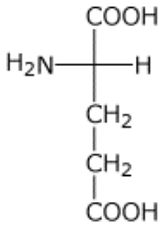
Revision –organic pathways, naming, analytical and food chemistry.

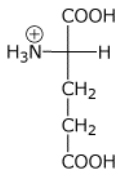
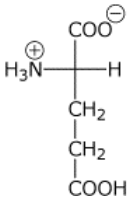
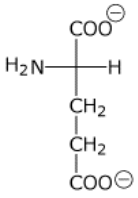
1. Consider glutamic acid, shown on the right.



   a. Give the IUPAC name for this amino acid

   2-aminopentandioic acid.

   b. Given that glutamic acid has an isoelectric point of pH 3.2, draw the dominant structure of the molecule in the solution of the given pH in the space provided on the right.

pH = 1	pH = 3.2	pH =10
		

   c. A 4.23 g tablet, claiming to contain 53 %m/m glutamic acid ($C_5H_9NO_4$), is dissolved in a 200 mL volumetric flask and made to the mark with distilled water. A 20.00 mL aliquot was transferred from the volumetric flask to a conical flask and titrated against a 0.152 M NaOH. An average titre of 22.15 mL was obtained.

      i. Write a balanced chemical equation, with states, for the reaction that occurs in the conical flask between glutamic acid and NaOH.

      $C_5H_9NO_4(aq) + 2NaOH \rightarrow Na_2C_5H_7NO_4(aq) + 2H_2O(l)$

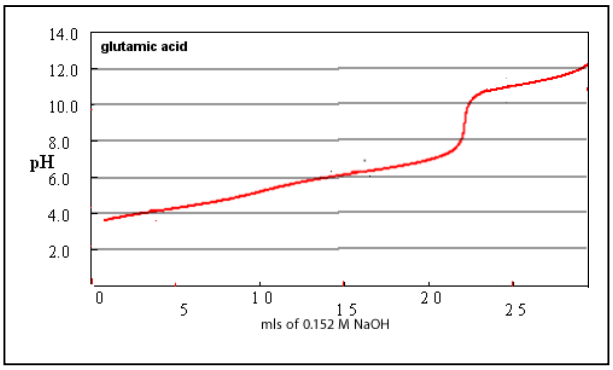
      ii. Calculate the amount, in mol, of NaOH present in the average titre.
      Mol = C X V = 0.152 X 0.02215 = 3.367 X 10^{-3}mol

      iii. Calculate the amount, in mol, found in the volumetric flask.
      Mol of glutamic acid found in the conical flask
      = ½ X 3.367 X 10^{-3}
      = 1.6835 X 10^{-3}mol

      => Mol of glutamic acid found in the volumetric flask
      => (200/20) X 1.684 X 10^{-3} mol = 1.684 X 10^{-2} mol

      iv. Calculate the content of glutamic acid in the tablet in %m/m to the right number of significant figures.
      mass of glutamic acid in the tablet
      => mass = 147.13 g/mol X 1.684 X 10^{-2} mol = 2.4777 grams
      => %m/m = (2.4777 / 4.23) X 100 = 58.6%m/m

d. The pH curve of the titration is shown on the right.



i. From the data booklet select an indicator that is best to use in this titration. *Phenolphthalein*

ii. What is the colour change expected from the selected indicator in I. above?
Clear to pink

e. Suggest how your answer to the %m/m of glutamic acid in the tablet would change if the following took place. Justify your suggestion**. Greater than, less than**, or **no change**

i. Phenol red was used as the indicator

Phenol red will change colour at a pH 6.8 and hence the end point will not be reflective of the equivalence point. A lower volume titre will indicate a lower %m/m.

ii. The volumetric flask was rinsed with distilled water

No change to the %m/m calculated. Since distilled water is used to fill the volumetric flask to the mark it doesn't matter that water is present in the flask.

iii. Distilled water was used to rinse the 20 mL pipette used to deliver the sample from the volumetric flask to the conical flask.

Lower calculate %m/m . Dilution of this volume of sample will deliover less of the sample into the conical flask and hence take a lower titre to reach the end point.

iv. A volume of 0.152 M NaOH was used to rinse out the burette prior to the titration.

No change to the calculated %m/m. It is good practice to rinse the burette with the solution used to fill it.

v. Distilled water was used to rinse the conical flask prior to transferring the 20.00 mL sample into the flask.
No change to the calculated %m/m. Since an accurate volume of 20.00 mL was delivered into the conical flask the end point will reached at the correct point in the titration.

2. Consider the organic pathway shown below.

a. Given that substance Q has the empirical formula C_2H_4O and it's ^{1}HNMR, IR and MS are shown on the next page, identify the following

i. Q
butanoic acid

ii. W
1-chlorobutane

iii. Z
2-chlorobutane

iv. J
but-1-ene

v. L
butan-1-amine

vi. X
Butan-2-ol

vii. Reagent 1
$Cr_2O_7^{-2}/H^+$ or MnO_4^-/H^+

viii. Reagent 2
$Cr_2O_7^{-2}/H^+$ or MnO_4^-/H^+

b. Identify the class of reactions represented by:

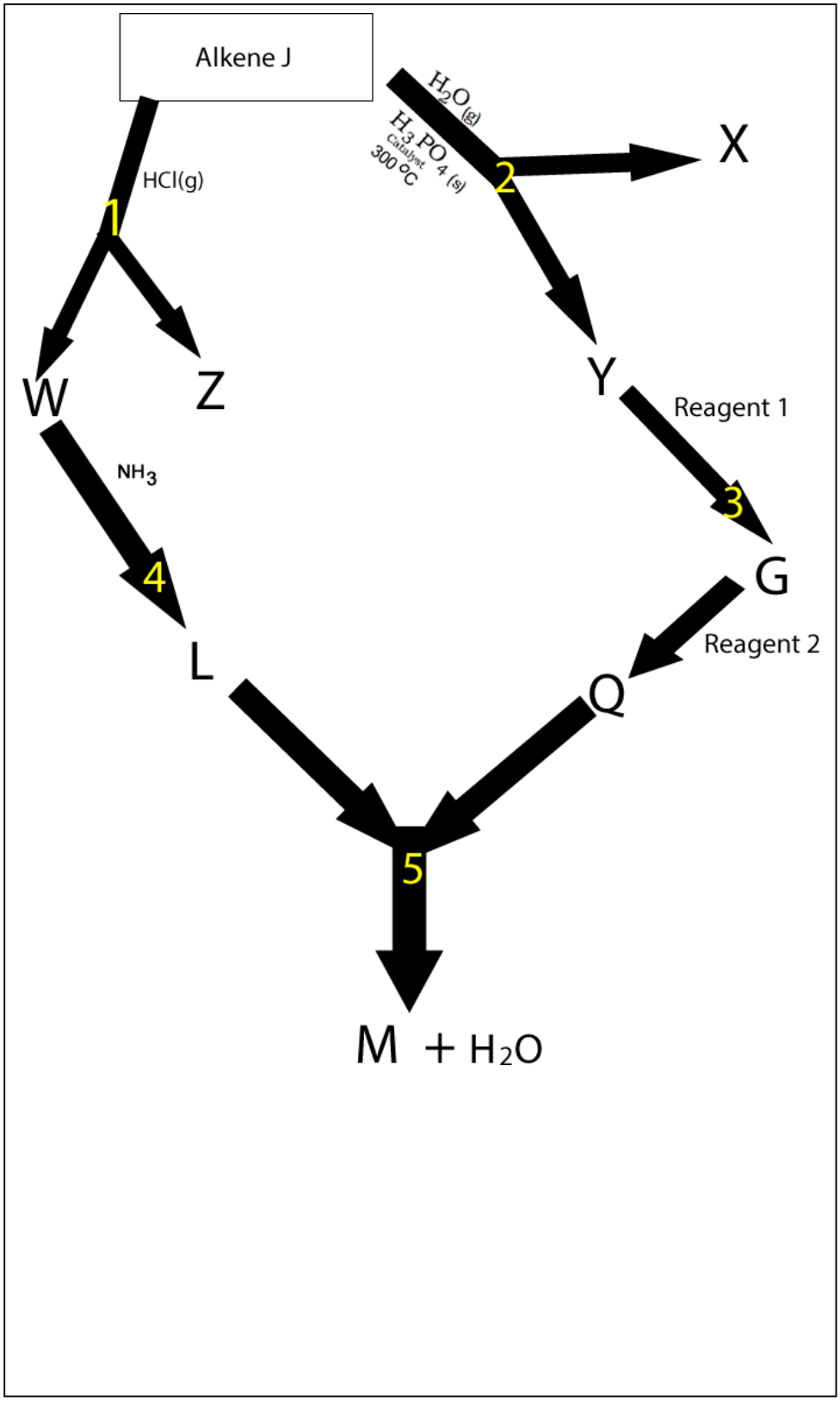
i. 1
Addition

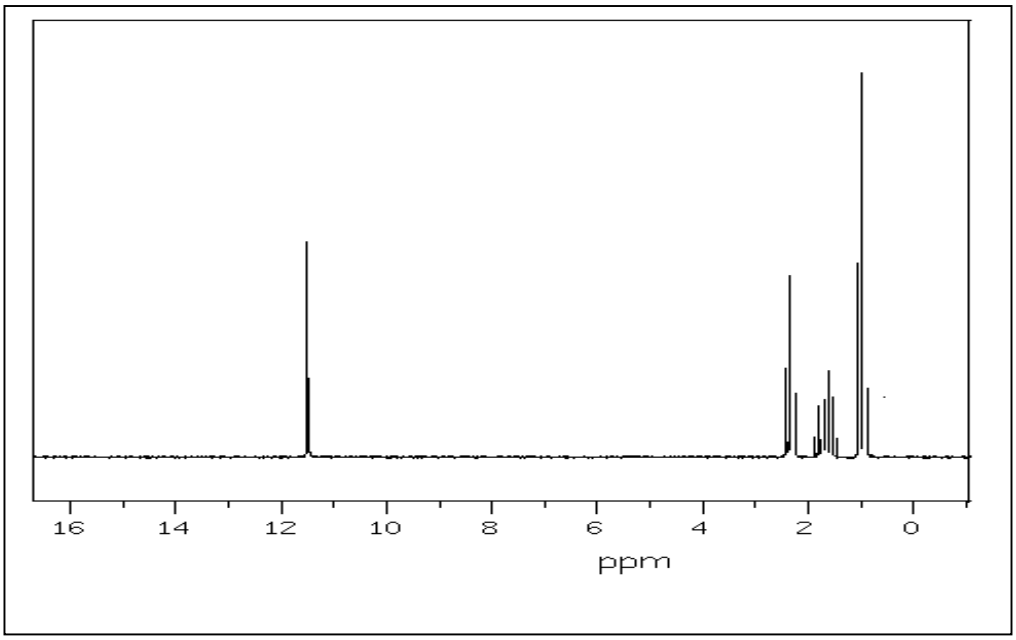
ii. 2
Addition

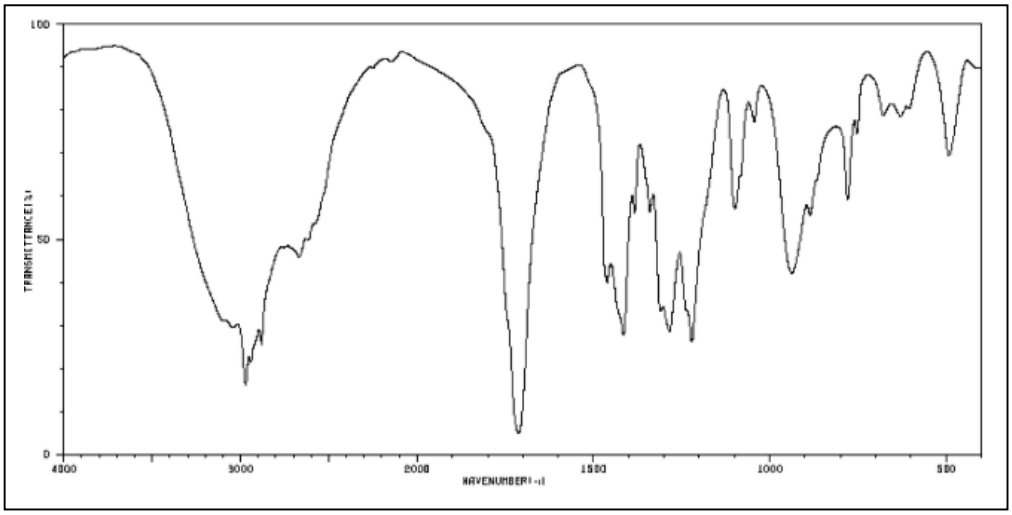
iii. 3
Oxidation

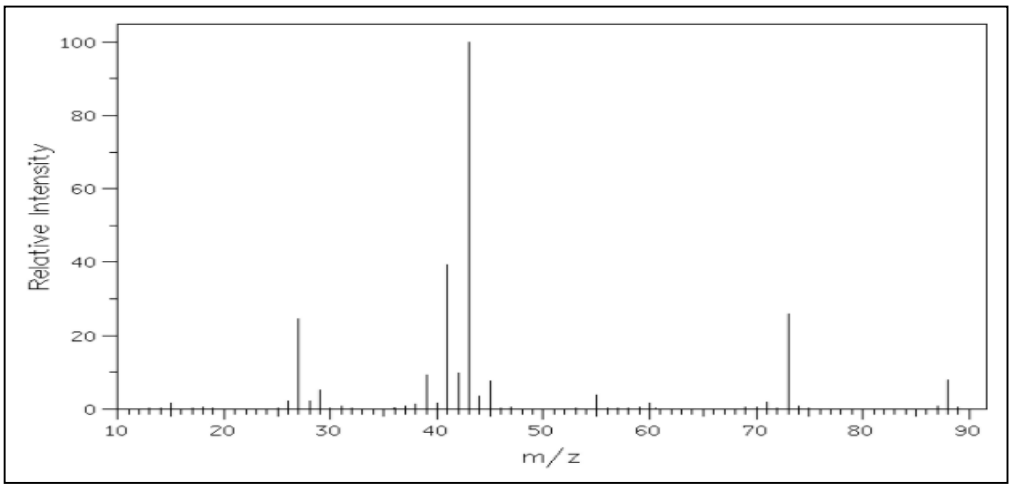
iv. 4
Substitution

v. 5
Condensation




16
14
12
10
8
6
4
2
0
ppm


100
50
0
4000
3000
2000
1500
1000
500


Relative Intensity
100
80
60
40
20
0
10
20
30
40
50
60
70
80
90
m/z

3. Consider the information given by the 3 spectra of compound Q.

i. What information can be derived from the parent ion peak of the mass spectrum of compound Q? *Formula mass*

ii. Give the molecular formula of Q

$C_4H_8O_2$

iii. Give a possible fragment that caused the base peak.

$CH_3CH_2CH_2^+$

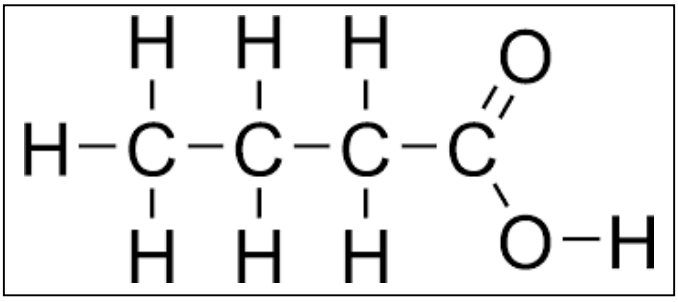
iv. What information can be derived from the IR spectrum as to the class of compounds that Q belongs to?

A broad absorption trough from 2500 to 3500 is indicative of acidic OH.
Absorption at 1680-1740 is indicative of acidic C=O.

v. How many hydrogen environments exist in compound Q?

4

vi. Draw the structural formula of compound Q



vii. Give the semi-structural formula of compound L

$CH_3CH_2CH_2CH_2NH_2$

viii. Give the semi-structural formula of compound M, circle and name one functional group present in the molecule.

$CH_3CH_2CH_2CH_2NHOCCH_2CH_2CH_3$

Amide group