

Rings, Polymers and Analysis

Carbonyl Compounds

1. (a) (i) silver mirror ✓

*ALLOW Ag(s) OR Ag mirror OR precipitate OR ppt OR solid
ALLOW brown OR black OR grey*

1

(ii) HOCH₂COOH ✓

*ALLOW CH₂OHCOOH OR CH₂OHCO₂H OR HOCH₂CO₂H
OR displayed OR skeletal formula OR HOCH₂COO⁻
DO NOT ALLOW C₂H₄O OR 2-hydroxyethanoic acid*

1

(b) HOCH₂CHO + 3[O] → HOCCOOH + H₂O

reagents ✓ both products ✓

ALLOW displayed/skeletal formula/COOHCOOH ✓✓

*if molecular formula used C₂H₄O₂ + 3[O] → C₂H₂O₄ + H₂O
max = 1 ✓*

*Any correctly balanced equation for partial oxidation can
score 1 mark ✓*

HOCH₂CHO + [O] → HOCH₂COOH

OR

HOCH₂CHO + 2[O] → OHCCOOH + H₂O

OR

HOCH₂CHO + [O] → OHCCHO + H₂O

OR

HOCH₂CHO + 2[O] → HOOCCHO + H₂O

2

(c) (i) HOCH₂CH₂OH ✓

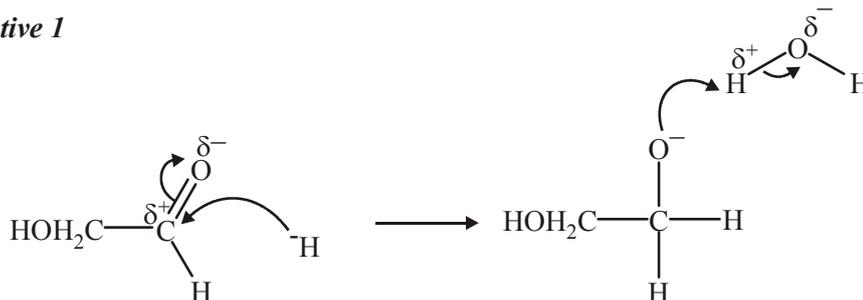
*ALLOW HO(CH₂)₂OH OR (CH₂OH)₂ OR skeletal formula OR
displayed formula*

DO NOT ALLOW molecular formula (C₂H₆O₂)

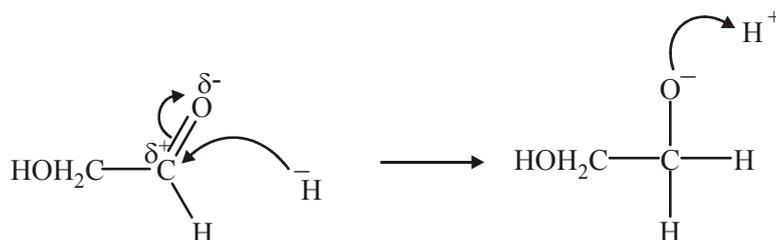
1

- (ii) curly arrow from H^- to $\text{C}^{\delta+}$ ✓
 dipoles and curly arrow from $\text{C}=\text{O}$ bond to O ✓
ALLOW curly arrow to C even if dipole missing or incorrect
 intermediate ✓
 curly arrow from intermediate to $\text{H}^{\delta+}$ in $\text{H}_2\text{O}/\text{H}^+$ and if H_2O
 is used it must show the curly arrow from the $\text{O}-\text{H}$ bond to the O ✓
lone pairs are not essential
ALLOW maximum of 3 marks if incorrect starting material is used

Alternative 1

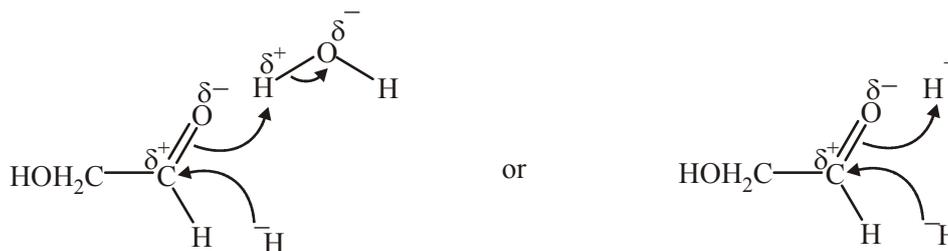


Alternative 2



products
are not
required

Alternative 3

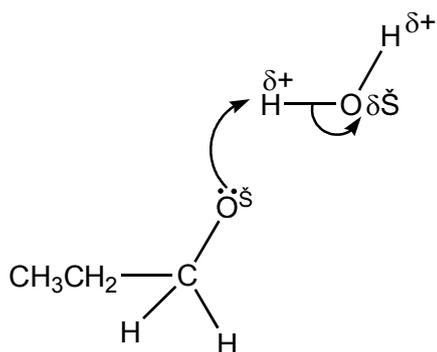


Alternative 3 scores all 4 marks even though the intermediate is not shown

4

[9]

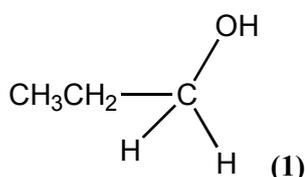
2. (i)



1 mark for each curly arrow (1)(1)

2

(ii)



1

(iii) electron pair donor (1)

1

(iv) electron pair on H^- attracted to δ^+ carbon forming a dative covalent bond (1)
the double/ π electron pair breaks (1)
electron pair now on O^- (1)

3

[7]

3. (a) (i) Tollens' reagent / ammoniacal silver nitrate (1)

silver mirror / precipitate (1)

butanoate / butanoic acid / unambiguous formula or structure (1)

3

(ii) **Any of:**

Br_2 – decolourises – (electrophilic) addition

Na – fizzes – redox

SOCl_2 / PCl_5 / acid chloride – white fumes –

substitution/chlorination

carboxylic acid + conc H_2SO_4 / acid chloride – sweet smell –

esterification/ condensation

test (1) - observation (1) - type of reaction (1)

3

NOT

2-4DNPH to give no precipitate

- (b) recrystallise /purify (the precipitate) **(1)**
 measure melting point **(1)**
 compare with known values **(1)** 3

[9]

4. (a) (i) heat with:
 Tollens' reagent / ammoniacal silver nitrate **(1)**
 to give: silver mirror / precipitate **(1)** 2

- (ii) aldehydes can be oxidised to a carboxylic acid **ora**
 / aldehydes can reduce Ag^+ to Ag **(1)** 1

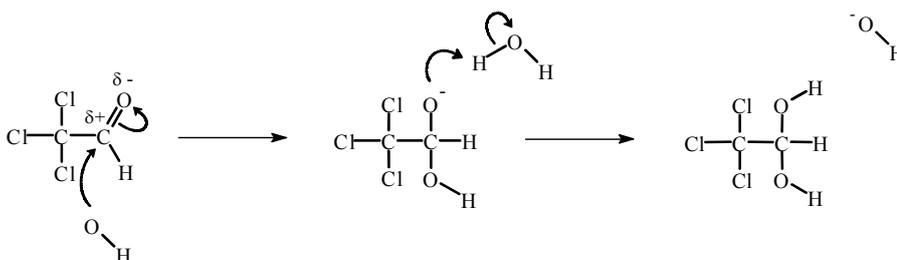
- (b) (i) $\text{CH}_3\text{CH}=\text{CHCH}_2\text{OH}$ **(1)**
(either stereoisomer) 1

- (ii) reduction / redox / addition **(1)**
(NOT hydrogenation) 1

- (c) $\text{C}_4\text{H}_6\text{O} + 5\text{O}_2 \rightarrow 4\text{CO}_2 + 3\text{H}_2\text{O}$ **(1)** 1

[6]

5. (a)



- curly arrow from O of OH to C **(1)**
 dipole on C=O and curly arrow breaking C=O **(1)**
 structure of the intermediate **(1)**
 curly arrow from O (of the correct intermediate)
 ... to H of H_2O **(1)** (allow O to H^+ ion here)
 curly arrow breaking the H-O bond in H_2O **(1)** 5



[2]

10. method

silver nitrate (1)

ammonia / ammoniacal (1)

warm / heat (1)

silver (mirror) / brown ppt forms (1)

explanation

silver ions reduced / $Ag^+ + e^- \rightarrow Ag$ (1)

aldehyde oxidised to a carboxylic acid (1)

correct structure – eg $C_6H_5CHCHCOO^-/COOH$ (1)

quality of written communication

mark for correct spelling, punctuation and grammar in at least two sentences (1) 8

[8]