

UNIVERSITI  
TEKNOLOGI  
PETRONAS

## FINAL EXAMINATION MAY 2024 SEMESTER

**COURSE : YBB1063 - ORGANIC CHEMISTRY I**  
**DATE : 5 AUGUST 2024 (MONDAY)**  
**TIME : 9:00 AM - 12:00 NOON (3 HOURS)**

### INSTRUCTIONS TO CANDIDATES

1. Answer **ALL** questions in the Answer Booklet.
2. Begin **EACH** answer on a new page in the Answer Booklet.
3. Indicate clearly answers that are cancelled, if any.
4. Where applicable, show clearly steps taken in arriving at the solutions and indicate **ALL** assumptions, if any.
5. **DO NOT** open this Question Booklet until instructed.

**Note :**

- i. There are **NINE (9)** pages in this Question Booklet including the cover page .
- ii. **DOUBLE-SIDED** Question Booklet.
- iii. Graph paper(s) will be provided

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1. Consider the following alkyl halide (Compound A).

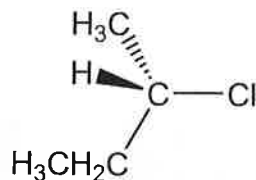


FIGURE Q1(i) : Compound A

- a. Determine the stereochemical configuration (*R* or *S*) of Compound A. Show all the working steps.

[5 marks]

- b. Compound A reacts with a nucleophile ( $\text{N}\equiv\text{C}^-$ ) in polar aprotic solvent (acetone) to produce Product B.

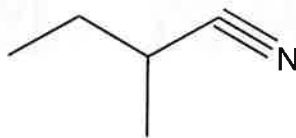


FIGURE Q1(b)(ii): Product B

Draw the three-dimensional structure of Product B to illustrate the inversion of stereochemical configuration.

[3 marks]

- c. Based on answer in **part (b)**, write the reaction mechanism using curved arrows to show the formation of Product B. Include the species of transition state.

[5 marks]

d. Compound A undergoes an elimination reaction to yield a mixture of alkenes.

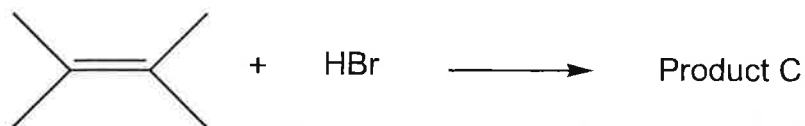
i. Draw the structures of the alkenes produced in bond-line formula.

[3 marks]

ii. Based on the answer in **part (d)(i)**, identify the major product and provide a rationale for your selection.

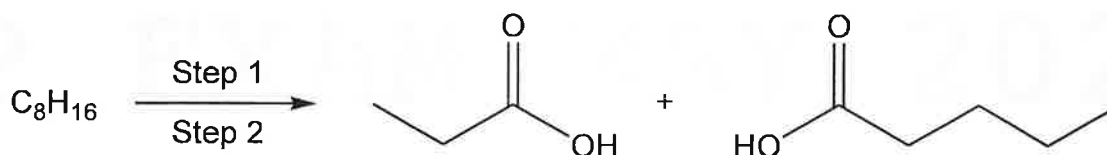
[4 marks]

2. a. **Figure Q2** illustrates the hydrohalogenation of an alkene.



**FIGURE Q2(a):** Hydrohalogenation of an alkene

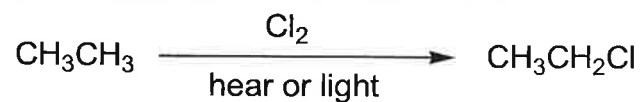
- Suggest the structure of Product C in bond-line formula.  
[2 marks]
  - Use curved arrows to illustrate the reaction mechanism leading to the formation of Product C.  
[6 marks]
- b. An unknown alkene with the formula  $C_8H_{16}$  is used as the substrate with a hot oxidizing agent to produce two carboxylic acids. The synthesis route is illustrated in **FIGURE Q2(b)**.



**FIGURE Q2(b):** Synthesis route to yield propanoic and pentanoic acids.

- Suggest suitable reagent(s) for Step 1 and Step 2.  
[6 marks]
- Draw the structure of unknown alkene in bond-line formula.  
[3 marks]
- Rationalize your answer in **part (b)(ii)**.  
[3 marks]

3. a. **FIGURE Q3(a)** shows the chlorination of ethane.



**FIGURE Q3(a):** Chlorination of ethane

Draw the reaction mechanism using half-headed curved arrows for the following stages.

i. Initiation

[2 marks]

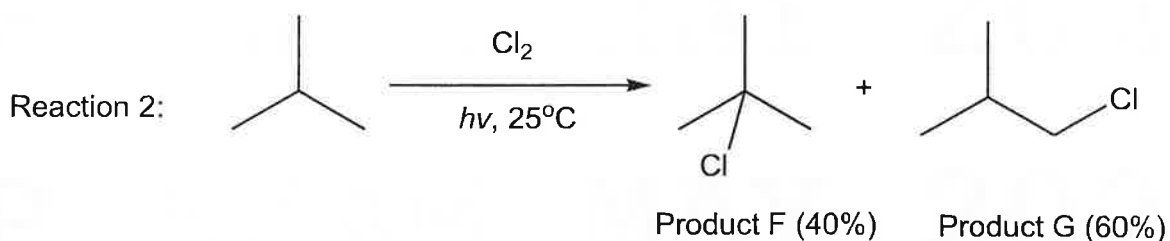
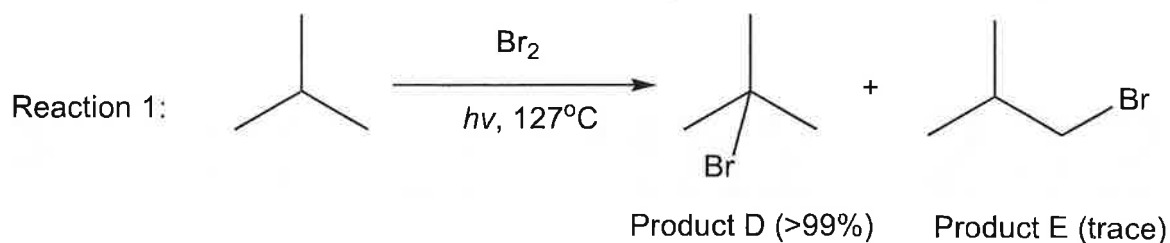
ii. Propagation

[4 marks]

iii. Termination

[6 marks]

b. Consider the following halogenation of 2-methylpropane.



**FIGURE Q3(b):** Halogenation of 2-methylpropane

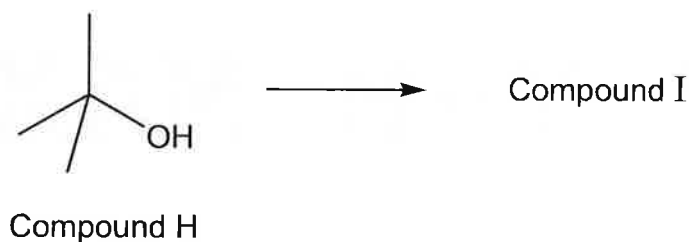
- i. Reaction 1 yields almost exclusively Product D with only traces of Product E. Explain this observation.

[5 marks]

- ii. The percentage yields of products in Reaction 2 differ markedly from those in Reaction 1. Provide an explanation for this variation.

[3 marks]

4. Compound I (alkene) is the only product formed from the reaction of compound H, depicted in **FIGURE Q4**.

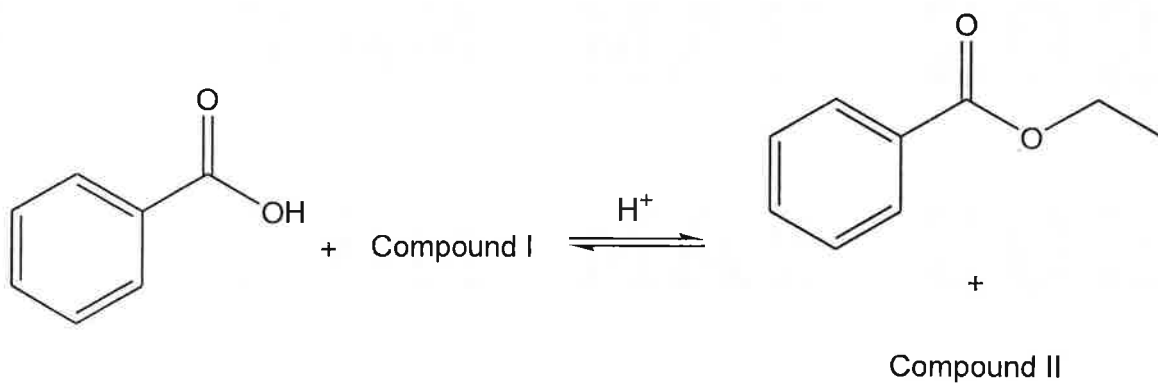


**FIGURE Q4:** Synthesis of compound I from compound H

- a. Suggest the suitable reagents(s) and experimental condition(s) that would drive the reaction to produce only a single alkene (compound I).  
[2 marks]
- b. Rationalize your answers in **part (a)**.  
[6 marks]
- c. Draw the reaction mechanism using curved arrows to show the formation of compound I.  
[6 marks]
- d. Construct the energy diagram illustrating the endothermic nature of the reaction.  
[6 marks]

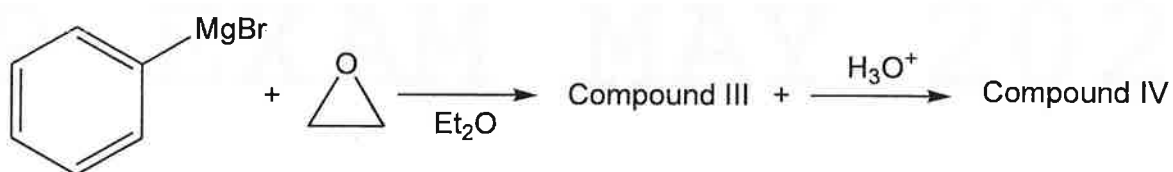
5. a. Draw the bond-line formula of Compounds I, II, III, IV, V, VI for the following reactions.

i.



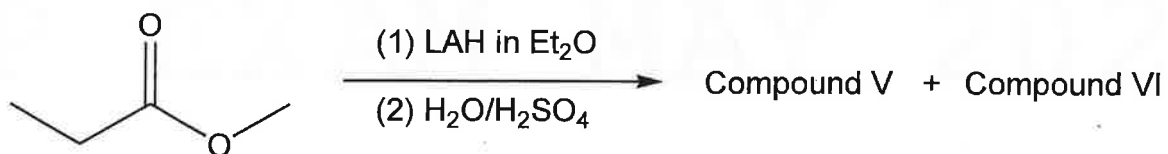
[2 marks]

ii.



[3 marks]

iii.

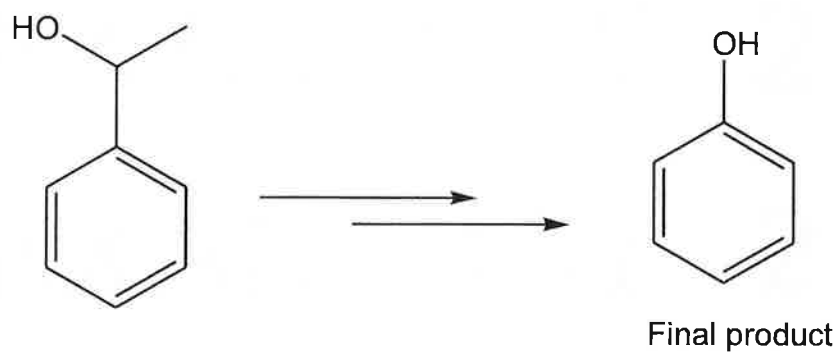


[3 marks]



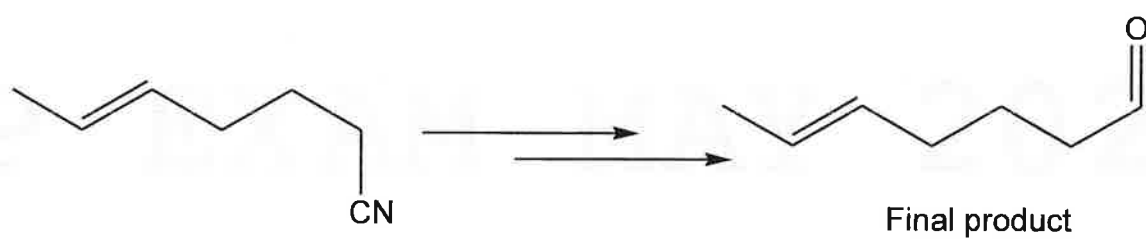
b. Outline the synthesis of the final product using the suitable reagent(s).

i.



[6 marks]

ii.



[6 marks]

- END OF PAPER -

