Past-paper walk-through

Aldehydes and ketones ▪ 17.1

eXercise

Questions in this set

- 9701/11 N25 Q36 ▪ 1 mark
- 9701/11 N25 Q38 ▪ 1 mark
- 9701/12 N25 Q34 ▪ 1 mark
- 9701/14 N25 Q34 ▪ 1 mark
- 9701/14 N25 Q35 ▪ 1 mark
- 9701/42 N25 Q7 ▪ 11 marks

Reading the mark scheme

- **B1** a mark that stands on its own – the point is either made or not.
- **M1** a *method* mark: the right approach, even if the number is wrong.
- **A1** an *answer* mark, and it usually needs its M mark first.
- **C1** a working mark on the way to the answer.
- // separates answers the examiner accepts equally.
- **ecf** = error carried forward: a later part is marked on your own earlier answer.
- **owtte** = "or words to that effect" – the wording need not match.

Question 36

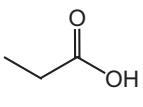
9701/11 N25 ▪ Q36 ▪ 1 mark

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

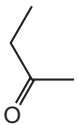
Molecules of compound R each contain four carbon atoms.

What is compound Q?

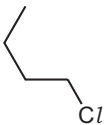
A



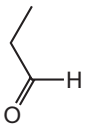
B



C



D



Solution 36

Answer: **D**

Why

- Adding HCN across a C=O adds exactly one carbon atom.
- R has four carbons, so Q must have three.
- Q also needs a carbonyl group for nucleophilic addition, so it is the three-carbon aldehyde or ketone.

Question 38

9701/11 N25 ▪ Q38 ▪ 1 mark

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

Solution 38

Answer: **C**

Why

- The iodoform test gives a yellow precipitate only for a $CH_3CO–$ group.
- Among the seven carbonyls with four or fewer carbons, that is ethanal, propanone and butanone.
- Methanal, propanal, butanal and 2-methylpropanal all lack it, so three react.

Question 34

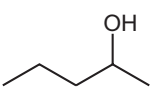
9701/12 N25 ▪ Q34 ▪ 1 mark

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

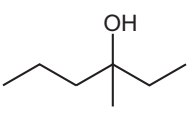
CH_3CH_2Li reacts with pentan-2-one. The mechanism is nucleophilic addition. The first step produces an anion which is then protonated to form the final product.

Which organic product is formed?

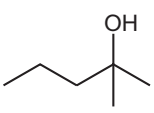
A



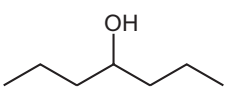
B



C



D



Solution 34

Answer: **B**

Why

- The ethyl carbanion attacks the $\delta+$ carbon of the C=O.
- Protonating the resulting alkoxide gives an alcohol.
- That carbon ends up bonded to two original alkyl chains plus the new ethyl group, so the product is a *tertiary* alcohol.

Question 34

9701/14 N25 ▪ Q34 ▪ 1 mark

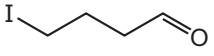
34 Three tests were performed on an unknown organic compound.

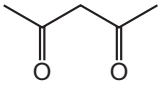
test reagent	test result
2,4-DNPH reagent	orange ppt
Tollens' reagent	no change
alkaline I_2(aq)	yellow ppt

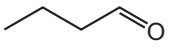
What is the organic compound tested?

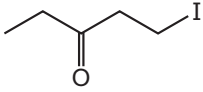
A **B** **C** **D**

Question 34









Solution 34

Answer: **B**

Why

- The orange precipitate with 2,4-DNPH shows a carbonyl group is present.
- No reaction with Tollens' rules out an aldehyde, so it must be a ketone.
- The yellow precipitate with alkaline iodine needs a $CH_3CO–$ group, so it is a methyl ketone.

Question 35

9701/14 N25 ▪ Q35 ▪ 1 mark

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.

Solution 35

Answer: **D**

Why

- The nucleophile is the cyanide ion, and it attacks using its lone pair on carbon – not a π bond.
- It attacks the $\delta+$ carbon of the C=O, pushing the π electrons onto the oxygen.
- The negatively charged oxygen then takes a proton from HCN.

Question 7

9701/42 N25 ▪ Q7 ▪ 11 marks

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.

P $CH_3(CH_2)_3CHO$ **Q** $CH_3CH_2CH(CH_3)CHO$ **R** $(CH_3)_2CHCH_2CHO$

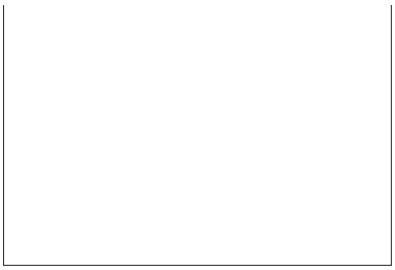
S $(CH_3)_3CCHO$ **T** $CH_3CH_2CH_2COCH_3$ **U** $CH_3CH_2COCH_2CH_3$

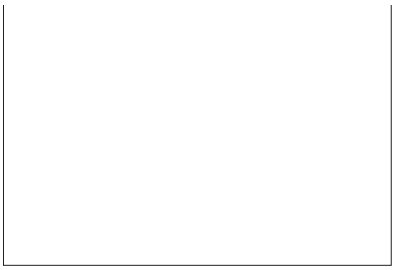
V $(CH_3)_2CHCOCH_3$

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

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

Question 7





[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).

Question 7

(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.

Question 7

Question 7

Question 7

[2]

P $CH_3(CH_2)_3CHO$ **Q** $CH_3CH_2CH(CH_3)CHO$ **R** $(CH_3)_2CHCH_2CHO$

S $(CH_3)_3CCHO$ **T** $CH_3CH_2CH_2COCH_3$ **U** $CH_3CH_2COCH_2CH_3$

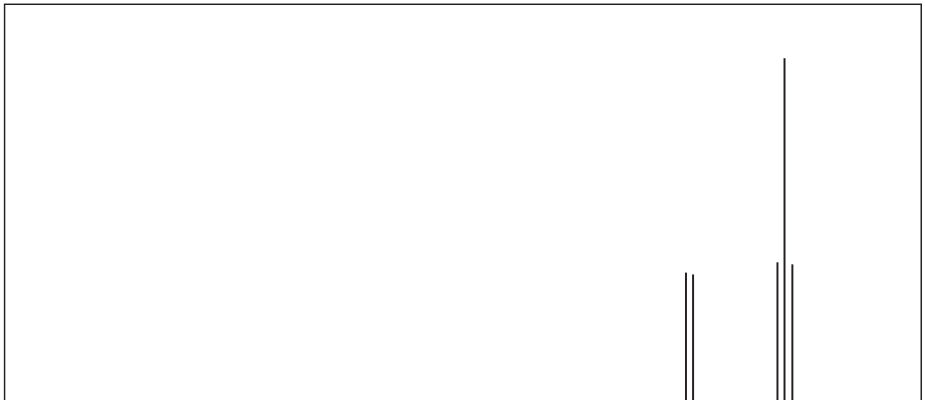
V $(CH_3)_2CHCOCH_3$

(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.

Question 7

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



Question 7

Question 7

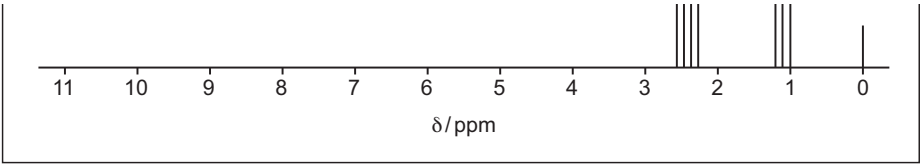


Fig. 7.1

(ii) Identify the compound that gives this spectrum.

Question 7

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

Give the reason for this splitting.

Question 7

Question 7

[1]

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

Question 7

(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	$(CH_3)_2CHCH_2CHO$	
S	$(CH_3)_3CCHO$	
T	$CH_3CH_2CH_2COCH_3$	
U	$CH_3CH_2COCH_2CH_3$	

[2]

Question 7

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Question 7

[Total: 11]

Solution 7

(a)

Mark scheme

- M1: Q CH3CH2CH(CH3)CHO
- M2:
- 2

Solution 7

(b)(i)

Mark scheme

- T CH3CH2CH2COCH3 AND V (CH3)2CHCOCH3
- 1

Solution 7

(b)(ii) Mark scheme

- ▪
- yellow solid
- ▪
- CH3CH2CH2COOH OR (CH3)2CHCOOH
- ▪
- CHI3
- Any two [1], all three [2]
- 2

Solution 7

(c)(i)

Mark scheme

- S (CH3)3CCHO
- 1
- AND
- 9701/42
- October/November 2025

Solution 7

(c)(ii)

Mark scheme

- U CH3CH2COCH2CH3
- 1

(c)(iii)

Mark scheme

- triplet AND two hydrogen atoms on neighbouring carbon atoms
- 1

Solution 7

(c)(iv)

Mark scheme

- TMS / tetramethylsilane / Si(CH3)4
- 1

Solution 7

(d)

Mark scheme

- 4
- 3
- 5
- 3
- Any two [1], all four [2]
- 2