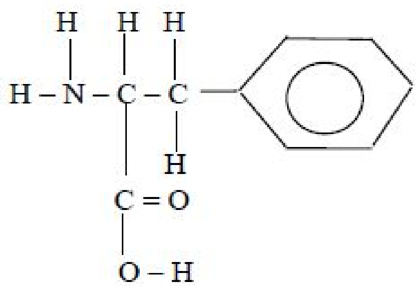
Mark Scheme - 4.7 Amino Acids, Peptides and Proteins

1. (a) Intermolecular bond formed (1) when hydrogen attached to a highly electronegative atom (1) is bonded to an electronegative atom attached to hydrogen (in another molecule) (1) forming a very strong dipole – dipole attraction (1) [3]
(maximum 3 marks)
QWC Legibility of text; accuracy of spelling, punctuation and grammar, clarity of meaning [1]

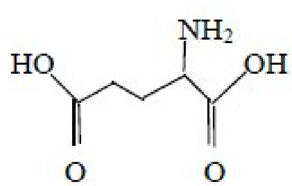
(b)



[1]

(c) Behaves as / can react with an acid or a base (1)
-COOH is an acidic group / donates proton, $-NH_2$ is a basic group / accepts proton (1) [2]

(d)



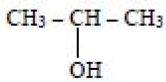
[1]

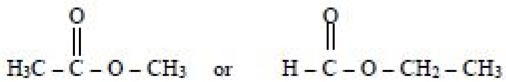
(e) Moles MSG = 1/169.08 = 5.91×10^{-3} (1)
Concentration = 5.91×10^{-3}/ 0.1 = 5.91×10^{-2} (1) [2]

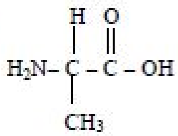
(f) (Neutral) $FeCl_3$ / Br_2 (1)
Purple colour / white precipitate (1) [2]

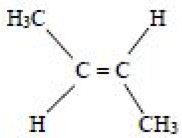
(g) 2,4-Dinitrophenylhydrazine / acidified sodium dichromate (1)
Yellow-orange precipitate / orange to green colour change (1) [2]

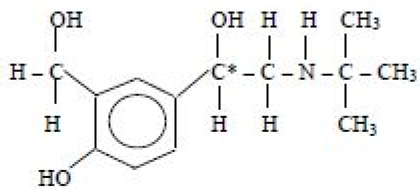
Total [14]

2. (a)(i)  [1]

(ii)  [1]

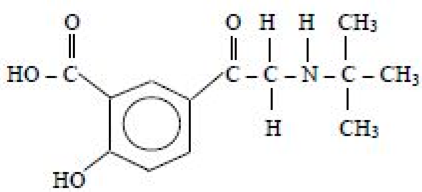
(iii)  [1]

(iv)  (or Z form) [1]

(b)(i)  [1]

(ii) The isomers rotate the plane of polarised light in opposite directions [1]

(iii) Side effects from other optical isomer / lower dose needed / improved pharmacological activity / only one isomer has correct orientation to bind with biological molecule [1]

(iv)  [2]

(1 mark for acid (accept aldehyde), 1 mark for ketone)

(c)(i) Ethylamine, ethanol, phenol, ethanoic acid [1]

(ii) Ethylamine is basic because it accepts a proton readily (1) due to the lone pair of electrons on the nitrogen. (1)
Phenol is acidic because it loses a proton / the anion formed is stabilised (1) by delocalisation of the negative charge over the benzene ring. (1)
(Accept description e.g. in phenoxide ion lone pairs of electrons on oxygen become delocalised with electrons in benzene ring.) [4]

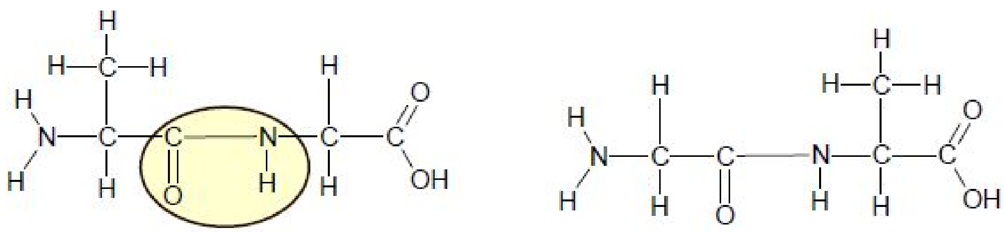
Total [14]

3.

(a) (i) Alanine forms a zwitterion (1)
Forces between alanine molecules are ionic bonding (1)
Ionic bonding much stronger than hydrogen bonding / van der Waals (1)

Max 2 marks [2]

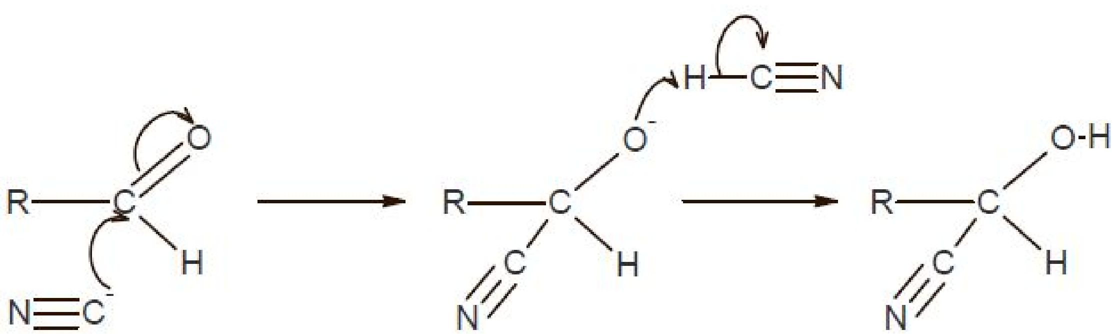
(ii) 1 mark for each correct structure [2]



(iii) 1 mark for correct identification of peptide link [1]

(b) Enzymes / Structural proteins / Hormones or specific example [1]

(c) 1 mark for arrows in first stage; 1 mark for correct intermediate; 1 mark for arrow giving gain of proton in second stage (from HCN or from H^+).



[3]

(d) Soda lime [1]

[10 marks]

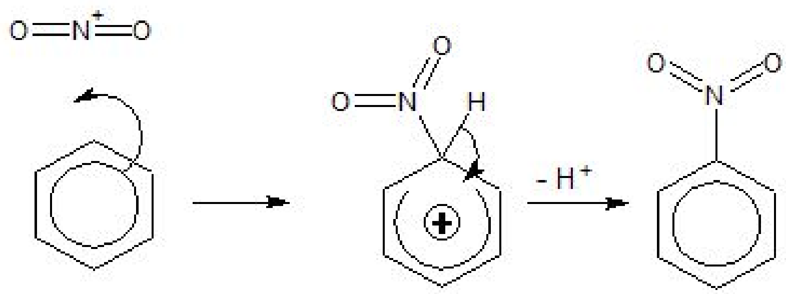
4.

(a) (i) Both molecules have lone pairs on nitrogen (1)

The lone pairs can form (coordinate) bonds with H^+ ions (1) [2]

(ii) Lone pair on N in phenylamine is delocalised over benzene ring (1) therefore less able to accept H^+ (1) [2]

(iii) I Arrow in first step (1)
Cation structure in second step (1)
Arrow in second step (1)

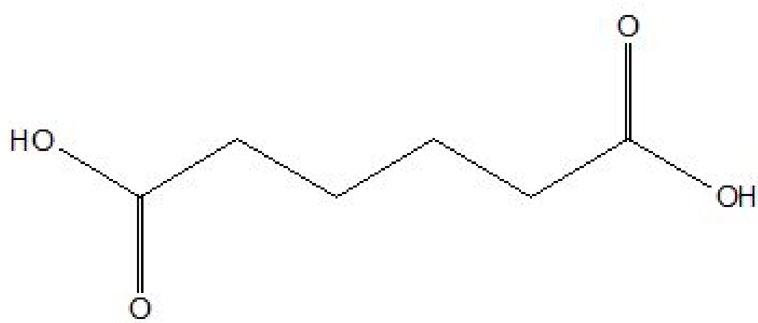


[3]

II (fractional) distillation / steam distillation [1]

III Sn and conc. HCl (1) followed by NaOH (1) [2]

(b) (i)



[1]

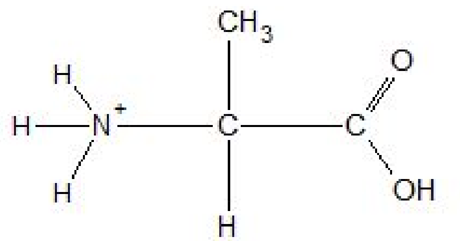
(ii) Addition polymerisation makes one product only /
Condensation produces one product plus a small molecule like water (1)

Addition polymerisation uses one starting material /
Condensation polymerisation has two different starting materials (1)

Addition polymerisation involves monomer with one functional group /
Condensation polymerisation involves monomer with two functional groups (1)

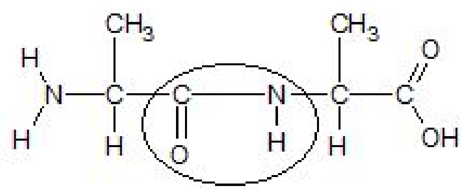
(max 2) [2]

(c) (i)



[1]

(ii)



[2]

(iii) Alanine has strong (electrostatic) forces between the zwitterions (1)

Butanoic acid has hydrogen bonding between molecules / electrostatic forces in alanine are stronger than forces in butanoic acid (1)

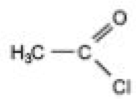
[2]

(iv) Soda lime (1) $CH_3CH_2NH_2$ (1) [2]

Total [20]

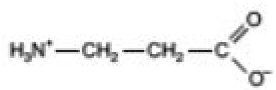
5.

(a) (i) Sodium / potassium cyanide [1]

(ii) 

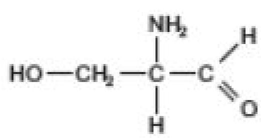
[1]

(iii) Sulfuric / hydrochloric acid [1]

(iv) 

[1]

(v) eg



[1]

(vi) $LiAlH_4$ / H_2 / sodium, ethanol [1]

(vii) The nitrogen atoms act as electron pair donors / proton acceptors [1]

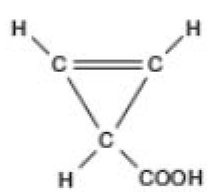
(b) (i) Molecular formula is $C_4H_4O_2$ [1]

(ii) 3 [1]

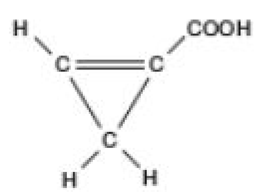
(iii) C = C / alkene [1]

(iv) Two of the (remaining) protons are in equivalent environments (and one is not) / there are CH and CH_2 present [1]

(v) Possibilities



OR



[1]

Total [12]

6.

(a) (i) The **nitrogen atom** has a **lone pair** of electrons making it an electron pair donor / proton acceptor **[1]**

(ii) Compound L must contain the grouping  (1)

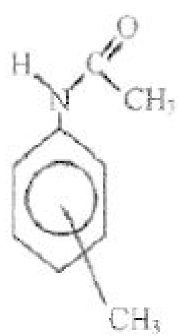
The nitrogen atom must be bonded directly to the ring as a (primary) aromatic amine is formed on hydrolysis (1)

As the hydrolysis compound is a phenol (and has an OH group directly bonded to the ring) a methyl group must also be bonded directly to the ring, as the molecular formula is C_7H_8O / the compound has the structure

(1)

The compound is likely to be an amide, as these are hydrolysed by bases to amines (1)

A suggested formula is



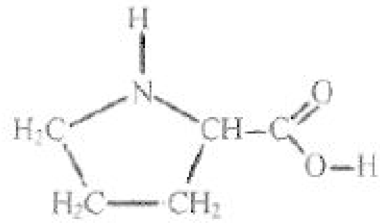
(1)

which is $C_9H_{11}NO$, an isomer of cathinone / has M_r of 149(1)

[6]

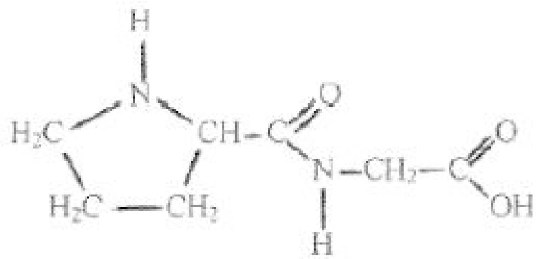
QWC Information organised clearly and coherently, using specialist vocabulary where appropriate *QWC* **[1]**

(b) (i)

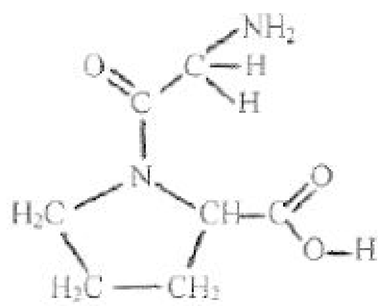

H
N
H₂C
CH–C
O
O–H
H₂C
CH₂

[1]

(ii)

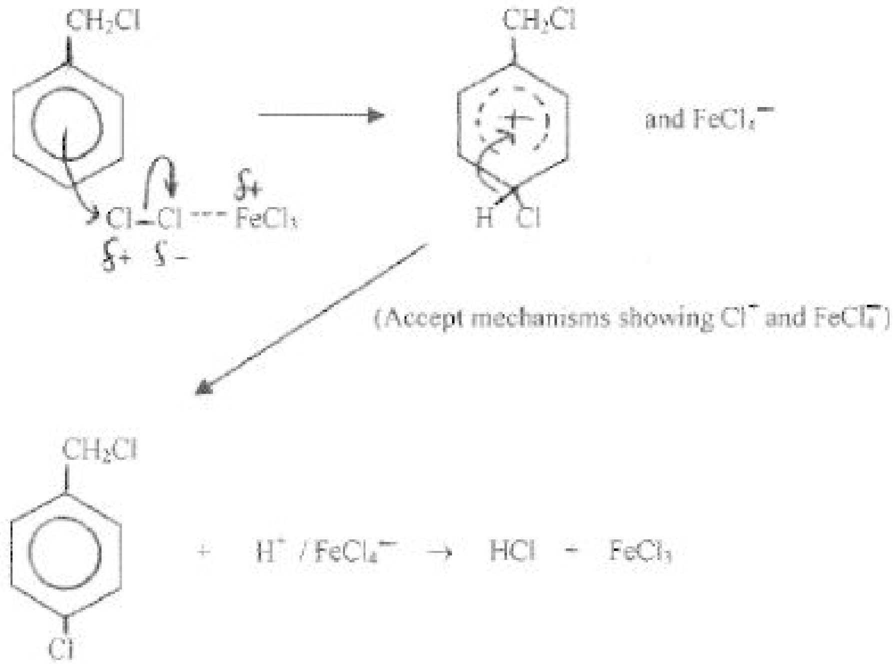

H
N
H₂C
CH–C
O
N–CH₂–C
O
OH
H
H₂C
CH₂

OR


NH₂
O
C
H
H
C
N
H₂C
CH–C
O
O–H
H₂C
CH₂

[1]

(c) (i)



Correct catalyst (1)

Correct curly arrows and polarisation / formation of Cl^+ (1)

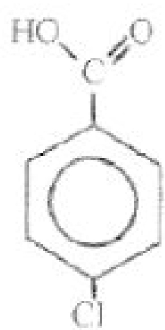
Wheland intermediate (1) Production of HCl and regeneration of $FeCl_3$ (1)

[4]

(ii) Volume of sodium hydroxide solution needed (1)
How long to reflux (1) **[2]**

(iii) The aromatic C – Cl bond is stronger than the aliphatic C – Cl bond (1)
This is because a p-electron(s) of the chlorine atom in the aromatic compound becomes part of / incorporated into the delocalised π system of the ring (1) **[2]**

(iv)



(1)

chlorine has two isotopes 35/37 in a 3:1 ratio (1)

[2]

Total [20]