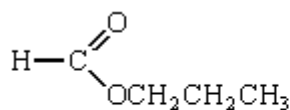


**Q1.** Which one of the following is **not** a correct general formula for the non-cyclic compounds listed?

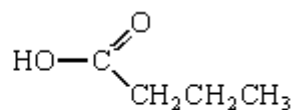
- A** alcohols  $C_nH_{2n+2}O$
- B** aldehydes  $C_nH_{2n+1}O$
- C** esters  $C_nH_{2n}O_2$
- C** primary amines  $C_nH_{2n+3}N$

(Total 1 mark)

**Q2.** (a) Consider the following pair of isomers.



**C**



**D**

(i) Name compound **C**.

.....

(ii) Identify a reagent which could be used in a test-tube reaction to distinguish between **C** and **D**. In each case, state what you would observe.

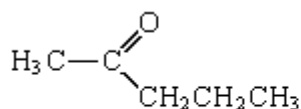
*Reagent* .....

*Observation with C* .....

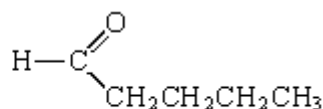
*Observation with D*.....

(4)

(b) Consider the following pair of isomers.



**E**



**F**

(i) Name compound **E**.

.....

(ii) Identify a reagent which could be used in a test-tube reaction to distinguish between **E** and **F**. In each case, state what you would observe.

Reagent .....

Observation with **E** .....

Observation with **F**.....

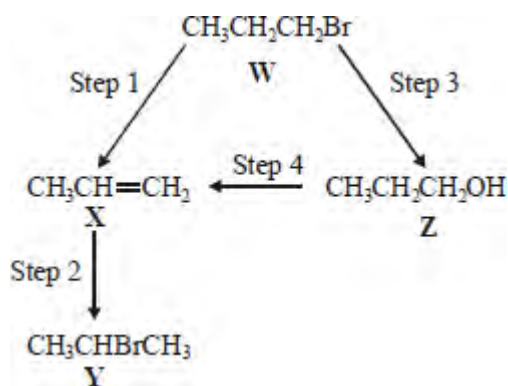
(4)

(c) Draw the structure of the chain isomer of **F** which shows optical isomerism.

(1)

(Total 9 marks)

**Q3.**For this question refer to the reaction scheme below.



Which one of the following statements is **not** correct?

**A** Reaction of **W** with sodium cyanide followed by hydrolysis of the resulting product gives propanoic acid.

- B** Mild oxidation of **Z** produces a compound that reacts with Tollens' reagent, forming a silver mirror.
- C** **Z** reacts with ethanoic acid to produce the ester propyl ethanoate.
- C** **W** undergoes addition polymerisation to form poly(propene).

(Total 1 mark)

**Q4.** Esters have many important commercial uses such as solvents and artificial flavourings in foods.

Esters can be prepared in several ways including the reactions of alcohols with carboxylic acids, acid anhydrides, acyl chlorides and other esters.

- (a) Ethyl butanoate is used as a pineapple flavouring in sweets and cakes.

Write an equation for the preparation of ethyl butanoate from an acid and an alcohol.

Give a catalyst used for the reaction.

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(4)

- (b) Butyl ethanoate is used as a solvent in the pharmaceutical industry.

Write an equation for the preparation of butyl ethanoate from an acid anhydride and an alcohol.

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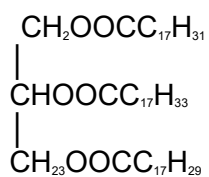
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(3)

- (c) Name and outline a mechanism for the reaction of  $\text{CH}_3\text{COCl}$  with  $\text{CH}_3\text{OH}$  to form an ester.

(5)

- (d) The ester shown below occurs in vegetable oils. Write an equation to show the formation of biodiesel from this ester.



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(3)

- (e) Draw the repeating unit of the polyester Terylene that is made from benzene-1,4-dicarboxylic acid and ethane-1,2-diol.

Although Terylene is biodegradable, it is preferable to recycle objects made from Terylene.

Give **one** advantage and **one** disadvantage of recycling objects made from Terylene.

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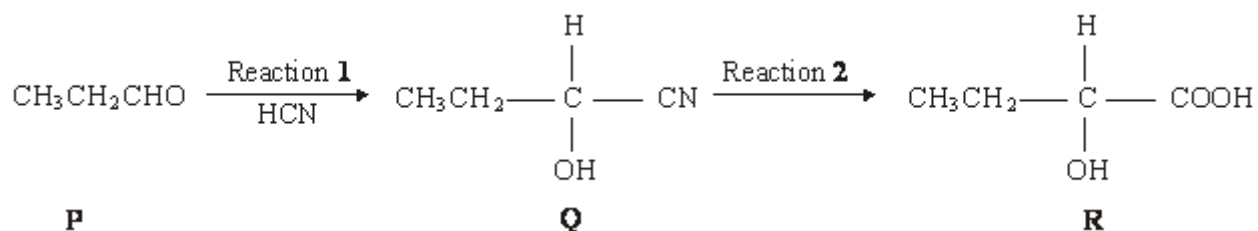
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(4)  
(Total 19 marks)

**Q5.** Consider the sequence of reactions below.



(a) Name and outline a mechanism for Reaction 1.

Name of mechanism .....

Mechanism

(5)

(b) (i) Name compound **Q**

.....

(ii) The molecular formula of **Q** is  $C_4H_7NO$ . Draw the structure of the isomer of **Q** which shows geometrical isomerism and is formed by the reaction of ammonia with an acyl chloride.

(3)

(c) Draw the structure of the main organic product formed in each case when **R** reacts separately with the following substances:

(i) methanol in the presence of a few drops of concentrated sulphuric acid;

(ii) acidified potassium dichromate(VI);

(iii) concentrated sulphuric acid in an elimination reaction.

(3)  
(Total 11 marks)

**Q6.** Propanoic acid reacts with methanol in the presence of a small amount of concentrated sulphuric acid. The empirical formula of the ester formed is

- A** CH<sub>2</sub>O
- B** C<sub>2</sub>H<sub>6</sub>O<sub>2</sub>
- C** C<sub>2</sub>H<sub>4</sub>O<sub>2</sub>
- D** C<sub>2</sub>H<sub>4</sub>O

(Total 1 mark)

**Q7.** (a) Compound **A**, HCOOCH<sub>2</sub>CH<sub>2</sub>CH<sub>3</sub>, is an ester. Name this ester and write an equation for its reaction with aqueous sodium hydroxide.

*Name* .....

*Equation* .....

(2)

(b) The initial rate of reaction between ester **A** and aqueous sodium hydroxide was measured in a series of experiments at a constant temperature. The data obtained are shown below.

Experiment	Initial concentration of NaOH / mol dm <sup>-3</sup>	Initial concentration of <b>A</b> / mol dm <sup>-3</sup>	Initial rate / mol dm <sup>-3</sup> s <sup>-1</sup>
1	0.040	0.030	4.0 × 10 <sup>-4</sup>
2	0.040	0.045	6.0 × 10 <sup>-4</sup>

3	0.060	0.045	$9.0 \times 10^{-4}$
4	0.120	0.060	to be calculated

Use the data in the table to deduce the order of reaction with respect to **A** and the order of reaction with respect to NaOH. Hence calculate the initial rate of reaction in Experiment 4.

Order with respect to **A** .....

Order with respect to NaOH .....

Initial rate in Experiment 4 .....

.....

(3)

- (c) In a further experiment at a different temperature, the initial rate of reaction was found to be  $9.0 \times 10^{-3} \text{ mol dm}^{-3} \text{ s}^{-1}$  when the initial concentration of **A** was  $0.020 \text{ mol dm}^{-3}$  and the initial concentration of NaOH was  $2.00 \text{ mol dm}^{-3}$ . Under these new conditions with the much higher concentration of sodium hydroxide, the reaction is first order with respect to **A** and appears to be zero order with respect to sodium hydroxide.

- (i) Write a rate equation for the reaction under these new conditions.

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- (ii) Calculate a value for the rate constant under these new conditions and state its units.

Calculation .....

.....

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Units .....

- (iii) Suggest why the order of reaction with respect to sodium hydroxide appears to be zero under these new conditions.

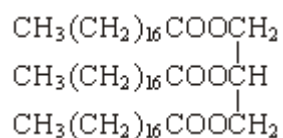
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(6)

- (d) A naturally-occurring triester, shown below, was heated under reflux with an excess of aqueous sodium hydroxide and the mixture produced was then distilled. One of the products distilled off and the other was left in the distillation flask.



- (i) Draw the structure of the product distilled off and give its name.

*Structure*

*Name* .....

- (ii) Give the formula of the product left in the distillation flask and give a use for it.

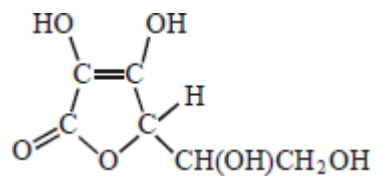
*Formula* .....

*Use* .....

(4)

(Total 15 marks)

**Q8.** Which one of the following is **not** a correct statement about vitamin C, shown below?



- A** It is a cyclic ester.
- B** It can form a carboxylic acid on oxidation.
- C** It decolourises a solution of bromine in water.
- D** It is a planar molecule.

**(Total 1 mark)**