

**SL HL** Paper 3 Section A Data Response (7)

Compound **X** is a crystalline solid that occurs naturally in some fruits.

Analysis of pure Compound **X** shows that it contains 68.84% carbon, 4.96% hydrogen and 26.20% oxygen by mass.

The mass spectrum of Compound **X** shows a molecular ion peak with  $m/z = 122$ .

The low resolution  $^1\text{H}$  NMR spectrum of Compound **X** shows two signals with an integration trace ratio of 5:1.

The infrared spectrum of Compound **X** shows a broad strong peak between  $2500$  and  $3000\text{ cm}^{-1}$  and a sharp peak at  $1700\text{ cm}^{-1}$ .

**(a) (i)** Show that the molecular formula of Compound **X** is  $\text{C}_7\text{H}_6\text{O}_2$ . **[2]**

**(ii)** State the information that can be deduced about the structure of Compound **X** from its  $^1\text{H}$  NMR spectrum. **[2]**

**(iii)** Deduce the molecular structure of Compound **X**. **[1]**

**(b)** The value for the acid dissociation constant of Compound **X** is  $6.31 \times 10^{-5}$ . Using  $\text{HX}$  to represent Compound **X**, state the equation for the reaction of Compound **X** with water. **[1]**

**(c)** The following table shows the solubility of Compound **X** in water at different temperatures:

Temperature / $^{\circ}\text{C}$	Solubility / $\text{g dm}^{-3}$
0	1.7
18	2.7
25	3.4
40	5.5
75	21.5
100	56.3

Suggest how an impure sample of Compound **X** could be purified in a school laboratory. **[1]**

**(d)** Compound **X** reacts with propan-1-ol when warmed in the presence of a sulfuric acid catalyst. The inorganic product obtained in this reaction is water.

**(i)** State the name of the type of reaction that is taking place. **[1]**

**(ii)** Deduce the molecular formula of the organic product. **[1]**