

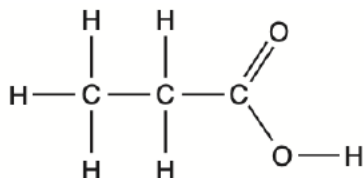
## **AS level Chemistry A**

**H032/02** Depth in chemistry

### **Question Set 5**

5. Propanoic acid,  $\text{CH}_3\text{CH}_2\text{COOH}$ , is a member of the homologous series of carboxylic acids.

- (a) Suggest the general formula for a carboxylic acid.  $\text{C}_n\text{H}_{2n+1}\text{COOH}$  [1]
- (b) The displayed formula for propanoic acid is shown below.



tetrahedral -  $109.5^\circ$   
4 bonding pairs of electrons around carbon  
which repel equally so are as far apart as possible.

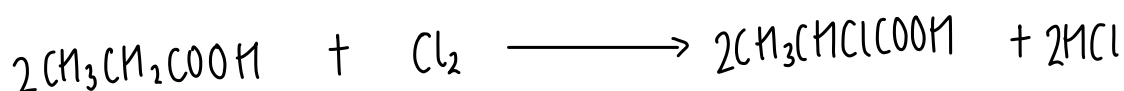
- (i) State the shape and bond angle around a carbon atom in the alkyl group of propanoic acid. Explain the shape. [2]
- (ii) Suggest a value for the C-O-H bond angle in propanoic acid.  $104.5^\circ$  [1]
- (c) Compound **D** is a neutral compound which is a structural isomer of propanoic acid,  $\text{CH}_3\text{CH}_2\text{COOH}$ .

The infrared spectrum of compound **D** is shown below.

www.sdb.sdb.aist.go.jp, Spectral Database for Organic Compounds  
SDBS. Item removed due to third party copyright restrictions.

Suggest **two** possible structures of compound **D**. Explain **all** your reasoning.

- (d) 2-Chloropropanoic acid,  $\text{CH}_3\text{CHClCOOH}$ , can be made by reacting propanoic acid with chlorine in a radical substitution reaction. [4]
- (i) State the conditions for the reaction. UV light [1]
- (ii) Write the overall equation for the reaction. [1]



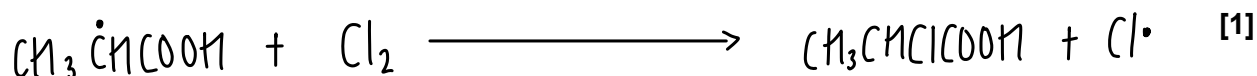
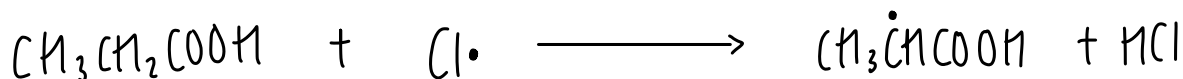
- (iii) The first step in the reaction mechanism involves homolytic fission of a chlorine molecule to form two chlorine radicals.

Why is this step an example of *homolytic fission*?

homolytic fission is the breaking of a covalent bond where one electron in the covalent bond goes to one atom, and the other goes to the other atom. [2]

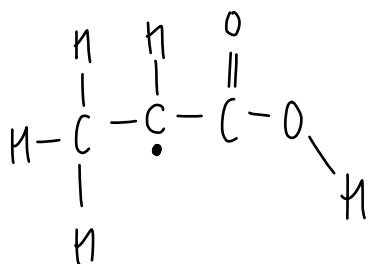
- (iv) Write **two** equations to show the propagation steps in the mechanism for this reaction. [1]

Use dots, •, to show the unpaired electrons on radicals.



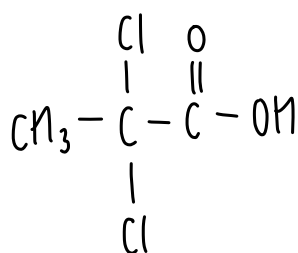
- (v) Draw the displayed formula of the radical formed in the first propagation step.

Use a dot, •, to show the position of the unpaired electron.



- (vi) Further substitution forms a mixture of organic products.

Draw the structure of an organic product formed from 2-chloropropanoic acid by further substitution.



**Total Marks for Question Set 5: 15**

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