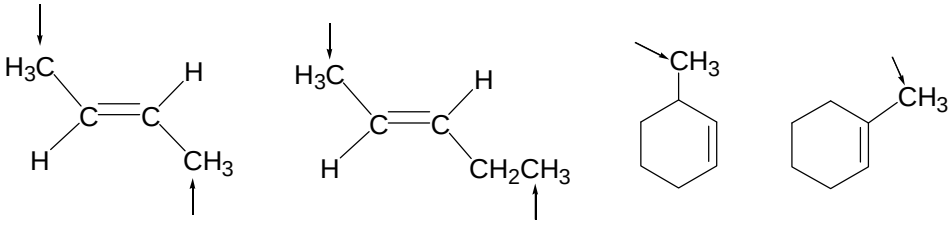
Advanced Placement Credits Test 2008
Module Template

1.	**Module Code:**	CM1121
2.	**Module Title:**	BASIC ORGANIC CHEMISTRY
3.	**Modular Credits [MC]:**	4
4.	**Module Description:**	The module deals primarily with the basic principles to understand the structure and reactivity of organic molecules. Emphasis is on substitution and elimination reactions and chemistry of various functional groups. Basic concepts on how simple molecules can be constructed, reactions mechanism, organic transformations and stereochemistry are covered in this module.
5.	**Module Content/Syllabus:** (to include topics to be covered)	1. Structure and Bonding 2. Polar Covalent Bonds; Acids and Bases 3. Alkanes and Cycloalkanes: Structure, Stereochemistry and Reactions 4. Alkenes: Structure, Reactivity, Synthesis and Reactions 5. Alkynes: Structure, Reactivity, Synthesis and Reactions 6. Stereochemistry 7. Organohalides: Structure, Reactivity, Synthesis 8. Nucleophilic Substitution and Elimination Reactions 9. Benzene and Aromaticity 10. Electrophilic Aromatic Substitution 11. Alcohols and Phenols: Structure, Reactivity, Synthesis and Reactions 12. Ethers and Epoxides: Structure, Reactivity, Synthesis and Reactions 13. Carbonyl Compounds: Structure, Reactivity, Synthesis and Reactions
6.	**Tutorial/Assignment Sample Questions** (you may attach the Qns as an appendix to this document)	See attached.
7.	**Recommended Textbooks/Readings:**	Organic Chemistry, John McMurry Organic Chemistry, T. W. Graham Solomons, Craig B. Fryhle

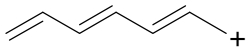
8.	**Exam Format:** (please indicate the duration and assessment format, e.g. MCQ, Short-answer Qns, Essay Qns)	(i) Duration: 2 hours (ii) Assessment Format: 4 questions
9.	**Sample of Exam Questions:** (you may attach the Qns as an appendix to this document)	See attached.

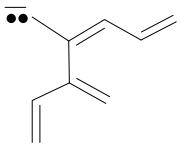
CM1121: MASS TUTORIAL QUESTION SET 1

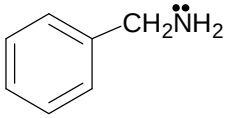
1. Do the sp^2 carbons and the indicated sp^3 carbons lie on the same plane?

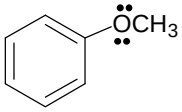


2. Draw the resonance contributors for the following species:

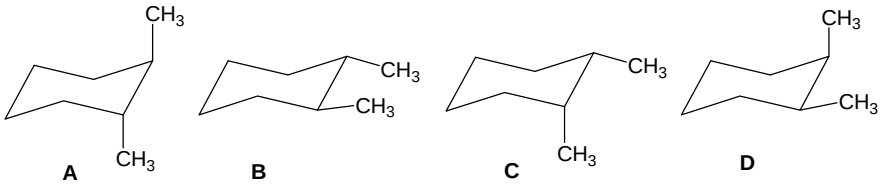
(a) 

(b) 

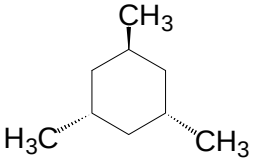
(c) 

(d) 

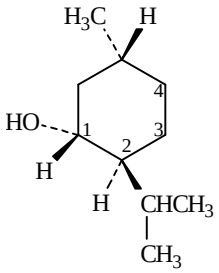
3. Which of the following structures represents a cis isomer?



4. Draw the most stable conformer of:



5. (-)-Menthol can be isolated from the peppermint plant and is responsible for the characteristic flavor and taste of peppermint. The structure of (-)-menthol is:



Draw the two chair conformations that are in equilibrium for (-)-menthol.

NATIONAL UNIVERSITY OF SINGAPORE

CM1121 – Advanced Placement Credit TEST

TIME ALLOWED: 2 HOURS

INSTRUCTIONS TO CANDIDATES

1. This examination paper contains **FOUR (4)** questions and comprises **FIVE (5)** pages.

2. Answer **ALL** questions.

3. Answer each question beginning on a **FRESH** page of the answer book.

4. This is a CLOSED BOOK examination.

Question 1

(a) What is the shape of the benzene molecule?

(A) trigonal planar

(B) hexagonal chair

(C) hexagonal planar

(D) hexagonal boat

(b) If you add HBr to the double bond in 2-methyl-2-butene, which carbon does the bromine atom bond to?

(A) 1 (B) 2 (C) 3

(D) 4 (E) 5

(c) Which alcohol will make only 100% 3-heptene by a dehydration reaction?

(A) 2,2-dimethyl-3-pentanol

(B) 1-heptanol

(C) 2-heptanol

(D) 3-heptanol

(E) 4-heptanol

(d) Why do pure ethers have such low boiling points compared to other molecules with the same molecular weight but with hydroxyl groups?

(A) Ethers have high dielectric strength

(B) Ethers have smaller molecular size for a given molecular weight

(C) Ethers have a higher bond dissociation energy

(D) Ethers lack hydrogen bonding when pure

(E) Ethers have lower density

(e) How many monobromo isomers are possible for the reaction product of 2-methylpropane and bromine?

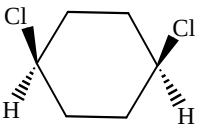
(A) 1 isomer

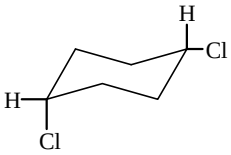
(B) 2 isomers

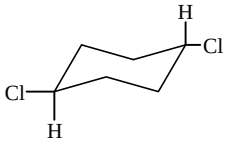
(C) 3 isomers

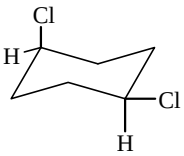
(D) 4 or more isomers

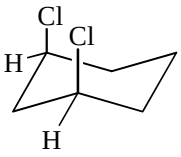
(f) Which of the chair forms are the same compound as the planar structure given below?



(I) 

(II) 

(III) 

(IV) 

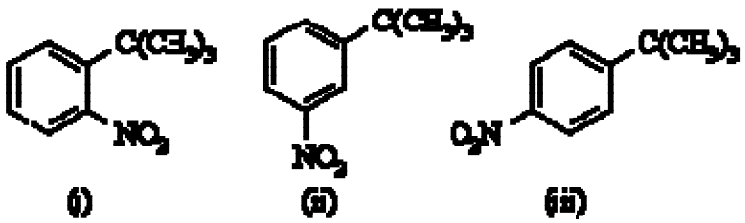
(A) I and II

(B) II and III

(C) III and IV

(D) I and III

(g) Arrange the following products according to the % yield obtained from the nitration of t-butylbenzene.



(A) (i) > (ii) > (iii)

(B) (iii) > (i) > (ii)

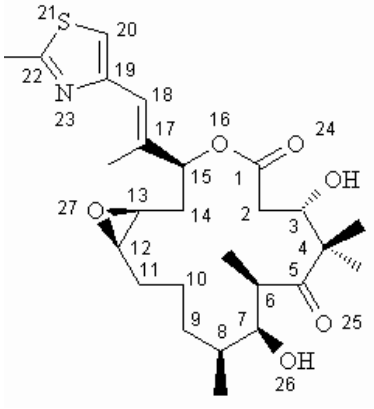
(C) (i) > (iii) > (ii)

(D) (ii) > (iii) > (i)

(E) (ii) > (i) > (iii)

(15 marks)

(e) The structure of EPOTHILONE A, a compound with anticancer activity similar to Taxol is shown to the right.



What is the hybridization (sp^3, sp^2 or sp) at each of the following atoms in Epothilone A ?

C8 _____ C12 _____

C14 _____ C17 _____

C22 _____

(10 marks)

Question 2

The following paragraph describes a series of reactions on a series of unknown but related compounds:

A hydrocarbon **A** contains a cyclobutane ring and has molecular formula C_6H_{10}. Treatment of **A** with dilute H_2SO_4 gave two isomeric alcohols, **B** and **C**. **B** is a tertiary alcohol and **C** is a secondary alcohol. Dehydration of **B** gave two isomeric hydrocarbons **D** and **E**, whilst dehydration of **C** gave **A** and another isomeric hydrocarbon **F. D**, **E** and **F** were further investigated chemically by their reactions with (i) H_2 in the presence of Pd on carbon, and (ii) HBr (in the absence of light):

Reaction of either **A** or **F** with H_2 in the presence of Pd on carbon gave ethylcyclobutane.

Reaction of **A** with HBr (in the absence of light) gave **G**, a secondary bromide whereas reaction of **F** with HBr (in the absence of light) gave **H**, a tertiary isomer of **G**.

Reaction of either **D** or **E** with H_2 in the presence of Pd on carbon gave methylcyclopentane.

Reaction of **D** or **E** with HBr (in the absence of light) gave **I.**

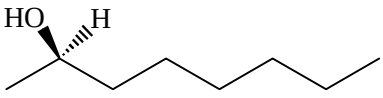
What are **A – I** ?

(30 marks)

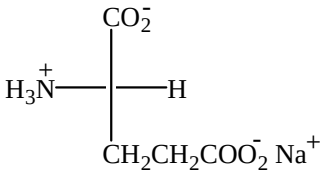
Question 3

For each of the compounds shown below, identify and label the stereogenic centres as *R* or *S*:

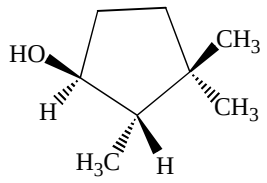
(a)



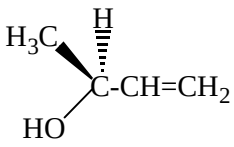
(b)



(c)



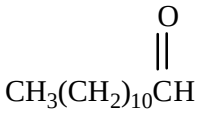
(d)



(20 marks)

Question 4

(a) The sex attractant of the female arctiid moth contains, among other components, a compound of molecular formula $C_{21}H_{40}$ that yields



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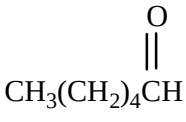
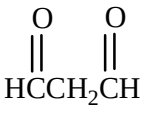
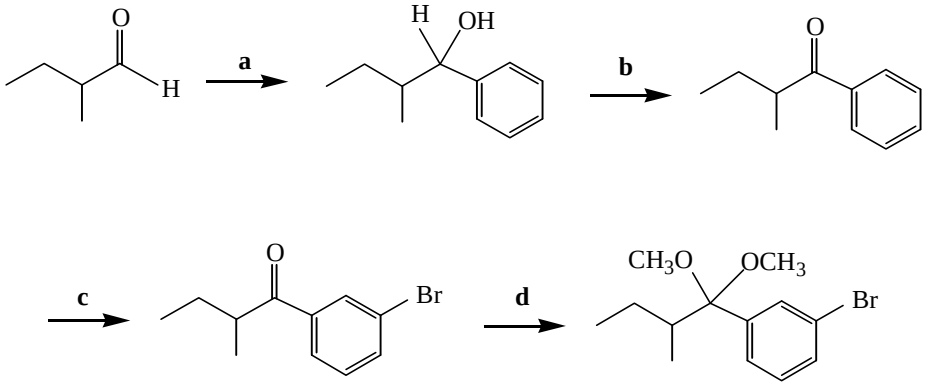


and



on ozonolysis. What is the constitution of this material (disregarding stereochemistry)?

(b) Identify the reagents a – d in the following scheme:



(25 marks)

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