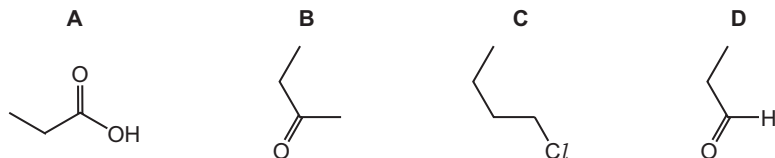


36 Compound Q reacts when heated with HCN in the presence of a catalyst to produce compound R.

Molecules of compound R each contain four carbon atoms.

What is compound Q?



38 Seven aldehydes and ketones

- contain only **one** oxygen atom per molecule
- have four or fewer carbon atoms in their structures.

Alkaline $I_2(aq)$ is added to each of these carbonyl compounds separately.

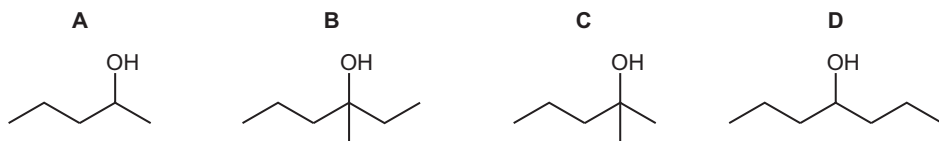
How many of these carbonyl compounds produce a yellow precipitate with alkaline $I_2(aq)$?

A 1 **B** 2 **C** 3 **D** 4

34 An organometallic lithium compound, RLi, contains the nucleophile R^- .

CH_3CH_2Li reacts with pentan-2-one. The mechanism is nucleophilic addition. The first step produces an anion which is then protonated to form the final product.

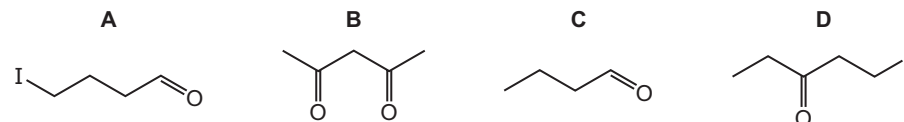
Which organic product is formed?



34 Three tests were performed on an unknown organic compound.

test reagent	test result
2,4-DNPH reagent	orange ppt
Tollens' reagent	no change
alkaline $I_2(aq)$	yellow ppt

What is the organic compound tested?

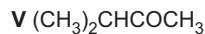
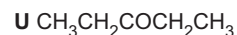
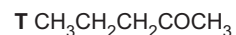
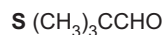
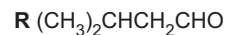
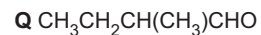


35 Butanone, $CH_3CH_2COCH_3$, and HCN mixed with a little KCN react together in a nucleophilic addition reaction.

Which description of the mechanism of this nucleophilic addition reaction is correct?

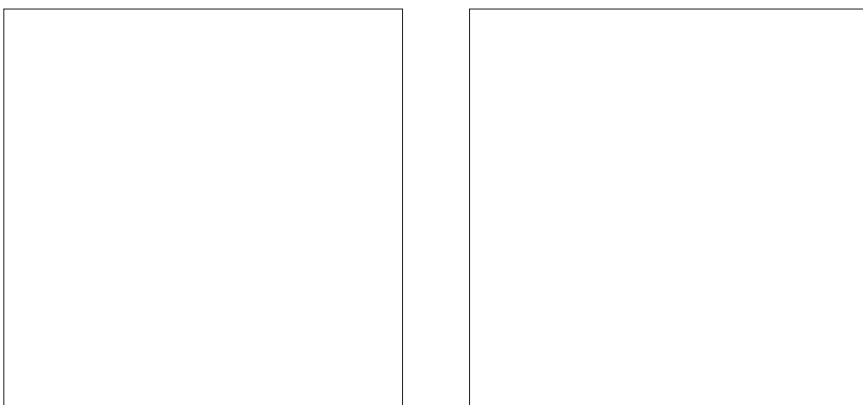
- A** The π bond pair of $C=O$ accepts H^+ from HCN and then CN^- acts as a nucleophile.
- B** A π bond pair from CN^- attacks the δ^+ C and HCN then donates H^+ to O.
- C** The lone pair on O accepts H^+ from HCN and then CN^- acts as a nucleophile.
- D** A lone pair from CN^- attacks the δ^+ C and then O^- accepts H^+ from HCN.

- 7 **P, Q, R, S, T, U, and V** are the seven structural isomers with molecular formula $C_5H_{10}O$ that have a carbonyl group.



- (a) Only one of these seven compounds has stereoisomers.

Draw three-dimensional diagrams of the **two** stereoisomers of this compound.



[2]

- (b) **P, Q, R, S, T, U, and V** are treated separately with alkaline $I_2(aq)$ and the product mixture is acidified.

- (i) Identify the **two** compounds that give a positive result with alkaline $I_2(aq)$.

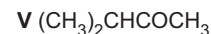
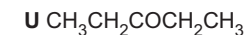
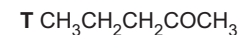
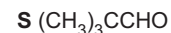
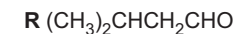
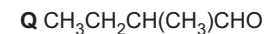
..... and [1]

- (ii) Describe the observations when **one** of the compounds you have identified in (b)(i) is treated with alkaline $I_2(aq)$ and give the structural formulae of the **two** carbon-containing products of this reaction.

observations

two carbon-containing products

and [2]



- (c) The proton (1H) NMR spectra of **P, Q, R, S, T, U, and V** are compared.

- (i) Identify the only compound that gives a spectrum with two singlets and no other peaks.

..... [1]

Fig. 7.1 shows the spectrum obtained from one of the compounds.

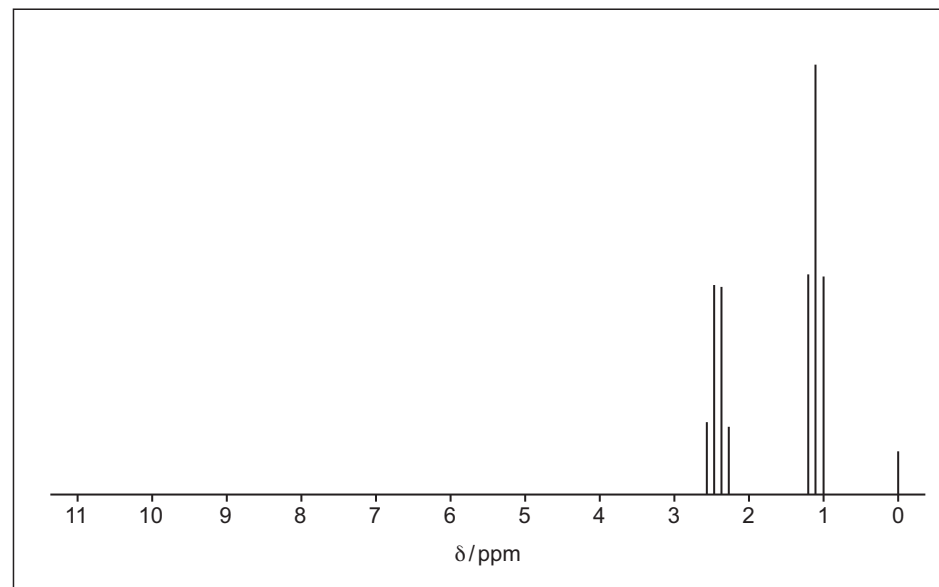


Fig. 7.1

- (ii) Identify the compound that gives this spectrum.

..... [1]

- (iii) Name the splitting pattern of the peak at $\delta = 1.1$ in Fig. 7.1.

Give the reason for this splitting.

name

reason [1]

- (iv) Identify the substance that gives the small peak at $\delta = 0$ in Fig. 7.1.

..... [1]

(d) The carbon-13 NMR spectra of **R**, **S**, **T** and **U** are compared.

Complete Table 7.1 to state the number of peaks in the spectrum of each compound.

Table 7.1

compound	number of peaks
R $(\text{CH}_3)_2\text{CHCH}_2\text{CHO}$	
S $(\text{CH}_3)_3\text{CCHO}$	
T $\text{CH}_3\text{CH}_2\text{CH}_2\text{COCH}_3$	
U $\text{CH}_3\text{CH}_2\text{COCH}_2\text{CH}_3$	

[2]

[Total: 11]