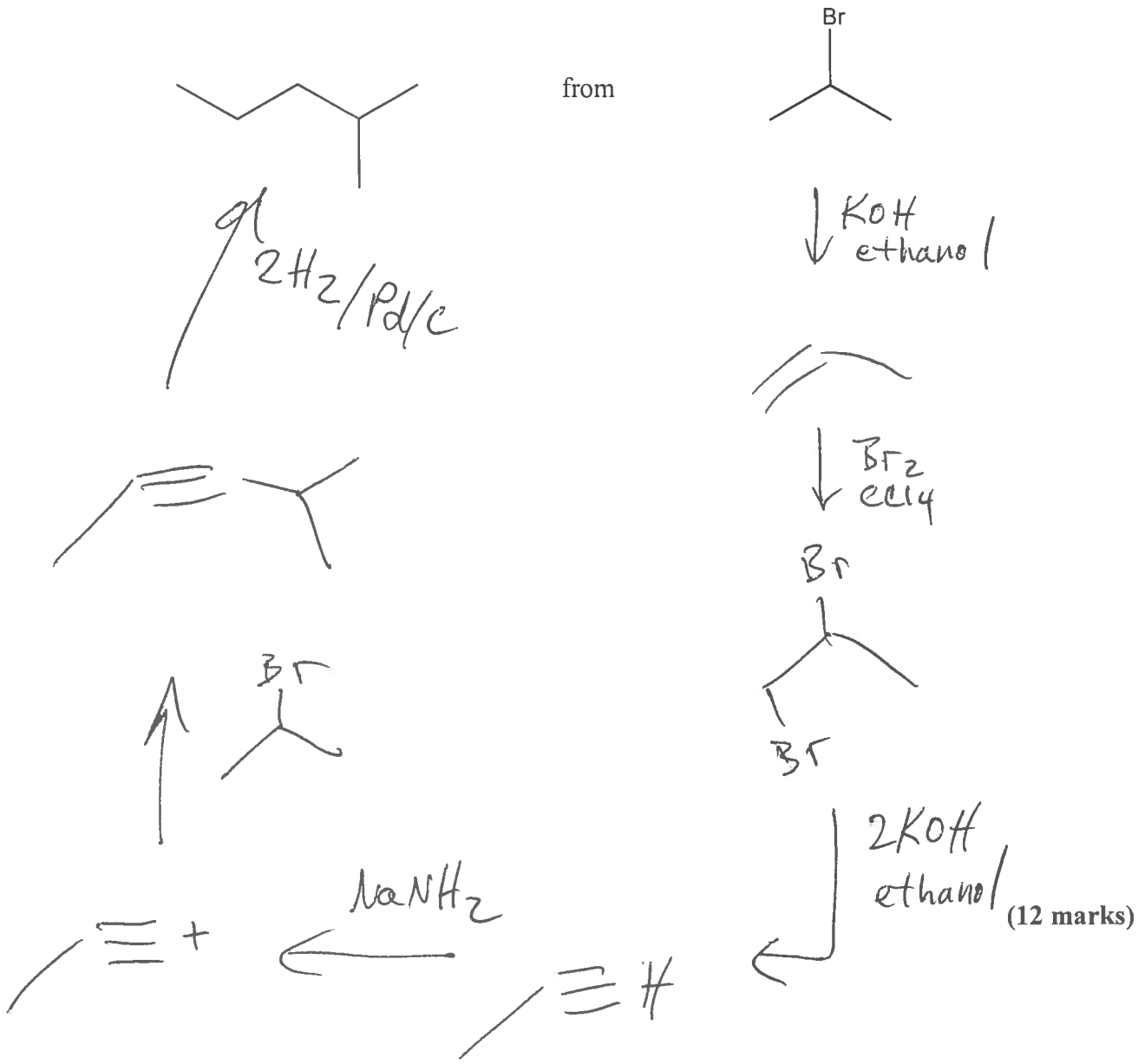
66% S and 34% R **(10 marks)**

15. Show by means of chemical equations how TWO (2) of the following conversions could be achieved.






**(12 marks)**



***** END OF EXAMINATION *****