**CARBOXYLIC ACIDS, AMINES, ESTERS AND ACYLATION**

HW MS

**1.**      (i)



**1**

          propan(e)-1,2,3-triol

*OR*

          1,2,3-propan(e)triol

*OR*

          Glycerol;

**1**

(ii)     CH3(CH2)16COONa  or  C17H35COONa or C18H35O2Na;

*(ignore 3 in front of formula but not if indicating trimer)*

**1**

(not just anion and penalise Na shown as covalently bonded) soap -   
allow with detergent but not detergent alone;

**1**

**[4]**

**2.**      **X** is CH3CN 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 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**

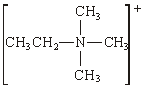
          Step 2: reagent      H2                  LiAlH4        Na            Zn/Fe/Sn    Not NaBH4            condition      Ni/Pt/Pd        ether        ethanol     HCl

**2**

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

**1**

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



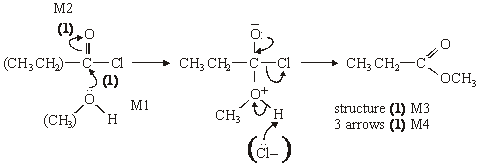
**1**

          nucleophilic substitution

**1**

**[9]**

**3.** *Mechanism*



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

**5**

**Notes**

extra curly arrows are penalised

alone loses M2 but can score M1 for attack on C+, similarly



in M4, allow extra: Cl– attack on H, showing loss of H+

**[5]**

          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 CH3– or –CH3 or  or CH3    or   H3C



**4.** (a)     Melting range would be  
         wide (>3 deg C) / not sharp

*Allow melts over a range of temperatures.*

**1**

below / before the true m.p.

*Do not allow ‘above or below’.*

**1**

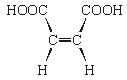
(b)     Temperature on thermometer not the same as the sample

*Allow sample heats up at a different / higher / lower rate than thermometer.*

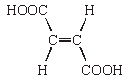
**1**

**[3]**

**5.**          (a)



**1**



**1**

*NB     The bonds shown in the structure must be correct*

         Isomerism: E-Z isomerism

*If written answer is correct, ignore incorrect labelling of structures.  
If no written answer, allow correctly labelled structures.*

**1**

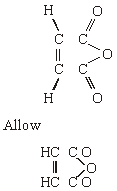
         Both COOH groups must be on the same side/ close together/ cis

**1**

         No rotation about C=C axis

**1**

          Structure



**1**

(c)     e.g. 2NaOH + HO2CCHCHCO2H → NaO2CCHCHCO2Na + 2H2O

          Both H replaced

**1**

Balanced for atoms and charges

**1**

*NB Allow ionic equations and      2NaOH + C4H4O4 → C4H2O4Na2+ 2H2O*

*Allow one if structure incorrect but molecular formula  
     correct*

*Allow one for a correct equation showing one H replaced*

**[8]**

**6.**     Advantage; reaction goes to completion, not reversible  
or faster

**1**

         Disadvantage; reaction vigorous/dangerous

*(exothermic must be qualified)*

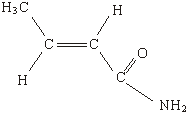
          or HCl(g) evolved/toxic  
or CH3COCl expensive

*NB     Allow converse answers  
     Do not allow reactions with other reagents e.g. water  
     or ease of separation*

**1**

**[2]**

**7.**        (a)

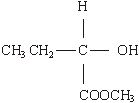


*(allow 1 for amide even if not C4H7NO, i.e. RCONH2)*

*(if not amide, allow one for any isomer of C4H7NO which shows  
geometric isomerism)*

**2**

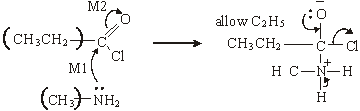
(b)



**1**

**[3]**

**8.**          (a)     (nucleophilic) addition-elimination;



*(M3 for structure)  
(M4 for 3 arrows and lone pair)  
(M2 not allowed independent of M1, but allow M1 for correct attack  
on C+ if M2 show as independent first.)  
(+on C of C=O loses M2 but ignore δ+ if correct)  
(Cl– removing Ft loses M4)*

**1**



*(If MS lost above for wrong C chain, do not penalise same error again here)*

**5**

(b)     M1 CH3CH2COCl + H2O → CH3CH2COOH + HCl 1  
*(penalise wrong alkyl group once at first error)*

**1**

M2 Mr of CH3CH2COCl = 92.5 1  
*(if Mr wrong, penalise M2 only)*

**1**

          M3 moles of CH3CH2COCl = 1.48/92.5 = 0.016 1

**1**

M4 moles NaOH = 2 × 0.016 = 0.032 1  
(allow for × 2 conseq to wrong no of moles)

**1**

M5 volume of NaOH = 0.032/0.42 = 0.0762 dm3 or 76.2 cm3 1  
*(with correct units)  
(if* ×*2 missed in M4 lose M5 also)*

**1**

**[11]**

**9.**      (a)     **M1**    CH3CH2CH2COOH

*not C3H7COOH*

**1**

**M2**    CH3CH2OH or C2H5OH

**1**

**M3** CH3CH2CH2COOCH2CH3 + H2O

*allow C3H7COOC2H5penalise M3 for wrong products and unbalanced equation*

**1**

**M4** H2SO4 or HCl or H3PO4 conc or dil or neither

*not HNO3*

**1**

(b)     **M1**    CH3CH2CH2CH2OH

**1**

*not C4H9OH*

**M2** (CH3CO) 2O

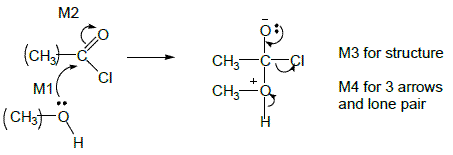
**1**

**M3** → CH3COOCH2CH2CH2CH3 + CH3COOH

*allow CH3COOC4H9penalise M3 for wrong products and unbalanced equation*

**1**

(c)     (nucleophilic) addition-elimination



*not acylation alone*

*M2 not allowed indep of M1 but allow M1 for correct attack on C+*

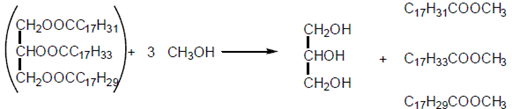
*+C=O loses M2*

*only allow M4 after correct or v close M3  
ignore Cl– removing H+*

**5**

(d)

              (1)                                                              (1)                             (1)



*ignore errors in initial triester*

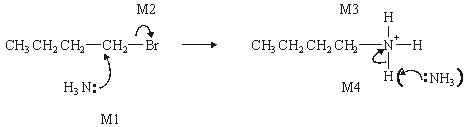
*First mark for 3CH3OH*

*Third mark for all three esters*

**3**

**[15]**

**10.**      (a)     Nucleophilic substitution



**1**

          M1, M2 and M4 for arrows, M3 for structure of cation

*(Allow M2 alone first, i.e. SN1 formation of carbocation)*

*(Penalise M4 if Br– used to remove H+)*

**4**

(b)     Step 1        CH3CH2CH2CN   1

CH3CH2CH2Br + KCN → CH3CH2CH2CN + KBr balanced

**1**

                            (or CN–) (or Br–)  
                   (*not HCN*)

**1**

Step 2        CH3CH2CH2CN + 2H2 → CH3CH2CH2CH2NH2                     (or 4[H])

**1**

(c)         Lone pair (on N) (in correct context)

**1**

R group increases electron density / donates electrons /pushes  
electrons / has positive inductive effect

**1**

(d)     CH3CH2N(CH3)2

**1**

**[11]**

**11.** 1-chloropropane        no visible change

*Accept ‘small amount of precipitate’ or ‘precipitate forms slowly’.*

**1**

  ethanoyl chloride        white precipitate

*Accept ‘large amount of precipitate’ or ‘precipitate forms immediately’.*

**1**

**[2]**

**12.** A

**[1]**

**13.** A

**[1]**

**14.** C

**[1]**

**15.** C

**[1]**

**16.** D

**[1]**

**17.** A

**[1]**

**18.** D

**[1]**