

M1.(a) Heating speeds up (hydrolysis / breaking of peptide bonds)

OR forms non-sweet (amino acids)

1

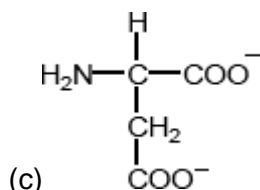
(b) (2-)aminobutanedioic acid OR

2 not necessary but penalise other numbers at start

(2-)aminobutane(-1,4-)dioic acid

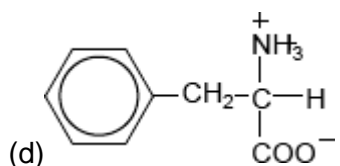
1,4 not necessary but penalise other numbers and 1,4 must be in correct place (QoL)

1



*allow $-\text{CO}_2^-$
allow NH_2-*

1



*allow $-\text{CO}_2^-$
allow $+\text{NH}_3-$
don't penalize position of + on NH_3*

1

(e) (i) **M1** Compounds/molecules with same structural formula

Not just structure

1

M2 But with bonds/atoms/groups arranged differently in space or in 3D

Allow –with different spatial arrangement of atom/bond/group

1

Independent marks

(ii) (Plane) polarised light

1

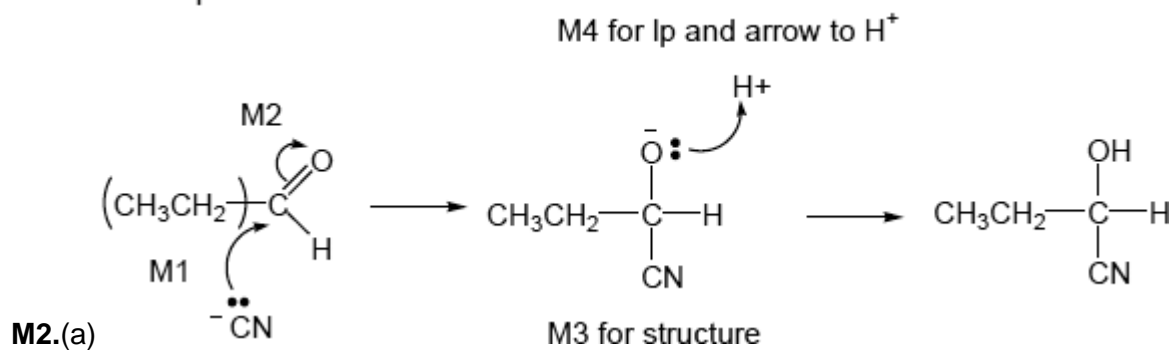
Rotated in opposite directions

Not bent or turned or twisted; not different directions (QoL)

1

[8]

nucleophilic addition



- allow :CN⁻
- M2 not allowed independent of M1, but
- 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 C₂H₅
- M1 and M4 for lp and curly arrow

1

4

(b) 2-bromobutanenitrile

Allow 2-bromobutane-1-nitrile

1

(c) **M1** ammonia or NH₃

Ignore temp or pressure

1

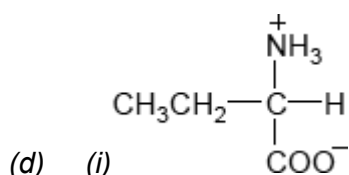
M2 excess (ammonia) excess tied to NH_3 and may score in M1 unless contradicted

Ignore concentrated or sealed container, Acid loses conditions mark

1

M3 nucleophilic substitution
Allow close spelling

1



Allow C_2H_5

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

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

Don't penalize position of + on NH_3

1

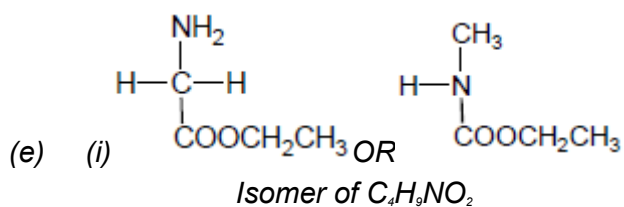
(ii) **M1** electrostatic forces between ions in X **QOL**
Allow ionic bonding.

1

Marks independent

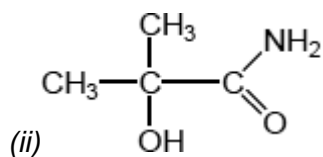
M2 (stronger than) hydrogen bonding between $\text{CH}_3\text{CH}_2\text{CH}(\text{OH})\text{COOH}$
CE mention of molecules of **X** or inter molecular forces
between **X** loses both marks

1

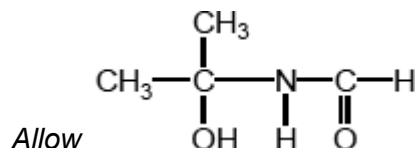


Allow NH₂-

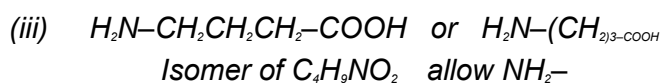
1



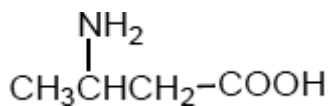
Isomer of C₄H₉NO₂ allow NH₂-



1



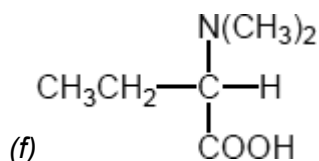
OR



Do **not** allow -C₃H₆-

Beware – do not credit X itself

1



Answer has 6 carbons so **NOT** isomer of X

Allow C₂H₅

Must have bond from C to N not to methyl group

1

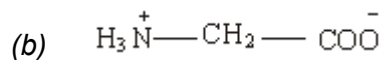
[16]

- M3. (a) polyamide or nylon (2,4)
(allow nylon without numbers but if numbers are present they must be correct)

1

condensation

1



1

- (c) ionic bonding in aminoethanoic acid
(can only score if includes that aminoethanoic is ionic)

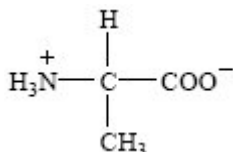
1

stronger attractions than Hydrogen bonding in hydroxyethanoic acid
(e.g. stronger Hydrogen bonding in aminoethanoic acid scores 0)
(mention of electrostatic forces between molecules scores 0)

1

[5]

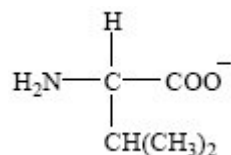
M4. (a) (i)



allow $-\text{CO}_2^-$
allow $\cdot\text{NH}_3^-$
don't penalize position of + on NH_3

1

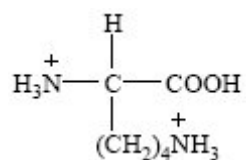
(ii)



allow $-\text{CO}_2^-$
allow NH_2^-
allow C_3H_7

1

(iii)



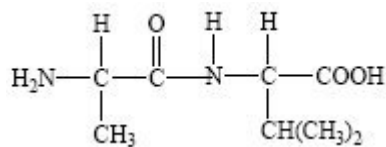
allow $-\text{CO}_2\text{H}$

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

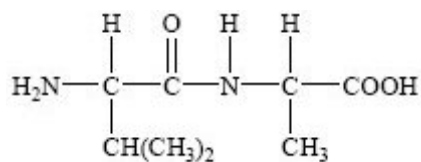
don't penalize position of + on NH_3

1

(b)



1



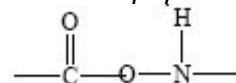
allow $-\text{CO}_2\text{H}$

allow NH_2-

allow C_3H_7

allow as zwitterions

if error in peptide link e.g.



if twice, penalise both times

not polymers

if wrong amino acid in both can score Max 1

1

(c) chromatography or electrophoresis

ignore qualification to chromatography

1

[6]

M5. (a) (i) hydrolysis

not hydration

1

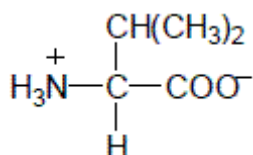
(ii) 2-aminopropanoic acid

ignore alanine

QoL

1

(iii)



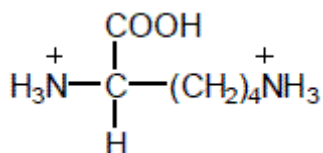
allow $-\text{CO}_2^-$

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

don't penalize position of + on NH_3

1

(iv)



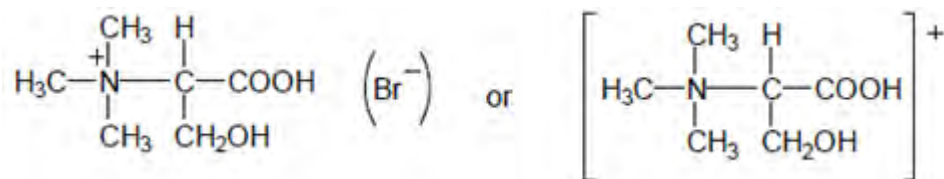
allow $-\text{CO}_2^-$

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

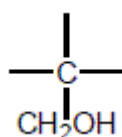
don't penalize position of + on NH_3

1

(b) (i)



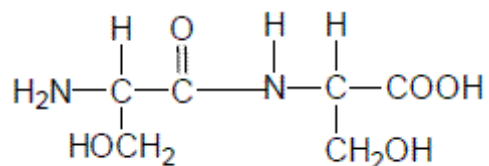
allow $-\text{CO}_2\text{H}$



allow limit as
+ on N or outside []

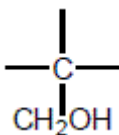
1

(ii)



allow $-\text{CO}_2\text{H}$ allow $-\text{CONH}-$ or $-\text{COHN}-$

allow NH_2-



allow limit as

1

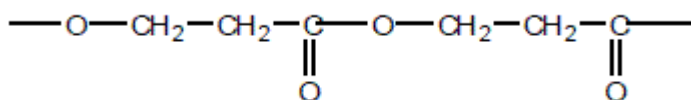
[6]

M6. (a) 3-hydroxypropanoic acid

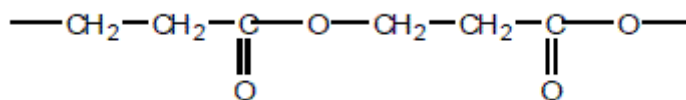
allow 3-hydroxypropionic acid
must be correct spelling

1

(b) (i) must show trailing bonds



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



not allow dimer

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

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

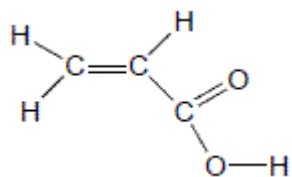
(ii) condensation (polymerisation)
Allow close spelling

1

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

1

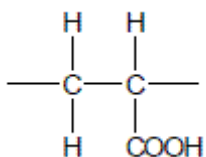
(ii)



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

1

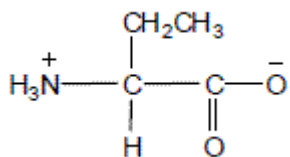
(iii) must show trailing bonds



allow polyalkene conseq on their c(ii)
ignore n

1

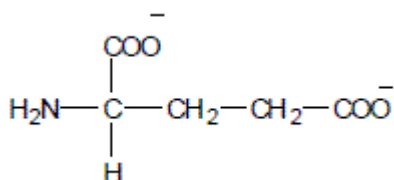
(d)



allow NH₃⁺—
allow COO⁻

1

(e) (i)



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

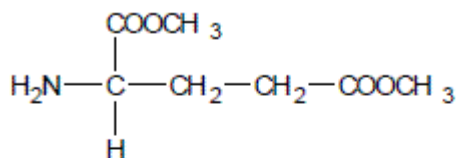
NB two carboxylate groups

Allow COONa or COO⁻ Na⁺ but not covalent bond to Na

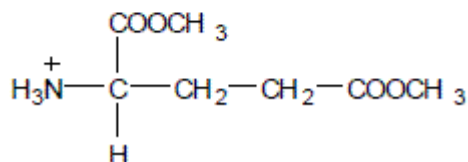
allow NH₂-

1

(ii)



OR



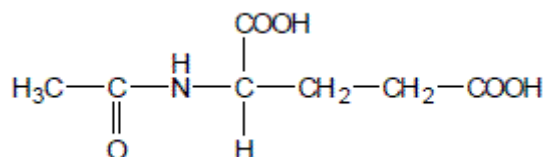
In (e), do not penalise a slip in the number of carbons in the -CH₂CH₂- chain, but all must be bonded correctly

NB two ester groups

allow NH₂- or ⁺NH₃-

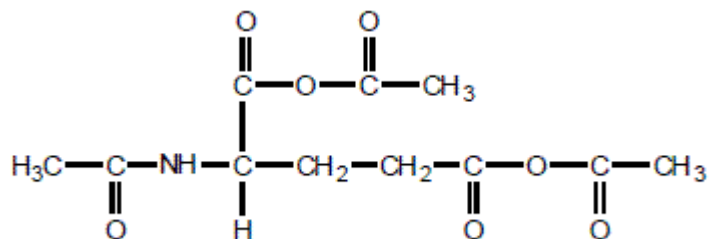
1

(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]