M1.B

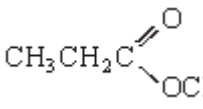
[1]

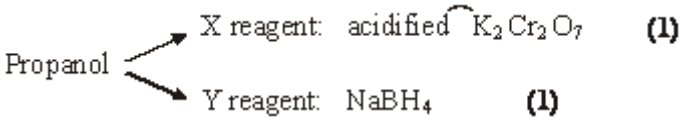
M2. (a) X contains > C=O **(1)**

if X and Y reversed lose this mark but allow remaining max 6/7

∴ X is CH_3CH_2COOH **(1)**

∴ Y is $CH_3CH_2CH_2OH$ **(1)**

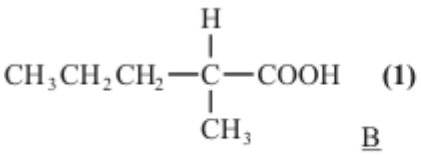
∴ A is  **(1)**



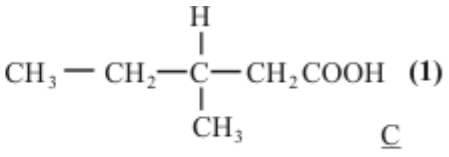
Conc H_2SO_4 : catalyst **(1)**

7

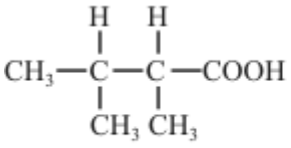
(b)

 **(1)**

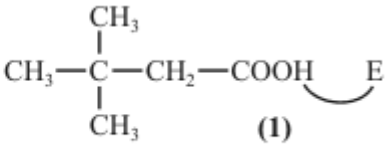
B

 **(1)**

C

 **(1)**

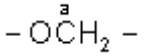
D

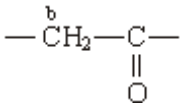
 **(1)**

E

in any order

4

(c)  3.1 – 3.9 **(1)**



2.1 – 2.6 **(1)**

a: quartet **(1)** ⌒ 3 adjacent H **(1)**

b: triplet **(1)** ⌒ 2 adjacent H **(1)**

6

(d) 3269 cm^{-1} ∴ OH ⌒ alcohol **(1)**

∴ G is (1)

2

Notes

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

Ignore wrong names

Y $CH_3CH_2CH_2OH$

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]

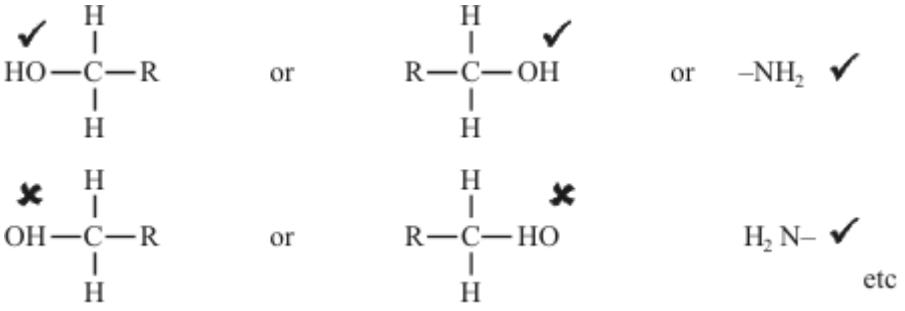
Organic points

(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.

(2) Structures

penalise sticks (i.e. ) once per paper



Penalise once per paper

allow CH_3– or –CH_3 or  or CH_3
or H_3C–

M3. D

[1]

M4. (a) $CH_3COCl + AlCl_3 \rightarrow CH_3\overset{+}{C}O + \overset{-}{AlCl_4}$
(1) equation (1)

2

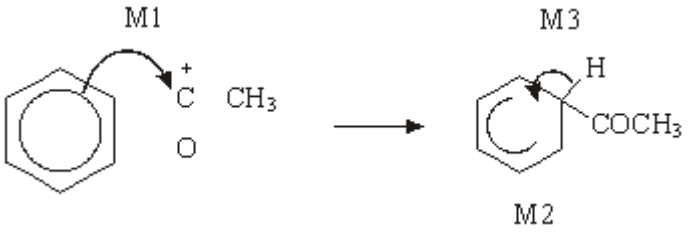
penalise wrong alkyl group once at first error
position of + on electrophile can be on O or C or outside [ ]

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

+

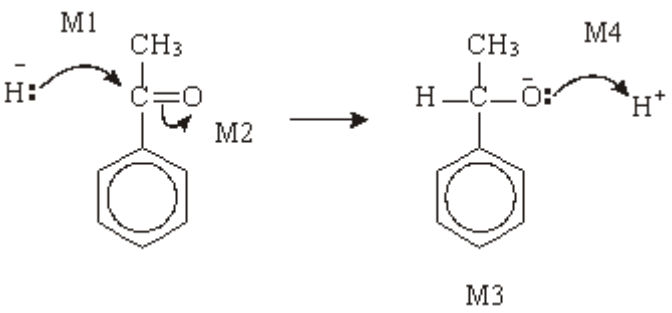
+ must be on C of RCO

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]

M5. **X** is CH_3CN or ethanenitrile or ethanonitrile or methyl cyanide or cyanomethane or ethyl nitrile or methanecarbonitrile

***Not** ethanitrile*

but contradiciton of name and structure lose marks

1

Y is $CH_3CH_2NH_2$ 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

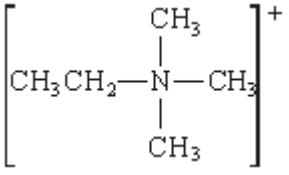
2

Step 2: reagent H_2 $LiAlH_4$ Na Zn/Fe/Sn Not $NaBH_4$
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



(Br^-) + can be on N or outside brackets as shown

1

nucleophilic substitution

1

[9]

M6. (a) (i)

Reagent	Tollens	Fehlings or Benedicts	$K_2Cr_2O_7/H^+$ or acidified	$KMnO_4/H^+$	I_2/NaOH
Propanal	silver (mirror)	red ppt or goes red *(not red solution)*	goes green	goes colourless	No reaction
Propanone	no reaction	no reaction	no reaction	no reaction	Yellow (ppt)

(penalise incomplete reagent e.g. $K_2Cr_2O_7$ or $Cr_2O_7^{2-}/H^+$ then mark on)

3

(ii) propanal 3 peaks

ignore splitting even if wrong

1

propanone 1 peak

1

(b) **X** is CH_3CH_2COOH or propanoic acid if both name and formula given, both must be correct, but

1

Y is $CH_3CH(OH)CH_3$ 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

$K_2Cr_2O_7/H^+$ or other oxidation methods as above
allow $Cr_2O_7^{2-}H^+$ 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	ether or dry	Ni / Pt etc

1 **1** **1**

or dry		

Step 3 esterification or (nucleophilic) addition-elimination or condensation **1**

(conc) H_2SO_4 or HCl **1**

warm (allow without acid reagent if **X** and **Y** given as reagents) **1**

or reflux or heat **1**

[15]