M1.(a) **Wear plastic gloves:**

Essential – to prevent contamination from the hands to the plate

1

Add developing solvent to a depth of not more than 1 cm^3:

Essential – if the solvent is too deep it will dissolve the mixture from the plate

1

Allow the solvent to rise up the plate to the top:

Not essential – the R_f value can be calculated if the solvent front does not reach the top of the plate

1

Allow the plate to dry in a fume cupboard:

Essential – the solvent is toxic

Allow hazardous

1

(b) Spray with developing agent or use UV

1

Measure distances from initial pencil line to the spots (*x*)

1

Measure distance from initial pencil line to solvent front line (*y*)

1

R_f value = *x* / *y*

1

(c) Amino acids have different polarities

1

Therefore, have different retention on the stationary phase or different solubility in the developing solvent

1

[10]

M2.(a) **If 2 stage test for one compound, award no marks for that compound, eg no mark for ROH or RX to alkene then Br_2 test. If reagent is wrong or missing, no mark for that test; if wrong but close/incomplete, lose reagent mark but can award for correct observation. In each test, penalise each example of wrong chemistry, eg $AgClr_2$**

propan-1-ol

acidifiedpotassiumdichromate

sodium

Named acid + conc H_2SO_4

named acyl chloride

PCl_5

M1

1

(orange) turns green

effervescence

Sweet smell

Sweet smell /misty fumes

Misty fumes

M2

1

propanal

add Tollens or Fehlings / Benedicts

acidifiedpotassiumdichromate

Bradys or 2,4-dnph

if dichromate used for alcohol cannot be used for aldehyde

M3 **1**

Tollens: silver mirror or Fehlings/ Benedicts: red ppt

(orange) turns green

Yellow or orange ppt

M4 **1**

propanoic acid

Named carbonate/ hydrogencarbonate

water and UI (paper)

Named alcohol + conc H_2SO_4

sodium or magnesium

PCl_5

if sodium used for alcohol cannot be used for acid

M5 **1**

effervescence

orange/red

Sweet smell

effervescence

Misty fumes

if PCl_5 used for alcohol cannot be used for acid

M6 **1**

1-chloro propane

NaOH then acidified $AgNO_3$

$AgNO_3$

If acidification missed after NaOH,no mark here but allow mark for observation

M7

1

white ppt

white ppt

M8

1

(b) oxidation (of alcohol by oxygen in air)

M1

1

absorption at 1680 -1750 (due to C=O)

Must refer to the spectrum

M2

1

comparison of polarity of molecules or correct imf statement:propanone is less polar OR propan-2-ol is more polarOR propanone has dipole-dipole forcesOR propan-2-ol has hydrogen bonding

M3

1

about attraction to stationary phase or solubility in moving phasePropan-2-ol has greater affinity for stationary phase or vice versaOR propanone is more soluble in solvent/moving phase or vice versa

M4

1

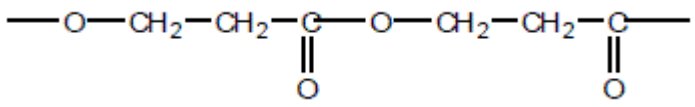
[12]

M3. (a) 3-hydroxypropanoic acid

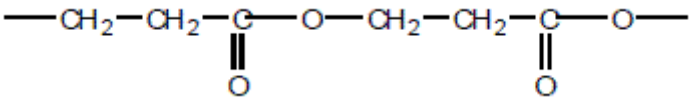
allow 3-hydroxypropionic acid
must be correct spelling

1

(b) (i) must show trailing bonds



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



not allow dimer
allow –O–$CH_2CH_2COOCH_2CH_2CO$–
or –$CH_2CH_2COOCH_2CH_2COO$–
ignore ( ) or n
NB answer has a total of 6 carbons and 4 oxygens

1

(ii) condensation (polymerisation)

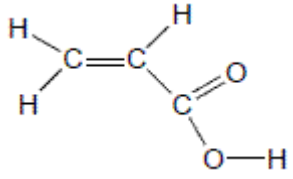
Allow close spelling

1

(c) (i) C=C or carbon-carbon <u>double</u> bond

1

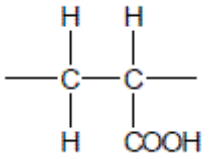
(ii)



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

1

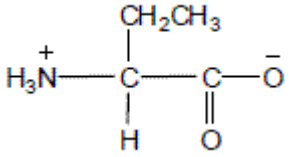
(iii) must show trailing bonds



allow polyalkene conseq on their c(ii)
ignore n

1

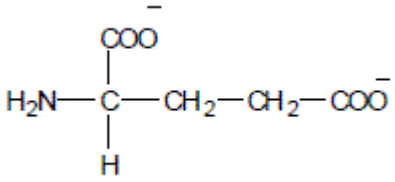
(d)



allow NH_3^+—
allow COO^-

1

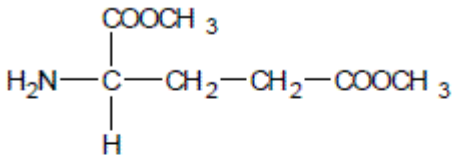
(e) (i)



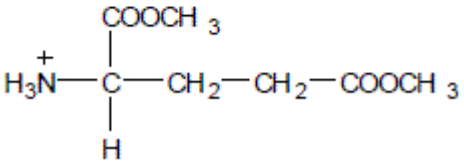
In (e), do not penalise a slip in the number of carbons in the $-CH_2CH_2-$ chain, but all must be bonded correctly
NB two carboxylate groups
Allow COONa or COO^- Na^+ but not covalent bond to Na
allow NH_2–

1

(ii)



OR



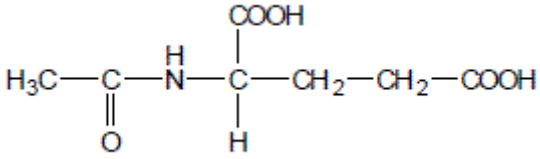
In (e), do not penalise a slip in the number of carbons in the -CH_2CH_2- chain, but all must be bonded correctly

NB two ester groups

allow NH_2– or $^+NH_3$–

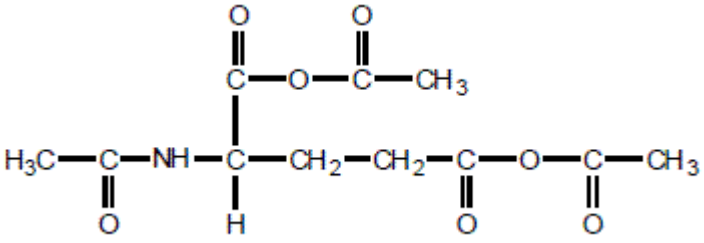
1

(iii)



In 4(e), do not penalise a slip in the number of carbons in the -CH_2CH_2- 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 <u>moving or mobile</u>

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

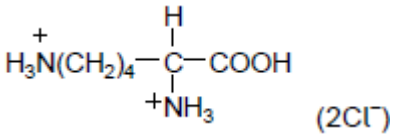
[13]

M4.(a) 2,6-diaminohexanoic acid

Ignore additional , or – or spaces.

1

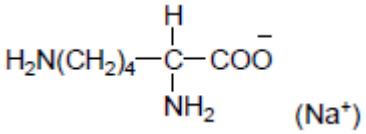
(b) (i)



NB both N must be protonated.
Allow $-NH_3^+$ allow CO_2H Allow $-^+H_3N$.
Penalise – C_4H_8 – here.

1

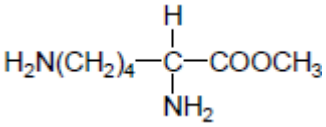
(ii)



Allow CO_2^-.
Allow $-H_2N$.
Allow –COONa but penalise O–Na bond shown.

1

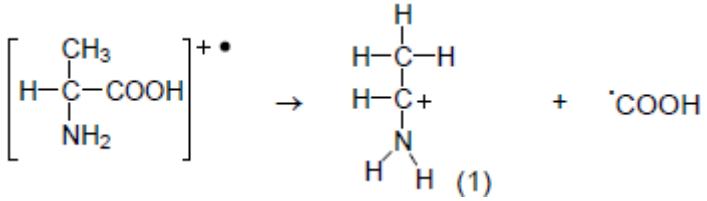
(iii)



Allow CO_2CH_3.
Allow $-NH_3^+$ or $-H_2N$.

1

(c)



(1)

1 for displayed formula of fragment ion.

1 for molecular ion of alanine AND radical.

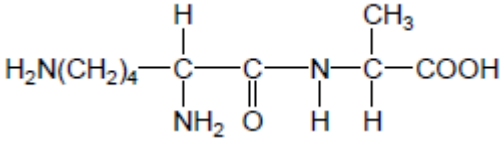
Allow molecular ion without brackets and fragment ion in brackets with outside +.

Allow dot anywhere on radical.

Allow $[C_3H_7NO_2]^{+\bullet}$ for molecular ion.

2

(d)



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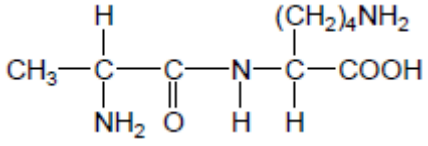

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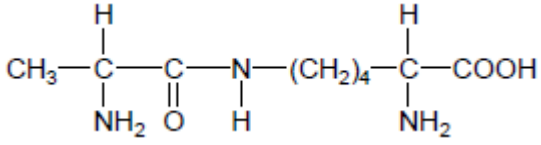

Dipeptide, not repeating unit /.

Allow CO_2H Allow $–H_2N$.

Allow –CONH–.

1

(e) M1 In acid lysine has double positive or more positive charge

1

M2 (Lysine ion) has greater affinity / greater attraction / adheres better / sticks better to polar / stationary phase

M2 only scores after a correct M1.

Ignore greater retention time.

1

[9]

M5.(a) (i) Two rings only around nitrogen or sulfur

Lose this mark if more than 2 atoms are ringed.

Do not allow two atoms at the same end of the ion.

1

(ii) 275.8

Accept this answer only. Do not allow 276

1

(iii) Carboxylate / COO^-

Allow salt of carboxylic acid or just carboxylic acid.

1

(b) (32.1 / 102.1) = 31.4%

Do not penalise precision but do not allow 1 significant figure.

1

(c) Zineb is mixed with a solvent / water

Max=2 if M1 missed

1

Use of column / paper / TLC

Lose M1 and M2 for GLC

1

Appropriate collection of the ETU fraction
OR Appropriate method of detecting ETU

Allow ETU is an early fraction in a column or collecting a

range of samples over time, lowest retention time / travels furthest on paper or TLC (allow 1 mark for having the longest retention time in GLC).

1

Method of identification of ETU (by <u>comparison</u> with standard using chromatography)

If method completely inappropriate, only M1 is accessible

1

[8]