M1.B

[1]

M2.B

[1]

M3.C

[1]

M4.B

[1]

M5.B

[1]

M6.C

[1]

M7.B

[1]

M8.D

[1]

M9.D

M10.A

M11.D

M12.   (a)   Pentan-2-one

1

   (b)   (i)   1680 – 1750 (cm^{-1})

1

           (ii)   3230 – 3550 or 1000 – 1300 (cm^{-1})

1

           (iii)   4

1

   (c)

Reagent	$K_2Cr_2O_7/H^+$	$KMnO_4/H^+$	Na	$CH_3COOH/$ H_2SO_4	1
with **C**	no reaction	no reaction	no reaction	no reaction	1
with **D**	goes green	goes colourless	effervescence	smell	1

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

   (d)

Reagent	Tollens	Fehlings or Benedicts	1
with **E**	silver (mirror)	red ppt or goes red *(not red solution)*	1

[9]

M13.B
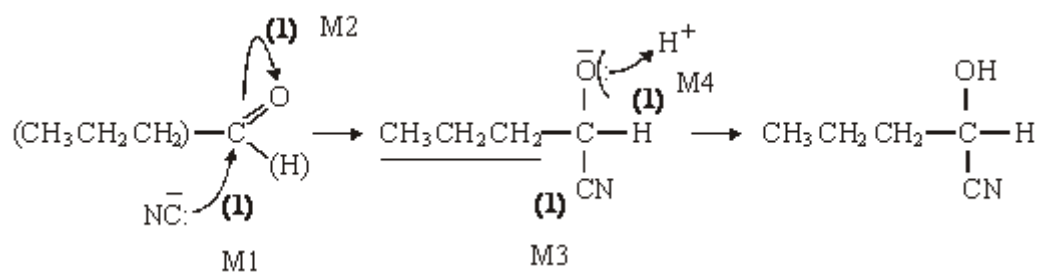
M14.(a)   *Mechanism*

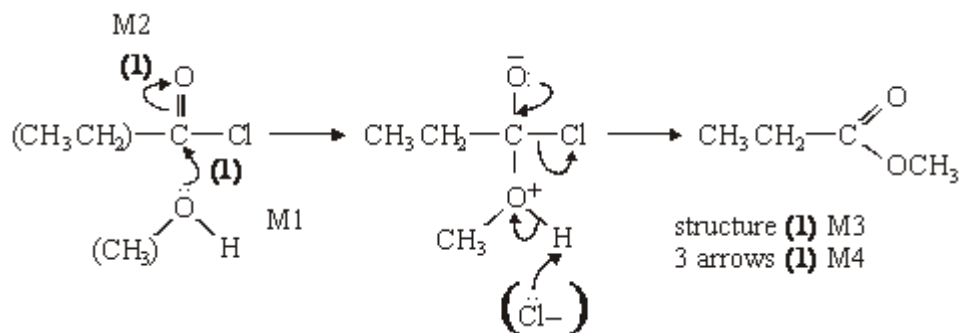*Allow C₃H₇ if structure shown elsewhere*
penalise HCN splitting if wrong

Name of product: 2-hydroxypenta(neo)nitrile **(1)**
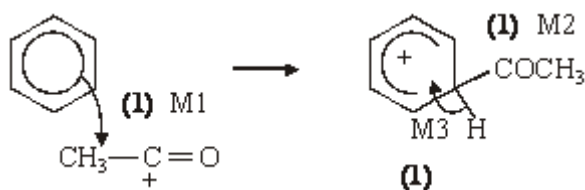
or 1-cyanobutan-1-ol

5

(b)   *Mechanism*

Name of organic product: methylpropanoate **(1)**

5

(c)   (i)   ([) CH₃CO (])⁺ **(1)**

(ii)

4

Notes

(abc) extra curly arrows are penalised

(a)   be lenient on position of negative sign on : CN^- but arrow must come from lp

(a)/(b) $C\overset{\frown}{=\!\!=}O$ alone loses M2 but can score M1 for attack on C+, similarly $C\overset{\frown}{-\!\!-}Cl$

(a)   allow 2-hydroxypentanonitrile or 2-hydroxypenta(ne)nitrile ... pentylnitrile

(b)   in M4, allow extra: Cl^- attack on H, showing loss of H^+

(c)   (i)   allow formula in an "equation"(balanced or not)
              be lenient on the position of the + on the formula

      (ii)   for M1 the arrow must go to the C or the + on the C
              don't be too harsh about the horseshoe, but + must not be close to the saturated C
              M3 must be final step not earlier; allow M3 even if structure (M2) is wrong
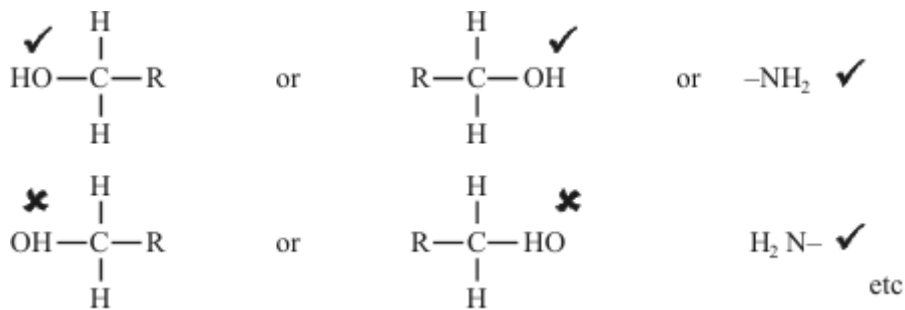
[14]

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.
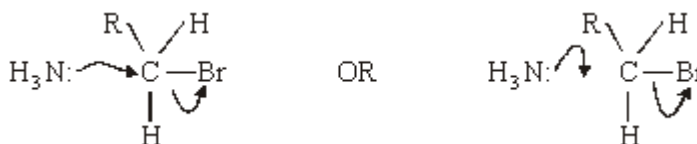
(2)   Structures

penalise sticks (i.e. $-\overset{|}{\underset{|}{C}}-$) once per paper

$$HO—\overset{\displaystyle H}{\underset{\displaystyle H}{\overset{\displaystyle |}{\underset{\displaystyle |}{C}}}}—R \quad ✔ \qquad \text{or} \qquad R—\overset{\displaystyle H}{\underset{\displaystyle H}{\overset{\displaystyle |}{\underset{\displaystyle |}{C}}}}—OH \quad ✔ \qquad \text{or} \quad -NH_2 \ ✔$$

$$OH—\overset{\displaystyle H}{\underset{\displaystyle H}{\overset{\displaystyle |}{\underset{\displaystyle |}{C}}}}—R \quad ✘ \qquad \text{or} \qquad R—\overset{\displaystyle H}{\underset{\displaystyle H}{\overset{\displaystyle |}{\underset{\displaystyle |}{C}}}}—HO \quad ✘ \qquad H_2N- \ ✔ \qquad etc$$

<u>Penalise once per paper</u>

<u>allow</u> CH_3- or $-CH_3$ or $\overset{\displaystyle CH_3}{|}$ or CH_3
or H_3C-

M15. (a) $K_2Cr_2O_7/H_2SO_4$ reuced by

$CH_3CH_2CH_2CH_2OH$ **(1)**

oxidised to $CH_3(CH_2)_2CHO$ **(1)**
and $CH_3(CH_2)_2COOH$ **(1)**

$CH_3CH_2CH_2CHO$ **(1)**

oxidised to $CH_3(CH_2)_2COOH$ **(1)**

Equation: $Cr_2O_7{}^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$ **(1)**
Note: Deduct one if all three compounds given as reducing agents.
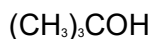
6

(b) Tollens' reduced by
$CH_3CH_2CH_2CHO$ **(1)**

oxidised to $CH_3(CH_2)_2COOH$ **(1)**

Equation $[Ag(NH_3)_2]^+ + e^- \rightarrow Ag + 2NH_3$ **(1)**

3

(c) $CH_3CH_2CH_2CH_2OH$ **(1)**

Product $CH_3CH_2CH_2CH_2OOCCH_3$ **(1)**

(CH$_3$)$_3$COH

Product (CH$_3$)$_3$COOCCH$_3$ **(1)**

4

(d)   CH$_3$CH$_2$CH$_2$OH has five peaks **(1)**

(CH$_3$)$_3$COH has two peaks **(1)**

2

[15]

M16.   (a)   (i)   propyl methanoate **(1)**

not propanyl

- *A wrong reagent or no reagent scores zero*
- *An incomplete reagent such as silver nitrate for Tollens, or potassium dichromate loses the reagent mark, but can get both observation marks*
- *penalise observations which just say colour change occurs or only state starting colour*

(ii)   *Reagent*: NaHCO$_3$ **(1)**
*Observation with **C***: no reaction **(1)**
*Observation with **D***: effervescence **(1)**

*for **C** and **D**   NOT Tollens*

Test	an identified (hydrogen) carbonate	acidified K$_2$Cr$_2$O$_7$	acidified KMnO$_4$	correct metal	UI or stated indicator	PCl$_5$
Observation with C	no reaction	goes green	goes colourless	no reaction	no change	no reaction
observation with D	bubbles or CO$_2$	no change	no change	bubbles or H$_2$	red or correct colour pH 3 – 6.9	(misty) fumes

4

(b)　(i)　*Reagent*: pentan-<u>2</u>-one **(1)**
　　　　　　or 2-pentanone
　　　　　　but not pent-2-one or pentyl

　　(ii)　*Reagent*: Tollen's or Fehling's **(1)**

　　　　Observation with E: no reaction **(1)**

　　　　Observation with F: silver mirror or red ppt **(1)**

　　　　for **E** and **F**

Test	Tollens	Fehlings or Benedicts	iodoform or I_2/NaOH	acidified $K_2Cr_2O_7$	Schiff's
observation with E	no reaction	no reaction	yellow (ppt)	no change	no reaction
observation with F	silver or mirror or grey or ppt	red or ppt not red solution	no reaction	goes green	goes pink

4

(c)

　　CH$_3$CH$_2$—C—CHO
　　　　　　|
　　　　　CH$_3$　　**(1)**

*must be aldehyde. Allow C_2H_5 for CH_3CH_2 otherwise this is
the only answer*

1

[9]