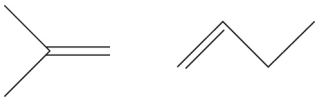
Chapter 17: Alcohols, esters and carboxylic acids

Homework questions

1 Two isomeric alcohols, X and Y, were shown to have the molecular formula $C_4H_{10}O$. Under conditions that ensured full oxidation, both alcohols produced carboxylic acids. When passed over heated pumice, the alcohols reacted to produce the products shown below.



from X

from Y

a **i** What are the reagents and conditions required for the full oxidation of both alcohols? [3]

ii Write the equation for the full oxidation of both alcohols, using molecular formulae. Represent the oxidising agent by [O]. [1]

b Describe and explain the main changes that take place in the infrared spectra of both alcohols as they are oxidised to the acids. [6]

c Identify X. Explain your answer. [3]

d Identify Y. Explain your answer. [3]

e **i** Write down the structural formula of the carboxylic acid formed by the oxidation of alcohol X. [1]

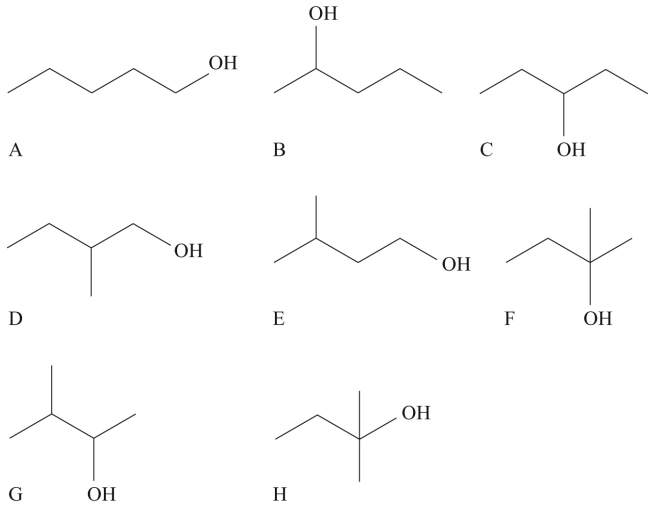
ii Write the formula of the ester formed from the reaction of this carboxylic acid and alcohol Y. [1]

iii Give the equation for the reaction and the conditions required. [2]

f Draw diagrams to show how molecules of Y can form hydrogen bonds. [3]

Total = 23

2 There are **eight** alcohols with the molecular formula $C_5H_{11}OH$.
Their skeletal formulae are given below:



a Name all eight alcohols. [8]

b List the letter of every alcohol from the eight that:

i is a primary alcohol [2]

ii is a secondary alcohol [1]

iii is a tertiary alcohol [1]

iv **cannot** be dehydrated to give an alkene – explain your answer [2]

v **can** be dehydrated to give pent-1-ene as a product [1]

vi will give three products after dehydration, two of which are *cis–trans* isomers – explain your answer. [3]

Total = 18

3 Three isomeric compounds, P, R and T, have the molecular formula $C_4H_8O_2$. Information about the compounds is given in the table below.

Compound	Information
P	P has a sweet smell. P is not miscible with water. P can be formed from ethanol and a carboxylic acid, Q.
R	R has a sweet smell. R is not miscible with water. R can be formed from methanol and a carboxylic acid, S.
T	T added to water forms a solution with a pH lower than 7. T contains an unbranched carbon chain.

a **i** Identify P and Q. Explain how you arrived at your answer. [3]

ii Give the equation for the formation of P from ethanol and the carboxylic acid Q. [1]

b **i** Identify R and S. Explain how you arrived at your answer. [3]

ii Give the equation for the formation of R from methanol and the carboxylic acid S. [1]

c In the reversible reaction between methanol and S, it was found that when 0.02 mol of S were mixed with 0.01 mol of methanol, 0.005 mol of R were present at equilibrium.

i Using the correct formulae for R and S, write the expression for the equilibrium constant for the reaction. [1]

ii Calculate the value for the equilibrium constant. Show all your working. [3]

iii What is the effect on the equilibrium constant of adding more S to the equilibrium mixture? Explain your answer. [2]

d Identify T. Explain how you arrived at your answer. [3]

e Explain why the boiling point of P is lower than that of T. [3]

Total = 20