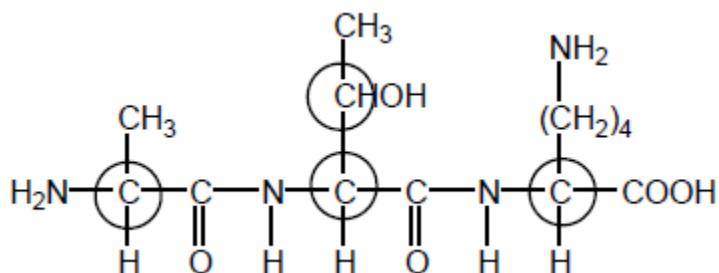


Mark schemes

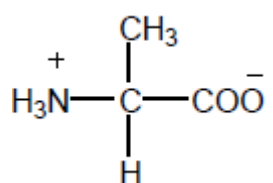
1 (a) (i)



These four only

1

(ii)



Allow $-\text{NH}_3^+$ and $^+\text{NH}_3-$

1

(iii) 2-amino-3-hydroxybutanoic acid

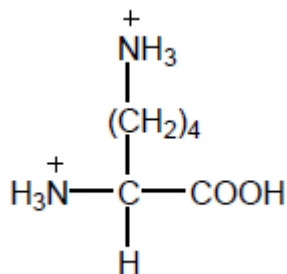
Ignore 1 in butan-1-oic acid

Do not penalise commas or missing hyphens

Penalise other numbers

1

(iv)



Allow $-\text{NH}_3^+$ and $^+\text{NH}_3-$

1

(b) (i) Condensation

Allow polyester

1

(ii) propane-1,3-diol

Must have e

Allow 1,3-propanediol

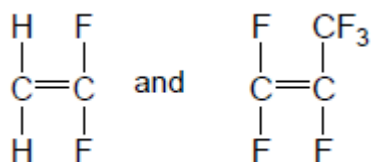
1

(c) (i) Addition

Not additional

1

(ii)

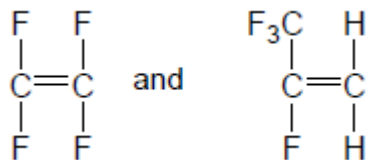


Allow monomers drawn either way round

Allow bond to F in CF₃

1

OR



1 for each structure within each pair

1

(d) c

If wrong, CE = 0

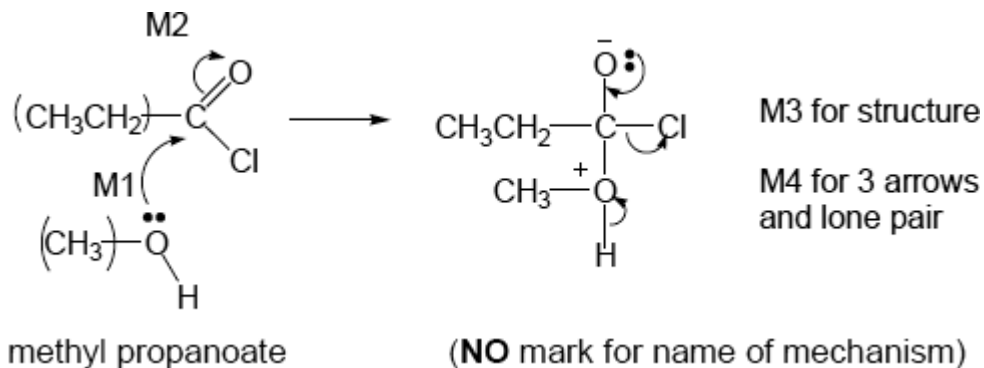
1

C-C or C-F bonds too strong

1

[11]

2 (a)

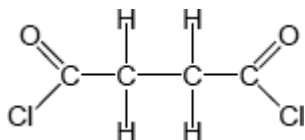


- *M2 not allowed independent of M1, but allow M1 for correct attack on C+*
- *+ rather than $\delta+$ on C=O loses M2*
- *If Cl lost with C=O breaking, max1 for M1*
- *M3 for correct structure with charges but lp on O is part of M4*
- *only allow M4 after correct/very close M3*
- *ignore Cl⁻ removing H⁺*

4

- (b) (i) pentane-1,5-diol
Second 'e' and numbers needed
Allow 1,5-pentanediol but this is not IUPAC name

(ii)



Must show ALL bonds

1

(iii) All three marks are independent

M1 (base or alkaline) Hydrolysis (allow close spelling)

1

Allow (nucleophilic) addition-elimination or saponification

M2 $\delta+$ C in polyester

1

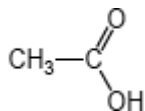
M3 reacts with OH⁻ or hydroxide ion

1

Not reacts with NaOH

1

(c) (i)



Allow CH_3COOH or $\text{CH}_3\text{CO}_2\text{H}$

1

(ii) (nucleophilic) addition-elimination

Both addition and elimination needed and in that order

OR

(nucleophilic) addition followed by elimination

*Do **not** allow electrophilic addition-elimination / esterification*

Ignore acylation

1

(iii) any **two** from: ethanoic anhydride is

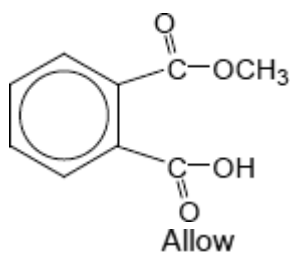
- less corrosive
- less vulnerable to hydrolysis
- less dangerous to use,
- less violent/exothermic/vigorous reaction OR more controllable rxn
- does not produce toxic/corrosive/harmful fumes (of HCl) OR does not produce HCl
- less volatile

NOT COST

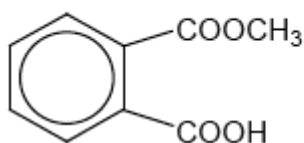
List principle beyond two answers

2

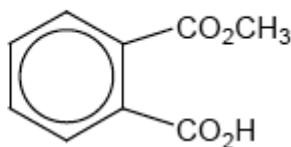
(d)



Allow



or



1

(e) (i) ester

*Do **not** allow ether*

Ignore functional group/linkage/bond

1

(ii) 12 or twelve (peaks)

1

(iii) 160 – 185

Allow a number or range within these limits

Penalize extra ranges given

Ignore units

1

(f) (i)

sulfuric acid	sodium hydroxide	✓
hydrochloric acid	ammonia	X or blank
ethanoic acid	potassium hydroxide	✓
nitric acid	methylamine	X or blank

4 correct scores 2

3 correct scores 1

2 or 1 correct scores 0

2

(ii) Pink to colourless

Allow 'red' OR 'purple' OR 'magenta' instead of 'pink'

*Do **not** allow 'clear' instead of 'colourless'*

1

[21]

3

(a) (i) (As a) soap

Allow washing, cleaning, degreasing, detergents

1

(ii) (Bio)diesel or biofuel or fuel for cars/lorries

Allow to make soap

1

(iii) (Cationic) surfactant /detergent /fabric softener /germicide / shampoos /
(hair) conditioners /spermicidal jelly

Allow cleaning

1

(b) (i) (Poly)ester

1

Terylene **OR** PET

Allow polyester

1

(ii) (Poly)amide 1

Kevlar **OR** nylons

Ignore numbers with nylons Allow polyamide(e)

1

(iii) (Independent marks)

$CE = 0$

Hydrogen bonding in b(ii)

1

Imfs in (b)(ii) are stronger

OR

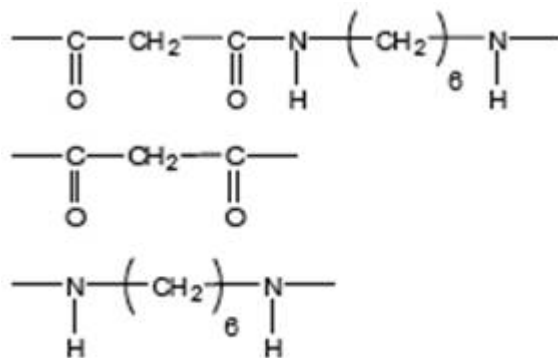
H bonding stronger than dipole–dipole/van der Waals/ dispersion/London forces in b(i)

1

[9]

4

(a) (i)



Allow –CONH- or - COHN -

Mark two halves separately

lose 1 each for missing trailing bonds at one or both ends or error in peptide link or either or both of H or OH on ends

1

Not allow –(C₆H₁₂)–

Ignore n

1

(ii) **M1** in polyamides - H bonding

1

M2 in polyalkenes - van der Waals forces

Penalise forces between atoms or van der Waals bonds

1

M3 Stronger forces (of attraction) in polyamides

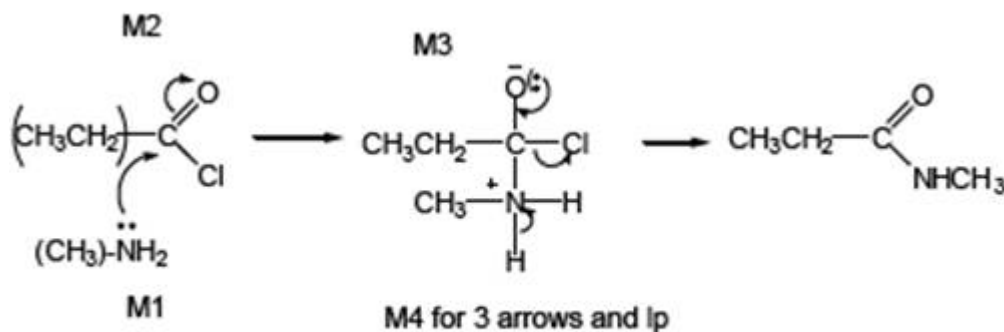
Or H bonding is stronger

(must be a comparison of correct forces to score M3)

Do not award if refer to stronger bonds

1

(b) (i) (nucleophilic) addition elimination



Not allow N-H₂

Minus sign on NH₂ loses M1

1

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

+ rather than δ+ on C=O loses M2

If Cl lost with C=O breaking, max 1 for M1

M3 for correct structure with charges but

lp on O is part of M4

only allow M4 after correct/ very close M3

For M4, ignore NH₃ removing H⁺ but lose

M4 for Cl removing H⁺ in mechanism, but ignore HCl as a product

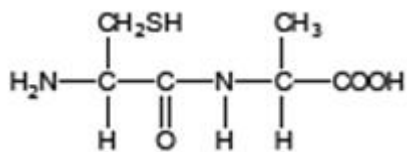
4

(ii) N-methylpropanamide

Not N-methylpropaneamide

1

(c)



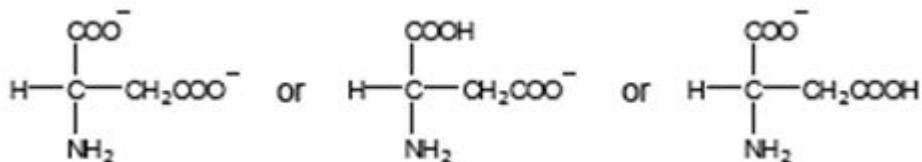
Allow $-\text{CONH}-$ or $-\text{COHN}-$

1

(d) (i) 2-amino-3-hydroxypropanoic acid

1

(ii)



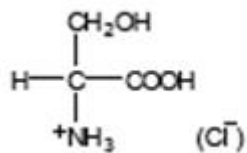
Must be salts of aspartic acid

allow $-\text{CO}_2^-$

allow NH_2-

1

(iii) Penalise use of aspartic acid once in d(iii) and d(iv)



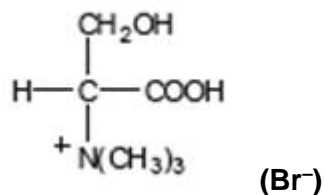
allow $-\text{CO}_2\text{H}$

allow $^+\text{NH}_3-$

don't penalize position of + on NH_3

1

(iv) Penalise use of aspartic acid once in d(iii) and d(iv)



allow $-\text{CO}_2^-$
must show C-N bond
don't penalize position of + on $\text{N}(\text{CH}_3)_3$

1

[16]

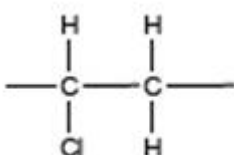
5

(a) Benzene-1,2-dicarboxylic acid

Allow 1,2-benzenedicarboxylic acid

1

(b)



Must show all bonds including trailing bonds
Ignore n

1

(c) (i) 2 $\text{C}_2\text{H}_5\text{OH}$

NB Two ethanols

1

H_2O

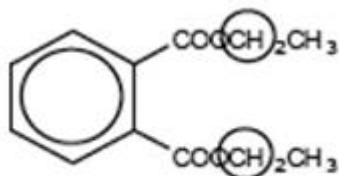
but only one water

1

(ii) 6 or six

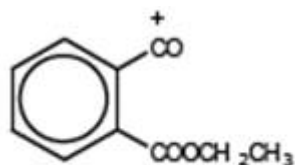
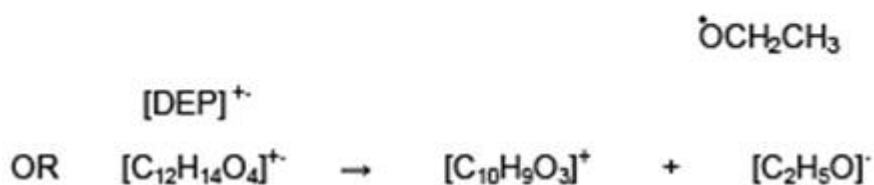
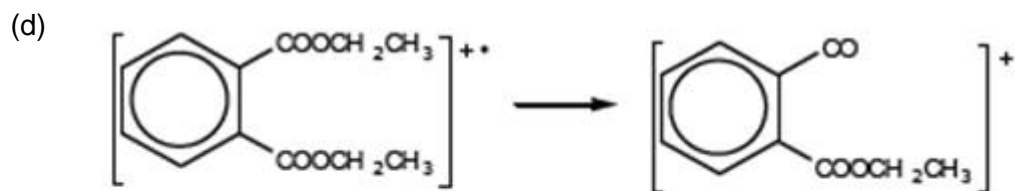
1

(iii)



Ignore overlap with O to the left or H to the right, but must only include this one carbon.
either or allow both (as they are identical)

1



Allow + on C or O in

1

Dot must be on O in radical

1

- (e) (i) Rate = $k[\text{DEP}]$
Must have brackets but can be ()

1

(ii) Any **two** of

- experiment repeated/continued over a long period
- repeated by independent body/other scientists/avoiding bias
- investigate breakdown products
- results made public

Not just repetition

Ignore animal testing

2 max

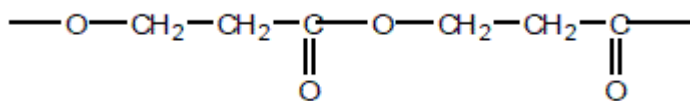
[11]

6

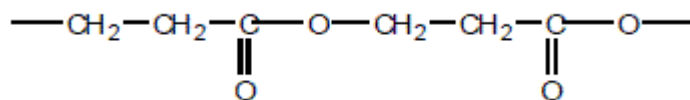
- (a) 3-hydroxypropanoic acid
allow 3-hydroxypropionic acid
must be correct spelling

1

- (b) (i) must show trailing bonds



or can start at any point in the sequence, e.g.



not allow dimer

allow $\text{---O---CH}_2\text{CH}_2\text{COOCH}_2\text{CH}_2\text{CO---}$

or $\text{---CH}_2\text{CH}_2\text{COOCH}_2\text{CH}_2\text{COO---}$

ignore () or n

NB answer has a total of 6 carbons and 4 oxygens

1

- (ii) condensation (polymerisation)

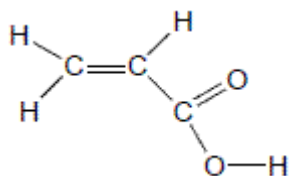
Allow close spelling

1

- (c) (i) C=C or carbon-carbon double bond

1

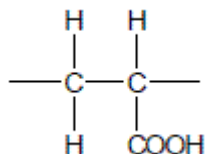
- (ii)



*must show **ALL** bonds including O-H*

1

- (iii) must show trailing bonds

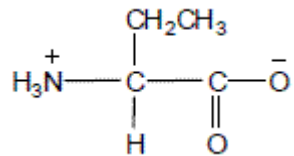


allow polyalkene conseq on their c(ii)

ignore n

1

(d)

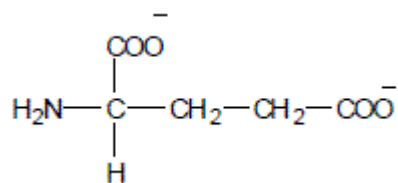


allow NH_3^+ —

allow COO^-

1

(e) (i)



In (e), do not penalise a slip in the number of carbons in the $-\text{CH}_2\text{CH}_2-$ chain, but all must be bonded correctly

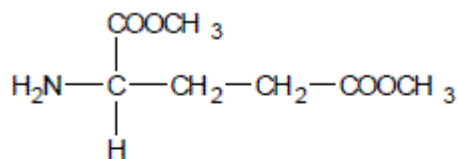
NB two carboxylate groups

Allow COONa or $\text{COO}^- \text{Na}^+$ but not covalent bond to Na

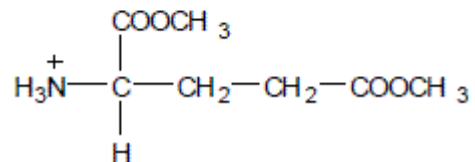
allow NH_2-

1

(ii)



OR



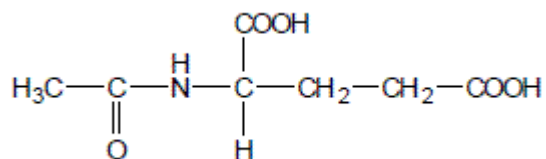
In (e), do not penalise a slip in the number of carbons in the $-\text{CH}_2\text{CH}_2-$ chain, but all must be bonded correctly

NB two ester groups

allow NH_2- or $^+\text{NH}_3-$

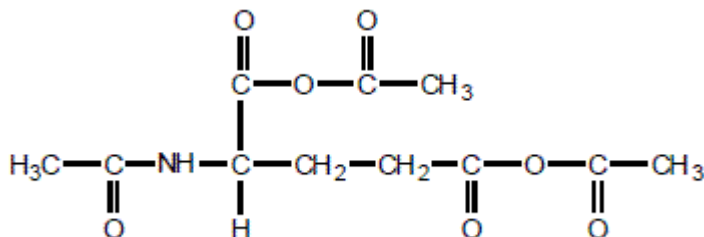
1

(iii)



In 4(e), do not penalise a slip in the number of carbons in the -CH₂CH₂- chain, but all must be bonded correctly

allow anhydride formation on either or both COOH groups (see below) with or without amide group formation



1

(f) **M1** phase or eluent or solvent (or named solvent) is moving or mobile

1

M2 stationary phase or solid or alumina/silica/resin

1

M3 separation depends on balance between solubility or affinity (of compounds) in each phase

OR

different adsorption or retention

OR

(amino acids have) different R_f values

OR

(amino acids) travel at different speeds or take different times

1

[13]