

Mark schemes

1

- (a) A mixture of liquids is heated to boiling point for a prolonged time 1

Vapour is formed which escapes from the liquid mixture, is changed back into liquid and returned to the liquid mixture 1

Any ethanal and ethanol that initially evaporates can then be oxidised 1

- (b) $\text{CH}_3\text{CH}_2\text{OH} + \text{H}_2\text{O} \longrightarrow \text{CH}_3\text{COOH} + 4\text{H}^+ + 4\text{e}^-$ 1

- (c) Mixture heated in a suitable flask / container 1
A labelled sketch illustrating these points scores the marks

With still head containing a thermometer 1

Water cooled condenser connected to the still head and suitable cooled collecting vessel 1

Collect sample at the boiling point of ethanal 1

Cooled collection vessel necessary to reduce evaporation of ethanal 1

- (d) Hydrogen bonding in ethanol and ethanoic acid or no hydrogen bonding in ethanal 1

Intermolecular forces / dipole-dipole are weaker than hydrogen bonding 1

- (e) Reagent to confirm the presence of ethanal:
Add Tollens' reagent / ammoniacal silver nitrate / aqueous silver nitrate followed by 1 drop of aqueous sodium hydroxide, then enough aqueous ammonia to dissolve the precipitate formed

OR

Add Fehling's solution 1

Warm
M2 and M3 can only be awarded if M1 is given correctly 1

Result with Tollen's reagent:

Silver mirror / black precipitate

OR

Result with Fehling's solution:

Red precipitate / orange-red precipitate

1

Reagent to confirm the absence of ethanoic acid

Add sodium hydrogencarbonate or sodium carbonate

1

Result; no effervescence observed; hence no acid present

1

M5 can only be awarded if M4 is given correctly

OR

Reagent; add ethanol and concentrated sulfuric acid and warm

Result; no sweet smell / no oily drops on the surface of the liquid,

hence no acid present

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2

Identification of acid by suitable method eg named indicator, named carbonate, specified reactive metal

Ignore any reference to the smell of the ester.

1

with expected results

Do not allow the use of any instrumental method eg i.r. or n.m.r.; must be a chemical test.

1

Identification of alcohol by suitable method eg oxidation by acidified potassium dichromate(VI)

1

with expected results

1

[4]

3

(a) (i) Green

Ignore shades of green.

1

(ii) Excess acidified potassium dichromate(VI)

1

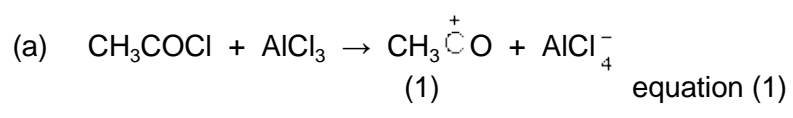
Reflux (for some time)

1

- In the diagram credit should be given for
- a vertical condenser
Lose M3 and M4 for a distillation apparatus. 1
 - an apparatus which would clearly work
Do not allow this mark for a flask drawn on its own.
Penalise diagrams where the apparatus is sealed. 1
- (iii) Distillation 1
- Immediately (the reagents are mixed) 1
- (b) Keep away from naked flames
Allow heat with water-bath or heating mantle.
If a list is given ignore eye protection, otherwise lose this mark. 1
- (c) (i) Tollens' or Fehling's reagents
*Incorrect reagent(s) loses **both** marks.*
Accept mis-spellings if meaning is clear. 1
- Silver mirror / red ppt. formed
Accept 'blue to red' but not 'red' alone. 1
- (ii) Sodium carbonate (solution) / Group II metal
Allow indicator solutions with appropriate colours.
Accept any named carbonate or hydrogen carbonate. 1
- Effervescence / evolves a gas
Accept 'fizzes'. 1
- (d) Propanoic acid
If this mark is lost allow one mark if there is reference to stronger intermolecular forces in the named compound.
Lose M1 and M3. 1
- Contains hydrogen bonding 1
- Some comparison with other compounds explaining that the intermolecular forces are stronger in propanoic acid 1

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4

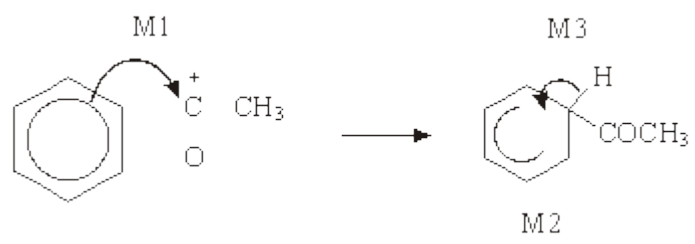


2

penalise wrong alkyl group once at first error
 position of + on electrophile can be on O or C or outside []
 penalise wrong curly arrow in the equation or lone pair on AlCl_3 else ignore

Electrophilic substitution
 NOT F/C acylation

1



*horseshoe must not extend beyond C2 to C6 but can be smaller
 + not too close to C1
 M3 arrow into hexagon unless Kekule
 allow M3 arrow independent of M2 structure*

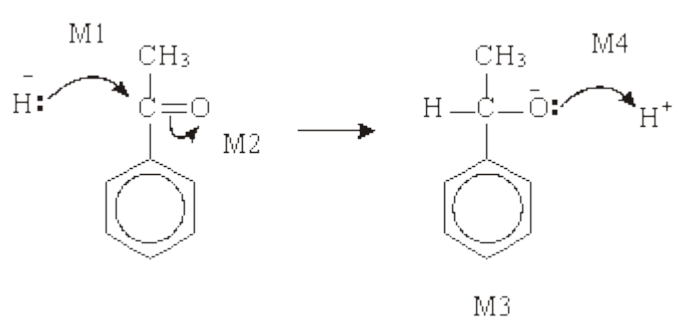
M1 arrow from within hexagon to C or to + on C

+ must be on C of $\overset{+}{\text{RCO}}$

3

(b) Nucleophilic addition
 NOT reduction

1



M2 not allowed independent, but can allow M1 for attack of H- on C+ formed

4

1-phenylethan(-1-)ol or (1-hydroxyethyl)benzene

1

(c) dehydration or elimination

1

(conc) H_2SO_4 or (conc) H_3PO_4

allow dilute and Al_2O_3

Do not allow iron oxides

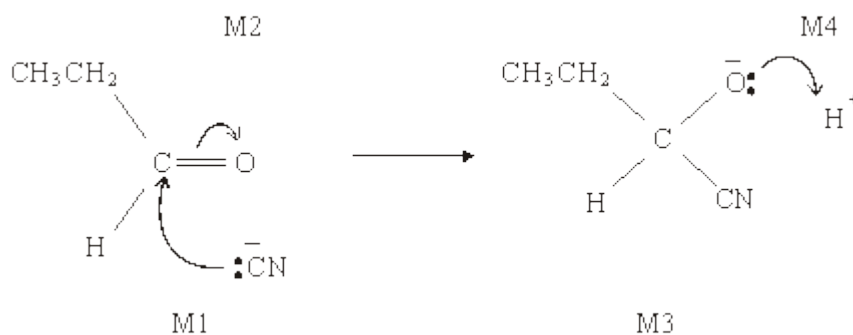
1

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5

(a) nucleophilic addition

1

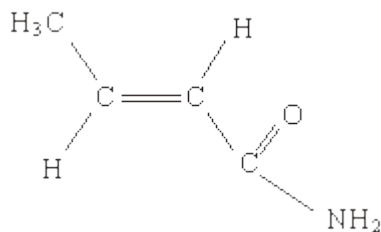


4

(b) (i) 2-hydroxybutanenitrile

1

(ii)

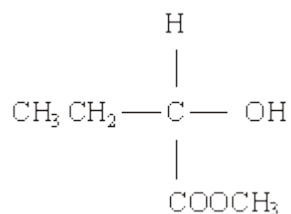


(allow 1 for amide even if not $\text{C}_4\text{H}_7\text{NO}$, i.e. RCONH_2)

(if not amide, allow one for any isomer of $\text{C}_4\text{H}_7\text{NO}$ which shows geometric isomerism)

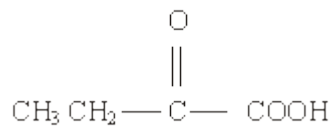
2

(c) (i)



1

(ii)



1

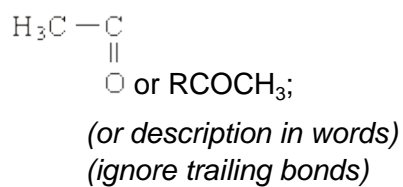
(iii) $\text{CH}_3\text{CH}=\text{CHCOOH}$

1

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6

(a) (i)



1

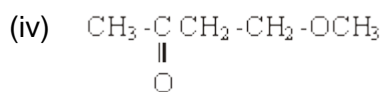
(ii) $\text{H}_3\text{C}-\text{O}$ or ROCH_3 ;

(allow 1 if both (i) and (ii) give CH_3- or $\text{H}_3\text{C}-$ only)

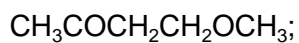
1

(iii) CH_2CH_2 or two adjacent methylene groups;

1



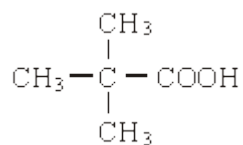
OR



1

(b) (i) OH in acids or (carboxylic) acid present

(ii)



(c)

reagent	$K_2Cr_2O_7 / H^+$	$KMnO_4 / H^+$
Y	no reaction	no reaction
Z	orange to green or turns green	purple to colourless or turns colourless

5

[9]

7

[1]

8

[1]

9

- (a) (i) Potassium (OR sodium) dichromate(VI) OR correct formula
OR potassium manganate(VII)
(Oxidation state not needed, but must be correct if included)
(Penalise errors in the formula or oxidation state, but mark conditions)

1

Acidified OR H_2SO_4 / HCl (NOT with $KMnO_4$) / H_3PO_4 / HNO_3
(Ignore heat or reflux)
(Credit "acidified" as part of reagent)

1

Oxidation or redox

1

- (ii) $NaBH_4$ OR $LiAlH_4$ OR H_2/Ni

1

$CH_3COCH_3 + 2[H] \rightarrow CH_3CH(OH)CH_3$
(Credit H_2 in the equation if H_2 has been chosen as reagent)

1

- (b) (i)
$$\begin{array}{c} CH_3CH_2C=O \\ | \\ H \end{array}$$

(Structure must show aldehyde structure)
(Credit C_2H_5 as alternative to CH_3CH_2)

(ii)

M1	Tollens' reagent OR ammoniacal silver nitrate OR $\text{AgNO}_3 + \text{NH}_3$	OR Fehling's solution	OR <u>acidified</u> potassium dichromate	1
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M2	stays colourless	stays blue	stays orange	1
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(Provided reagent is correct, credit "no reaction", "no change", "nothing", "no observation" for M2)

M3	silver <u>mirror</u> / <u>deposit</u> OR black / grey <u>precipitate</u>	red / brown / orange <u>precipitate</u> / <u>solid</u>	goes green	1
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(Credit other correct reagents and observation)

(For M1, penalise AgNO_3 alone, penalise $\text{Ag}(\text{NH}_3)_2^+$, penalise "potassium dichromate", etc., but, in each case, mark on and credit correct M2 and M3)

(If totally wrong reagent or no reagent, CE = no marks for M1, M2 or M3)

1

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