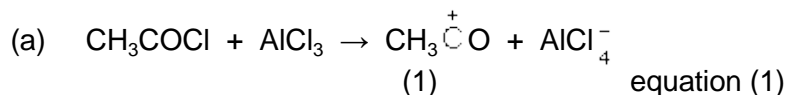


Mark schemes

1



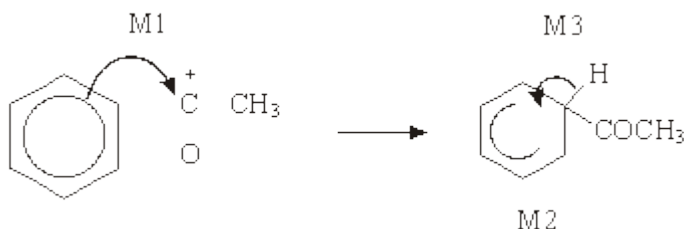
2

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

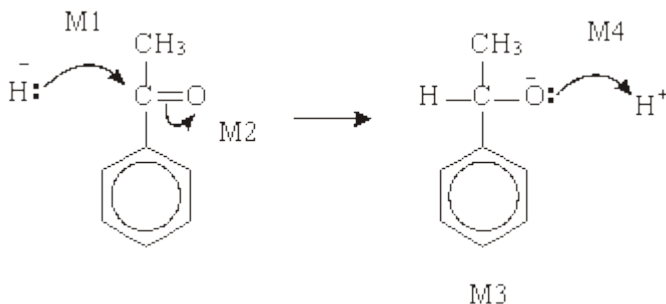
+ must be on C of $\overset{+}{\text{RCO}}$

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

[14]

B
2

[1]

D
3

[1]

4

(a) (i)

Reagent	Tollens	Fehlings or Benedicts	$\text{K}_2\text{Cr}_2\text{O}_7/\text{H}^+$ or acidified	KMnO_4/H^+	I_2/NaOH
Propanal	silver (mirror)	red ppt or goes red (<i>not red solution</i>)	goes green	goes colourless	No reaction
Propanone	no reaction	no reaction	no reaction	no reaction	Yellow (ppt)

(penalise incomplete reagent e.g. $\text{K}_2\text{Cr}_2\text{O}_7$ or $\text{Cr}_2\text{O}_7^{2-}/\text{H}^+$ then mark on)

3

(ii) propanal 3 peaks

ignore splitting even if wrong

1

propanone 1 peak

1

(b) X is CH₃CH₂COOH or propanoic acid if both name and formula given,
both must be correct, but

1

Y is CH₃CH(OH)CH₃ or propan-2-ol allow propanol with correct formula

1

Mark the type of reaction and reagent/condition independently.
The reagent must be correct or close to score condition

Step 1 Oxidation

K₂Cr₂O₇/H⁺ or other oxidation methods as above

allow Cr₂O₇²⁻H⁺ if penalised above (ecf)

reflux (not Tollens/Fehlings) or heat or warm

1

Step 2

reduction or nucleophilic addition	reduction or nucleophilic addition	reduction or hydrogenation
NaBH ₄	LiAlH ₄	H ₂
in (m)ethanol or water or ether or dry	ether or dry	Ni / Pt etc

1

1

1

Step 3 esterification or (nucleophilic) addition-elimination or condensation

1

(conc) H₂SO₄ or HCl

1

warm (allow without acid reagent if X and Y given as reagents)

1

or reflux or heat

1

[15]

5 X is CH₃CN or ethanenitrile or ethanonitrile or methyl cyanide or cyanomethane or ethyl nitrile or methanecarbonitrile

Not ethanitrile
but contradicton of name and structure lose marks

1

Y is CH₃CH₂NH₂ or ethylamine or aminoethane or ethanamine

1

Step 1: reagent KCN not HCN/HCl
condition (aq)/alcohol - only allow condition if reagent correct or incomplete

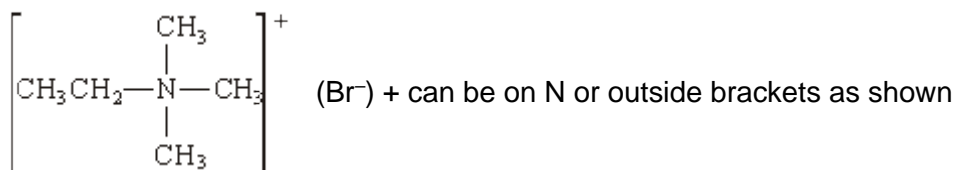
2

Step 2: reagent H₂ LiAlH₄ Na Zn/Fe/Sn Not NaBH₄
condition Ni/Pt/Pd ether ethanol HCl

2

Z is an amine or aminoalkane or named amine even if incorrect name for Z secondary (only award if amine correct)

1



1

nucleophilic substitution

1

[9]

6

[1]

7

[1]

Notes

- (a) first mark for C=O stated or shown in **X**

Ignore wrong names

Y $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$

allow C_3H_7 in **A** if **Y** correct or vice versa

Allow **(1)** for **A** if correct conseq to wrong **X** and **Y**

other oxidising agents: acidified KMnO_4 ; Tollens; Fehlings

other reducing agents: LiAlH_4 ; Na/ethanol; Ni/H_2 ; Zn or Sn or Fe/HCl

- (b) give **(1)** for carboxylic acid stated or COOH shown in each suggestion

(1) for correct **E**

any 2 out of 3 for **B**, **C** or **D**

allow C_3H_7 for either the **B** or **D** shown on the mark scheme

i.e. a correct structure labelled **B**, **C** or **D** or **E** will gain 2.

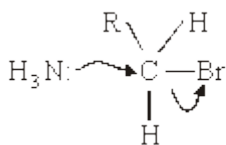
- (c) protons a – *quartet* must be correct to score 3 *adjacent H* mark. Same for b

- (d) allow **(1)** for any OH (alcohol) shown correctly in any structure – ignore extra functional groups. Structure must be completely correct to gain second mark

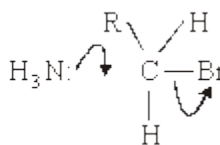
[19]

Organic points

- (1) Curly arrows: must show movement of a pair of electrons,
i.e. from bond to atom or from lp to atom / space
e.g.

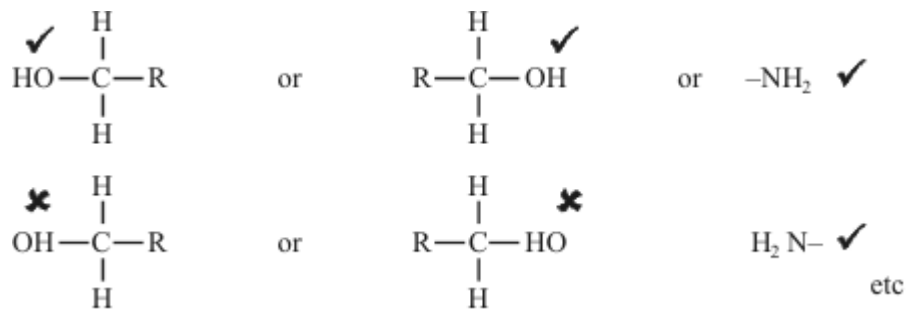


OR



(2) Structures

penalise sticks (i.e. $\begin{array}{c} | \\ -\text{C}- \\ | \end{array}$) once per paper



Penalise once per paper

allow CH_3- or $-\text{CH}_3$ or $\begin{array}{c} \text{CH}_3 \\ | \end{array}$ or CH_3
or $\text{H}_3\text{C}-$

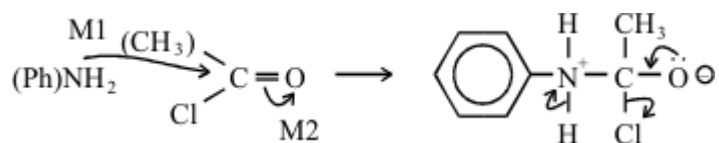
9

(a) CH_3COCl or $(\text{CH}_3\text{CO})_2\text{O}$ (1)

AlCl_3 or H_2O or CH_2SO_4 loses this mark

CH_3COOH loses reagent and M3, M4 = max 3

nucleophilic addition–elimination (1)



M3: structure

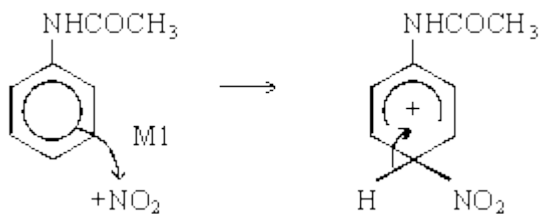
M4: 3 correct arrows

Allow M1 for attack on $\text{CH}_3-\text{C}^+=\text{O}$

Penalise Cl^- removing H^+

- (b) Conc HNO₃ (1)
 Conc H₂SO₄ (1)
 $\text{HNO}_3 + 2 \text{H}_2\text{SO}_4 \rightarrow \text{NO}_2^+ + \text{H}_3\text{O}^+ + 2 \text{HSO}_4^-$ (2)
 (or H₂SO₄) (or H₂O + HSO₄⁻)
HNO₃ / H₂SO₄ scores 1
Any 2

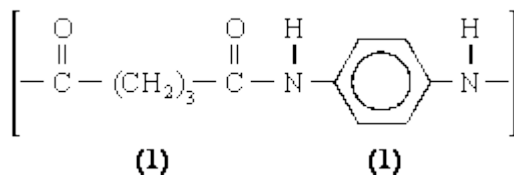
electrophilic substitution (1)



M2 structure
M3 arrow

6

- (c) Sn (or Fe) / HCl or Ni / H₂ (1)
 NOT LiAlH₄ NaBH₄



3

[15]