ALDEHYDES, KETONES AND OPTICAL ISOMERISM

HW MS

**1.**             (i)      molecules with same structure / structural formula **(1)**but with bonds **(atoms or groups)** arranged differently in  
space (3D) **(1)**

(ii)     Plane polarised light **(1)**Rotated (equally) in opposite directions **(1)**

**4**

**[4]**

**2.**     (a) (i)      *Reagent*: pentan-2-one **(1)**

*or 2-pentanone*

*but not pent-2-one or pentyl*

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

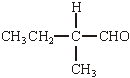
*Observation with* ***E***: no reaction **(1)**

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

         for **E** and **F**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Test | Tollens | Fehlings or Benedicts | iodoform or I2/NaOH | acidified K2Cr2O7 | 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)      **(1)**

*must be aldehyde. Allow C2H5 for CH3CH2 otherwise this is the only answer*

**1**

**[5]**

**3.**         (i)      CH3CH2CHO + HCN → CH3CH2CH(OH)CN **OR** C2H5CH(OH)CN

*aldehyde must be –CHO brackets optional*

**1**

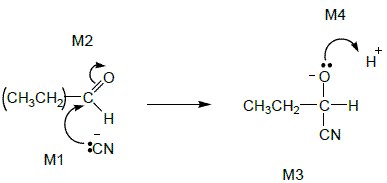
2-hydroxybutanenitrile **OR** 2-hydroxybutanonitrile

*no others*

**1**

(ii)     nucleophilic addition

**1**

****

*M1 includes lp and arrow to Carbonyl C and minus charge (on either C or N)  
Not allow M2 before M1, but allow M1 to C+ after non-scoring carbonyl arrow  
Ignore δ+, δ– on carbonyl group, but if wrong way round or full + charge on C lose M2*

*M3 for correct structure including minus sign. Allow C2H5*

*M4 for lp and curly arrow to H+*

**4**

(iii)     (propanone) slower ***OR*** propanal faster

**1**

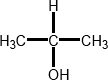
inductive effects of alkyl groups  
***OR***C of C=O less δ+ in propanone  
***OR***alkyl groups in ketone hinder attack  
***OR***easier to attack at end of chain

*if wrong, no further marks*

**1**

**[9]**

**4. L**



Allow (CH3)2CHOH     or      CH3CH(OH)CH3

*Allow name propan–2–ol*

*Penalise contradiction of name and structure*

**1**

**M**

****

Allow CH3CH=CH2

*Allow name propene*

*ignore -1- but penalise other numbers*

*Penalise contradiction of name and structure*

**1**

Step 1 NaBH4   or   LiAlH4

  Zn/HCl   or   Sn/HCl

  or H2/Ni   or  H2/Pt

*Ignore name if formula is correct*

*ignore solvent*

*ignore acid (for 2nd step) but penalise acidified NaBH4*

*Apply list principle for extra reagents and catalysts.*

M1

**1**

(nucleophilic) addition

Addition (not nucleophilic)

*Penalise electrophilic*

*Ignore reduction*

M2

**1**

Step 2   conc H2SO4   or   conc H3PO4   or   Al2O3

*Apply list principle for extra reagents and catalysts.*

M3

**1**

   elimination

*Independent from M3*

*penalise nucleophilic or electrophilic*

*ignore dehydration*

M4

**1**

Step  3  HBr

*Apply list principle for extra reagents and catalysts.*

M5

**1**

         electrophilic addition

*Independent from M5*

M6

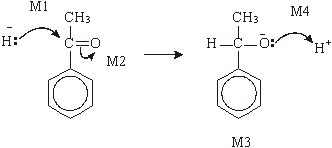
**1**

**[8]**

**5.**        (a)     Nucleophilic addition

*NOT reduction*

**1**

****

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

**4**

      (b)     dehydration or elimination

**1**

(conc) H2SO4 or (conc) H3PO4

*allow dilute and Al2O3*

*Do not allow iron oxides*

**1**

**[7]**

**6.** (a)     (i)      2-hydroxypropanoic acid  
***OR***2-hydroxypropan(-1-)oic acid

*Do not penalise different or missing punctuation or extra spaces.*

*Spelling must be exact and order of letters and numbers as here.*

*Can ignore −1− before –oic, but penalise any other numbers here.*

**1**

(ii)     C12H22O 11 + H2O  4CH3CH(OH)COOH

*Allow 4C3H6O3*

***OR***

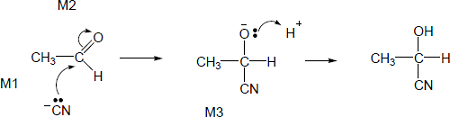
C12H22O11 + H 2O  2CH3CH(OH)COOH + C6H12O6

*Allow 2C3H6O3*

**1**

(b)     (i)      Nucleophilic addition

M4 for lp, arrow and H+



*•  M1 lp and minus must be on C*

*•  M1 and M4 include lone pair and curly arrow.*

*•  M2 not allowed independent of M1, but allow following some attempt at attack on carbonyl C*

*•  allow M1 for correct attack on C+*

*•  + rather than δ+ on C=O loses M2*

*•  M3 is for correct structure including minus sign but lone pair is part of M4*

*•  Allow arrow in M4 to H of H-CN with arrow forming cyanide ion.*

**5**

(ii)     Equal mixture of enantiomers / (optical) isomers

**1**

(iii)    (Plane) polarized light

*If missing no further mark.*

**1**

(Polarised light) rotated by single enantiomer but unaffected by racemate

*Both needed; not allow bend, twist etc.*

**1**

**[10]**

**7.** (a)    Nucleophilic addition

**1**

|  |  |
| --- | --- |
|  | M4 for lp, arrow and H+ |
|  |  |
|  | Allow C2H5− for CH3CH2− |

*•       M1 and M4 include lone pair and curly arrow.*

*•       Allow: CN− but arrow must start at lone pair on C.*

*•       M2 not allowed independent of M1, but allow M1 for correct          attack on C+.*

*•       + rather than δ+ on C=O loses M2.*

*•       Penalise incorrect partial charges.*

*•       M3 is for correct structure including minus sign but lone pair  
        is part of M4.*

*•       Penalise extra curly arrows in M4.*

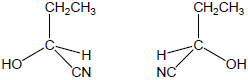
**4**

(b)    (i)      M1          
   
*M1 for correct structure of product of part (a).*

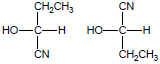
*Allow C2H5− for CH3CH2−.*

*Penalise wrongly bonded, OH or CN or CH2CH3 once only in clip.*

**1**

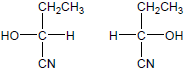
M2  
        

*M2 cannot be gained by simply swapping two or more groups with no attempt to show a mirror image., e.g. do not allow M2 for*

**

*because these do not show the enantiomers as mirror images.*

Students must show an attempt at mirror images, eg allow

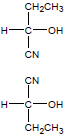


ie vertical groups same and horizontal swapped as if there was a mirror between them

No mirror need be shown

Do not penalize wedge bond when wedge comes into contact with both C & N

*However these two could score M2 if placed as below as if with a “mirror” horizontally between them.*

**

**1**

(ii)     M1        (Plane) polarized light

*M2 only scores following correct M1*

**1**

M2        Rotated in opposite directions (equally) (only allow if M1 correct or             close)

*Not just in different directions but allow one rotates light to the left and one to the right.*

*Not molecules rotate.*

**1**

(c)     2-hydroxybutane(-1-)nitrile

**1**

**[10]**

***8.****(a)     nucleophilic addition*

***1***

*Attack by HCN loses M1 and M2  
M2 not allowed independent of M1, but*

*allow M1 for correct attack on C+  
+C=O loses M2  
M2 only allowed if correct carbon attacked  
allow minus charge on N i.e. :CN–*

***4***

***M3*** *for completely correct structure not including lp*

*allow C3H7 in M3*

***M4*** *for lp and arrow*

*allow without –*

***1***

*2-hydroxy-2-methylpentan(e)nitrile*

*allow 2-hydroxy-2-methylpentanonitrile*

*(b)     Product from* ***Q*** *is a racemic mixture/equal amounts of enantiomers*

*if no reference to products then no marks;*

***1***

*racemic mixture is inactive or inactive explained*

*not* ***Q*** *is optically active or has a chiral centre etc*

***1***

*Product from* ***R*** *is inactive (molecule) or has no chiral centre*

***1***

***[9]***

**9.** (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**

**[15]**

**10.** B

**[1]**

**11.** D

**[1]**

**12.** B

**[1]**