

Student Name: \_\_\_\_\_



# CHEMISTRY 2024

## Unit 4

### Key Topic Test 2 – Organic Chemistry Pathways

Recommended writing time\*: 45 minutes

Total number of marks available: 50 marks

## QUESTION BOOK

\* The recommended writing time is a guide to the time students should take to complete this test. Teachers may wish to alter this time and can do so at their own discretion.

**Conditions and restrictions**

- Students are permitted to bring into the room for this test: pens, pencils, highlighters, erasers, sharpeners, rulers and a scientific calculator.
- Students are NOT permitted to bring into the room for this test: blank sheets of paper and/or white out liquid/tape.

**Materials supplied**

- Question and answer book of 11 pages.

**Instructions**

- Print your name in the space provided on the top of the front page.
- All written responses must be in English.

**Students are NOT permitted to bring mobile phones and/or any other unauthorised electronic communication devices into the room for this test.**

**SECTION A – Multiple-choice questions**

**Instructions for Section A**

Answer **all** questions.

Choose the response that is **correct** for the question.

A correct answer scores 1, an incorrect answer scores 0.

Marks are **not** deducted for incorrect answers.

If more than 1 answer is completed for any question, no mark will be given.

**Question 1**

The reaction between propene and bromine gas to form 1,2-dibromopropane is classed as what type of reaction?

- A. Reduction
- B. Oxidation
- C. Substitution
- D. Addition

**Question 2**

The ester ethyl butanoate could be formed from the reaction between

- A. ethanol and butanoic acid
- B. ethanoic acid and butan-1-ol
- C. ethanol and propanoic acid
- D. butane and ethanoic acid

**Question 3**

The molecular formula of a biochemical molecule is  $C_{20}H_{40}O_2N$ .

Choose the term that best describes this molecule.

- A. a protein
- B. an amino acid
- C. glycerol
- D. a fatty acid

**Question 4**

When vinegar is added to warm milk, the milk curdles. When curdling occurs the:

- A. triglyceride molecules are hydrolysed to glycerol and fatty acids.
- B. primary structure of the molecules is disrupted but the tertiary structure remains intact.
- C. protein molecules are hydrolysed back to the constituent amino acids.
- D. tertiary structure of the protein is disrupted but the primary structure remains intact.

**Question 5**

The molecule drawn is a primary amine.

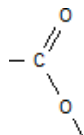
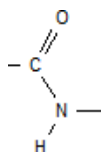
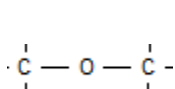


Choose the best two reactants for the synthesis of this molecule.

- A. Butan-2-ol and ammonia gas
- B. Butan-1-ol and ammonia gas
- C. 1-chlorobutane and ammonia gas
- D. propanoic acid and methanamine

**Question 6**

Three common linkages found in biochemical molecules are drawn below.



These linkages belong to, respectively, a:

- A. protein, amino acid and fatty acid
- B. polysaccharide, amino acid and biodiesel
- C. polysaccharide, protein and triglyceride
- D. monosaccharide, protein and triglyceride

**Question 7**

A biodiesel molecule is formed from the reaction between oleic acid and methanol. The molecular formula of the biodiesel molecule is:

- A.  $\text{C}_{19}\text{H}_{26}\text{O}_2$
- B.  $\text{C}_{19}\text{H}_{38}\text{O}_3$
- C.  $\text{C}_{19}\text{H}_{36}\text{O}_2$
- D.  $\text{C}_{57}\text{H}_{1188}\text{O}_6$

**Question 8**

When ethane is reacted with excess chlorine gas in the presence of *Ultra Violet* light the number of potential products that could be formed is

- A. 2
- B. 4
- C. 5
- D. 6

**Question 9**

Which alternative gives the correct half equation for the oxidation of ethanol to ethanal?

- A.  $\text{CH}_3\text{CH}_2\text{OH}(\text{aq}) \rightarrow \text{CH}_3\text{COH}(\text{aq}) + 2\text{H}^+(\text{aq}) + 2\text{e}^-$
- B.  $\text{CH}_3\text{CH}_2\text{OH}(\text{aq}) + 2\text{e}^- + \text{H}_2\text{O}(\text{l}) \rightarrow \text{CH}_3\text{COH}(\text{aq}) + 2\text{H}^+(\text{aq})$
- C.  $\text{CH}_3\text{CH}_2\text{OH}(\text{aq}) + \text{OH}^-(\text{aq}) \rightarrow \text{CH}_3\text{COH}(\text{aq}) + 7\text{H}^+(\text{aq}) + 4\text{e}^-$
- D.  $\text{CH}_3\text{CH}_2\text{OH}(\text{aq}) \rightarrow \text{CH}_3\text{COH}(\text{aq}) + 2\text{H}_2(\text{g}) + 4\text{e}^-$

**Question 10**

0.37 mole of iodine reacts exactly with 1.48 mole of a fatty acid. The fatty acid could be:

- A. stearic acid
- B. arachidonic acid
- C. linoleic acid
- D. linolenic acid

## SECTION B - Short-answer questions

**Instructions for Section B**

Questions must be answered in the spaces provided in this book.

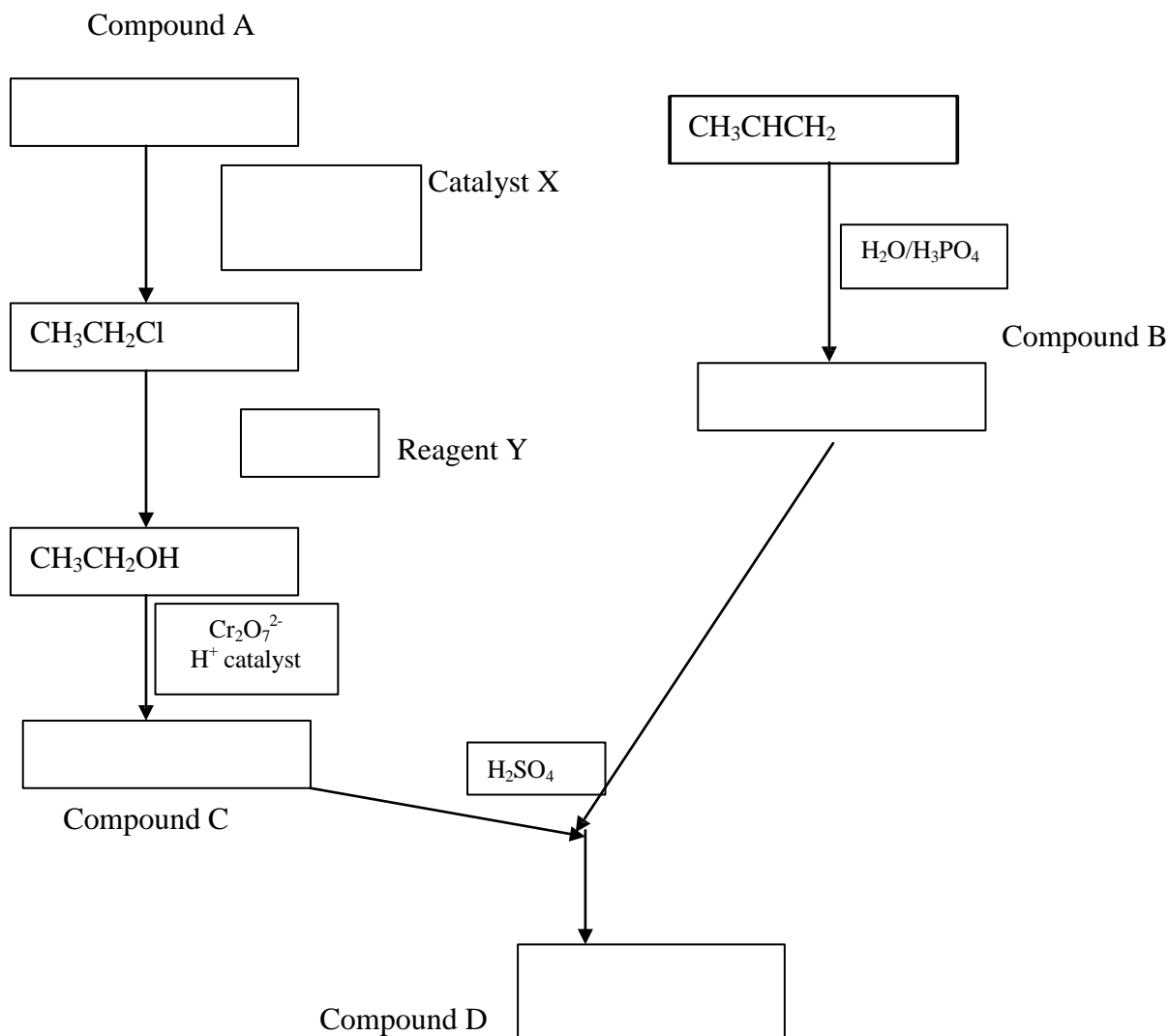
To obtain full marks for your responses you should

- Give simplified answers with an appropriate number of significant figures to all numerical questions; unsimplified answers will not be given full marks.
- Show all workings in your answers to numerical questions. No credit will be given for an incorrect answer unless it is accompanied by details of the working.

Make sure chemical equations are balanced and that the formulas for individual substances include an indication of state; for example,  $\text{H}_2(\text{g})$ ;  $\text{NaCl}(\text{s})$

**Question 1**

The reaction pathway below represents the synthesis of Compound D from Compound A and propan-1-ol.



a. Identify Catalyst X.

\_\_\_\_\_ 1 mark

b. Identify Reagent Y.

\_\_\_\_\_ 1 mark

c. In the appropriate boxes above, write the semi-structural formulas for compounds A, B and C.

3 marks

d. In the appropriate box above, write the skeletal formula for compound D.

2 marks

e. Give the systematic IUPAC names for:

i. Compound A: \_\_\_\_\_

ii. Compound D: \_\_\_\_\_

1 + 1 = 2 marks

f. Name the **type** of reactions that occurred at each of the following steps in the reaction pathway:

i. Formation of  $\text{CH}_3\text{CH}_2\text{OH}$  from  $\text{CH}_3\text{CH}_2\text{Cl}$ .

\_\_\_\_\_

ii. Formation of Compound C from  $\text{CH}_3\text{CH}_2\text{OH}$ .

\_\_\_\_\_

iii. Formation of Compound B.

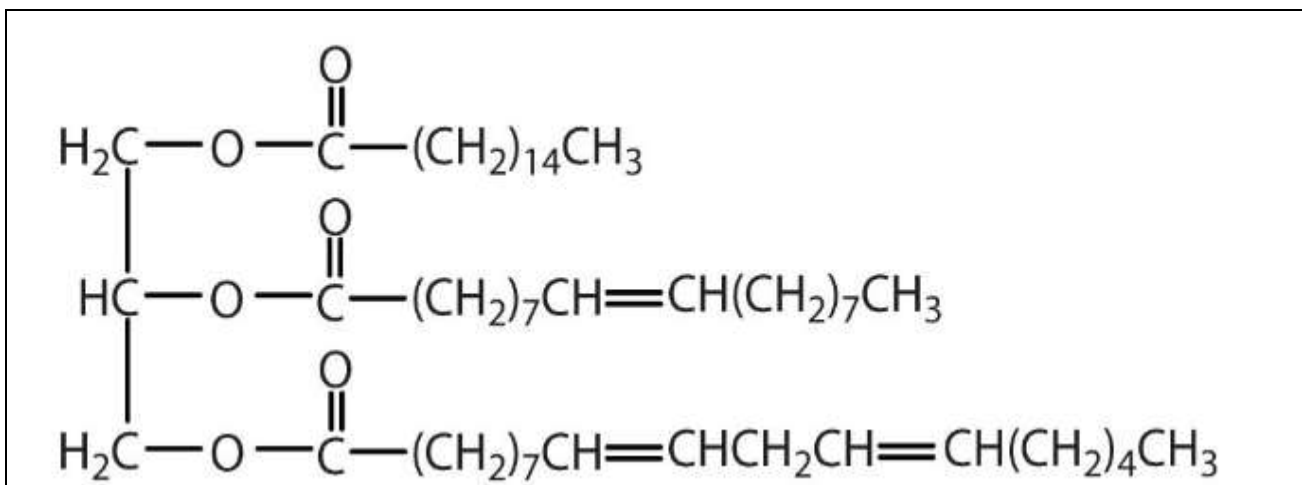
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1 + 1 + 1 = 3 marks

Total 12 marks

**Question 2**

The structure of a triglyceride molecule (lipid) is shown below.



a. Hot KOH solution was added to the lipid above. Four different products were formed.

- i. What is the name of this type of reaction? \_\_\_\_\_ 1 mark
- ii. Draw the structure of, and name, the smallest molecule formed. 2 marks

Name:

b. Explain how the use of biodiesel improves the sustainability of transport fuels. 2 marks

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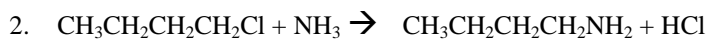
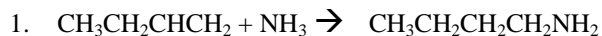
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- c. Compare the atom economy of the two reactions below. Justify why choosing reactions with higher atom economy is an advantage for society. 3 marks




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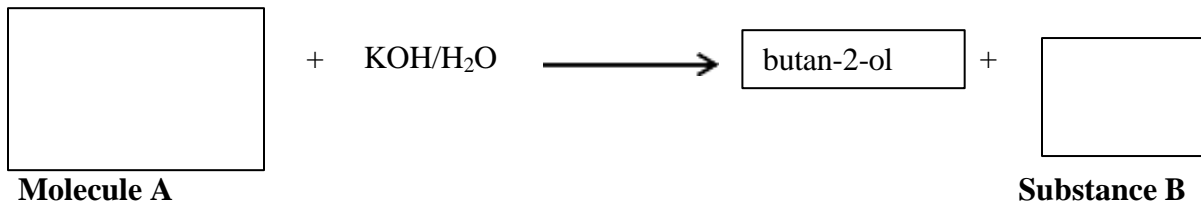


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Total 8 marks

### Question 3

- a. butan-2-ol can be formed from a substitution reaction.



- i. Use the box provided to name the missing reactant and the missing product. 2 marks

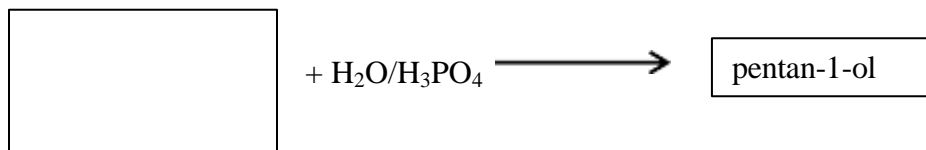
- ii. Butan-2-ol can be oxidized with acidified Cr<sub>2</sub>O<sub>7</sub><sup>2-</sup>. Draw the product of this reaction.

2 marks

- iii. Name this product. \_\_\_\_\_

1 mark

- b. pentan-1-ol can be formed from an addition reaction.



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- i.** Use the box provided to draw the missing reactant. 1 mark
- ii.** pentan-1-ol is unlikely to be the only product from this reaction. Draw the skeletal structure of another possible product. 2 marks



- c.** An ester is to be formed, starting with only ethanol. Draw a possible pathway for this process, showing any necessary catalysts or reagents.



4 marks

Total 12 marks

**Question 4**



- a. Name each of the amino acids used to construct the dipeptide shown.

\_\_\_\_\_ 2 marks

- b. How many molecules of water were formed when this polypeptide formed? \_\_\_\_\_

1 mark

Total 3 marks

**END OF KEY TOPIC TEST**