

Name of the Student: _____

Max. Marks : 28 Marks

Time : 28 Minutes

Q1.

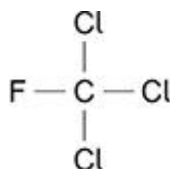
CFCs were used as refrigerants and in aerosols.

The scientists Rowland and Molina published research in 1974 to show that CFCs are responsible for the destruction of ozone molecules in the upper atmosphere.

A few years later, other scientists discovered that the concentration of ozone in the upper atmosphere was decreasing.

In 1987 there was an agreement by many countries to restrict the use of CFCs.

- (a) The molecule CFC-11 was commonly used as a refrigerant.



Use IUPAC rules to name CFC-11

(1)

- (b) A molecule of CFC-11 breaks down in the upper atmosphere to form a chlorine free radical.

Give the equation for this reaction.

(1)

- (c) A typical refrigerator contained 0.50 kg of CFC-11 ($M_r = 137.5$).

One molecule of CFC-11 causes the destruction of approximately 100 000 molecules of ozone.

Use these data to estimate the number of molecules of ozone that can be destroyed by 0.50 kg of CFC-11

Give your answer in standard form.

The Avogadro constant, $L = 6.022 \times 10^{23} \text{ mol}^{-1}$

Number of molecules of ozone _____

(2)

- (d) State the benefit to life on Earth of ozone in the upper atmosphere.

(1)

- (e) Suggest **one** reason why the use of CFCs was not restricted until several years after Rowland and Molina published their research.

(1)

- (f) CFC-11 is a greenhouse gas that can contribute to global warming.

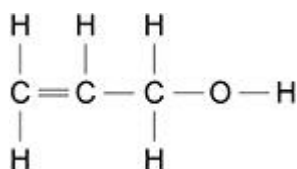
State and explain how CFC-11 is able to contribute to global warming.

(2)

(Total 8 marks)

Q2.

Prop-2-en-1-ol is a natural chemical found in garlic. It is also used in the production of plasticisers.

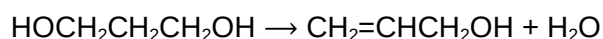


- (a) Prop-2-en-1-ol can be prepared by reacting 3-chloroprop-1-ene with dilute aqueous sodium hydroxide.

Name the mechanism for this reaction.

(1)

- (b) Prop-2-en-1-ol can also be formed from $\text{HOCH}_2\text{CH}_2\text{CH}_2\text{OH}$ in the presence of an acid catalyst.



Name and outline a mechanism for this reaction.

Name of mechanism _____

Outline of mechanism

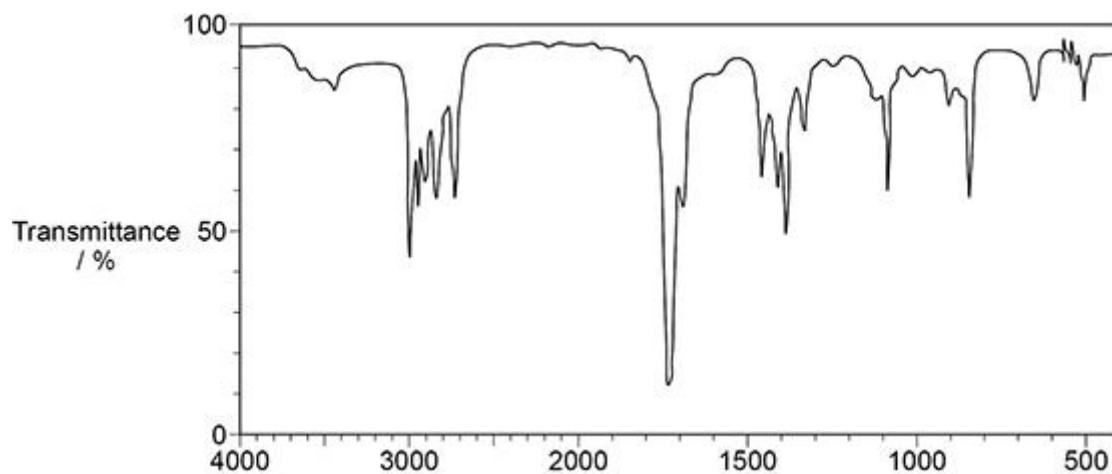
(4)

- (c) Prop-2-en-1-ol forms an addition polymer.

Draw the repeating unit of poly(prop-2-en-1-ol).

(1)

- (d) The figure below shows the infrared spectrum of a functional group isomer of prop-2-en-1-ol.



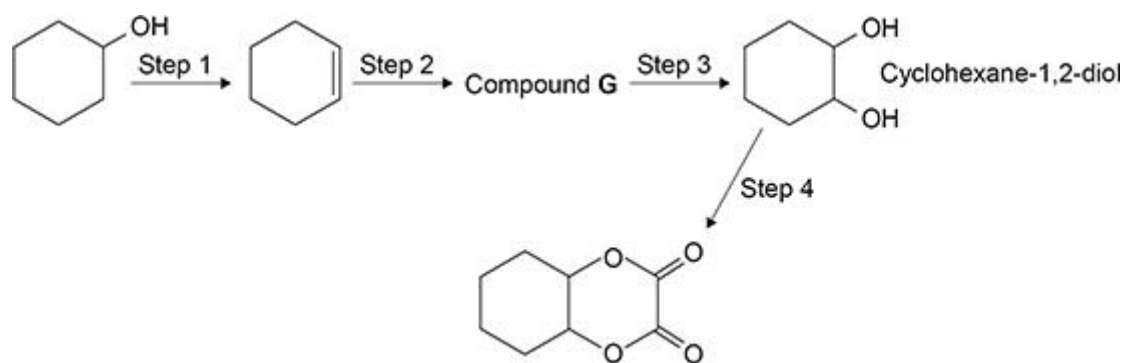
This isomer reacts with acidified potassium dichromate(VI) to form a green solution.

Draw the structure of this isomer.

(1)
(Total 7 marks)

Q3.

This question is about making a diester from cyclohexanol.



- (a) State the type of reaction in step 1.

Give the name of the reagent needed for step 1.

Type of reaction _____

Reagent _____

(2)

- (b) State the reagents needed and give equations for step 2 and step 3.

Show the structure of Compound **G** in your equations.

Step 2 reagent _____

Step 2 equation

Step 3 reagent _____

Step 3 equation

(4)

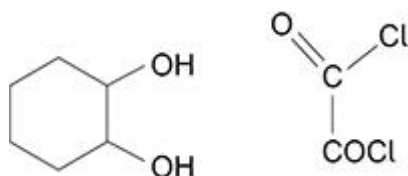
- (c) Cyclohexane-1,2-diol reacts with ethanedioyl dichloride.

Give the name of the mechanism for this reaction.

Complete the mechanism to show the formation of **one** ester link in the first step of this reaction.

Mechanism name _____

Mechanism



- (d) Suggest why chemists usually aim to design production methods
- with fewer steps
 - with a high percentage atom economy.

Fewer steps _____

High percentage atom economy _____

(2)

(Total 13 marks)