Trial Exam

Unit 3 VCE

Chemistry

Student name _____

Question and answer book

Reading time 15 minutes

Writing time: 1 hour and 30 minutes

Structure of book

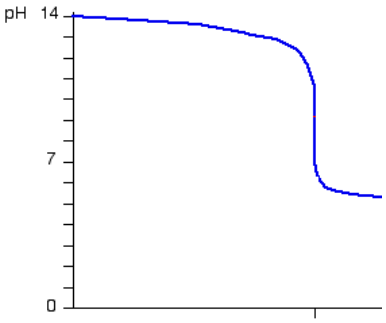
Section	Number of questions	Number of marks
A	25	25
B	5	59

ANSWER SHEET PART A: **NAME**_____

1.	A	B	C	D	**16.**	A	B	C	D
2.	A	B	C	D	**17.**	A	B	C	D
3.	A	B	C	D	**18.**	A	B	C	D
4.	A	B	C	D	**19.**	A	B	C	D
5.	A	B	C	D	**20.**	A	B	C	D
6.	A	B	C	D	**21.**	A	B	C	D
7.	A	B	C	D	**22.**	A	B	C	D
8.	A	B	C	D	**23.**	A	B	C	D
9.	A	B	C	D	**24.**	A	B	C	D
10.	A	B	C	D	**25.**	A	B	C	D
11.	A	B	C	D					
12.	A	B	C	D					
13.	A	B	C	D					
14.	A	B	C	D					
15.	A	B	C	D					

Circle the correct response to each question on the answer sheet.

1) A solution was analysed by titration. The pH curve is shown on the right. Which one of the following comments is most likely correct?
   a) A solution of strong base is titrated against a weak acid.
   b) A concentrated solution of hydrochloric acid is titrated against a weak base.
   c) A solution of NaOH is titrated against a 4.5M HCl solution.
   d) A concentrated solution of NaOH is titrated against a dilute solution of NaOH.



2) Which indicator should be used for this titration?
   a) Phenol red.
   b) Bromophenol blue
   c) Methyl orange
   d) Phenolphthalein

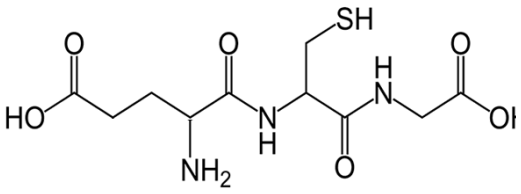
3) 1.50 grams of thymine ($C_5H_6N_2O_2$) would contain:
   a) 0.333 grams of nitrogen
   b) 0.33 grams of nitrogen
   c) 0.300 grams of oxygen
   d) 0.3 grams of oxygen

4) Serotonin is a compound that conducts nerve impulses in the brain and muscles. Each molecule has 12 hydrogen atoms and contains 6.82% hydrogen by mass. Its formula mass is:
   a) 176;
   b) 233;
   c) 156;
   d) Cannot be calculated from the information given.

5) A 3.00g sample of hydrated copper sulphate is strongly heated to a constant mass of 1.68g. Which one of the following options represents the formula of the hydrated sample of copper sulphate.
   a) $CuSO_4.3H_2O$
   b) $CuSO_4.5H_2O$
   c) $CuSO_4.6H_2O$
   d) $CuSO_4.7H_2O$

6) Ethane burns in oxygen according to the equation below.
   $2C_2H_6(g) + 7O_2(g) => 4CO_2(g) + 6H_2O(g)$
   If 30.0 grams of ethane is mixed with 32.0 grams of oxygen gas which comment below is true?
   a) 2/7 mol of ethane remain unreacted.
   b) 7/2 mol of oxygen remain unreacted.
   c) 5/7 mol of ethane remain unreacted
   d) 5/7 mol of oxygen remain unreacted

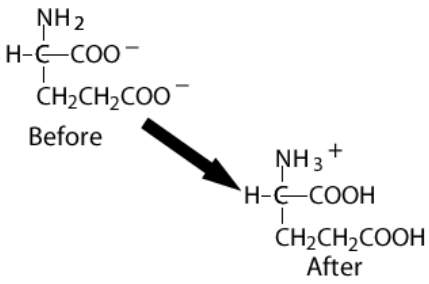
7) A small peptide is shown on the right.
   What amino acids formed it?
   a) Alanine, threonine, cysteine, glycine.
   b) Glutamic acid, cysteine, glycine.
   c) Alanine, glutamic acid, cysteine, glycine.
   d) Alanine, threonine, cysteine.



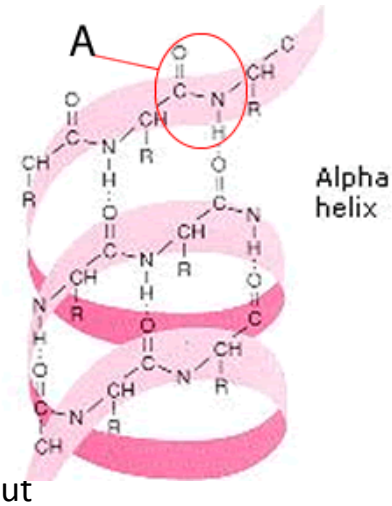
8) What option best describes the process by which the small peptide in question 7) above was formed?
   a) Hydrolysis
   b) Esterification polymerisation
   c) Oxidation
   d) Condensation polymerisation

9) Glutamic acid is placed in a solution of unknown pH. The pH of the solution is then changed and the structure of glutamic acid determined by analysis. The structure of glutamic acid before the change in pH and after is shown on the right. The original solution of glutamic acid is most likely:

a) at a pH of 10 and changes to a pH of 3;
b) at a pH of 10 and changes to a pH of 14;
c) at a pH of 2 and changes to a pH of 7;
d) neutral.



Questions 10 and 11 refer to the structure shown on the right.



10) The image on the right represents:

a) the secondary structure of a polypeptide brought about by hydrogen bonding;
b) the primary structure of a nucleic acid brought about by hydrogen bonding;
c) the tertiary structure of a nucleic acid brought about by disulphide links;
d) the tertiary structure of a polypeptide brought about by ionic, covalent and hydrogen bonding.

11) The functional group labelled “A” is known as:

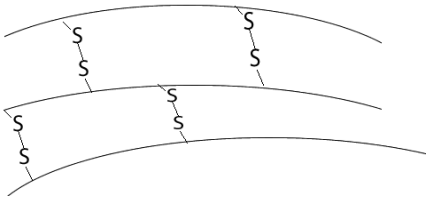
a) an ether link produced by a carboxyl and an amine functional group;
b) an ester link produced by a hydroxyl and a carboxyl functional group;
c) an amide link produced by an amino and a carboxyl functional groups;
d) an ether link produced by a two hydroxyl functional groups.

12) An enzyme works best at 37^{o}C causing the breakdown of a particular fat. When heated to 50^{o}C the enzyme no longer functions . Which is the likely reason?

a) The ionic and covalent bonds holding the helical structures of the enzyme together have been disrupted.
b) Covalent bonds have been disrupted, damaging the secondary structure of the enzyme.
c) Covalent bonds have been disrupted, damaging the primary structure of the enzyme.
d) Hydrogen bonds holding the tertiary structure of the enzyme in place have been disrupted.

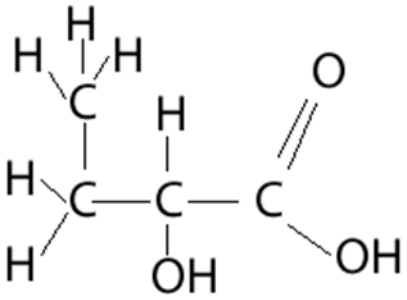
13) An enzyme in the body is made up of 100 amino acids and its structure is shown below.
How many (CONH) functional groups are present in the enzyme?

a) 100
b) 97
c) 99
d) 50



14) What is the correct systematic name of the compound on the right?

a) 3-methyl-2-hydroxypropanoic acid
b) 2- hydroxybutanoic acid
c) 1-methyl-2-hydroxypropanoic acid
d) 1-methyl-2-hydroxybutanoic acid



15) Which one of the following analytical techniques can be used to isolate and identify an unknown organic compound and determine its concentration?

a) High pressure liquid chromatography.
b) Atomic absorption spectroscopy
c) ^{1}H NMR
d) UV-Visible spectroscopy

16) Which one of the following cannot be used to investigate the molecular structure of a complex organic molecule?

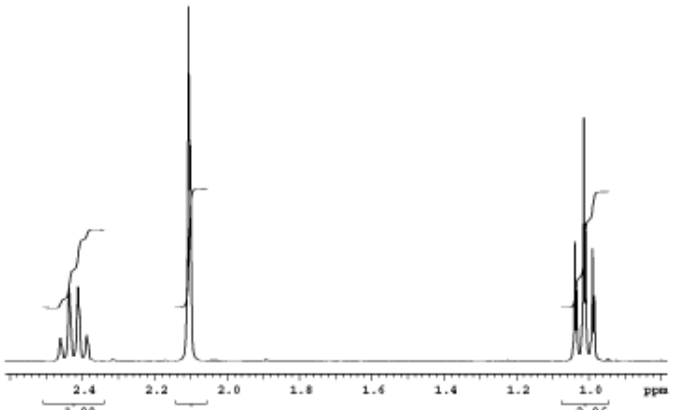
a) Infrared spectroscopy
b) Mass spectroscopy
c) UV-Visible spectroscopy
d) ^{13}C NMR spectroscopy

17) For analysis, a hydrocarbon is placed in a strong magnetic field and irradiated with electromagnetic radiation in the radio wave frequency. This is most likely to:

a) cause ionisation and fragmentation of the parent molecule;
b) cause electrons to become excited and jump to higher energy levels;
c) increase the bond vibration of the molecule;
d) cause a change in the energy state of nucleons.

18) The ^{1}H NMR spectrum of an organic molecule is shown below. Which one of the following options is most likely to form the spectrum shown?

a) $CH_3CHOHCH_3$
b) $CH_3COCH_2CH_3$
c) $CH_3COOCHCH_2$
d) $(CH_3)_2CH_2$



19) Which of the following techniques can be used to obtain the ratio of U^{235} and U^{238} isotopes in a sample of uranium ore?

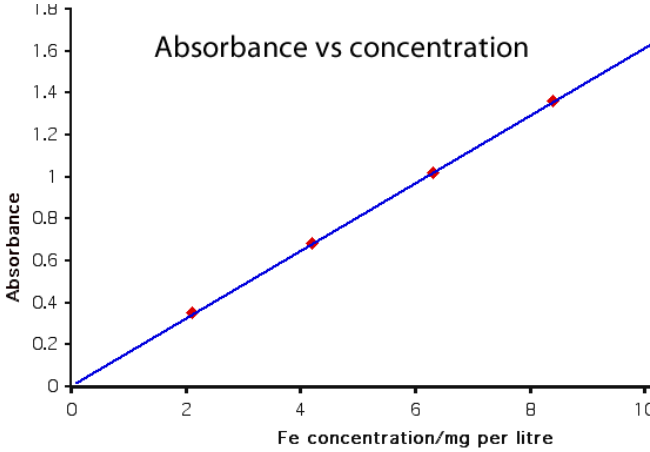
a) Gas-liquid chromatography and a suitable detector
b) UV-Visible spectrometry
c) Mass spectrometry
d) Atomic absorption spectrometry

20) The concentration of Fe^{2+} in a sample of drinking water is to be analysed using atomic absorption spectroscopy. Which one comment is true?

a) A set of standard solutions of Fe^{2+} will need to be prepared and an iron lamp will need to be used.
b) A source of white light is needed, the intensity of which will increase as it passes through the solution.
c) A copper lamp is used as well as standard solutions of Fe^{2+}.
d) High energy electrons are used to vaporise the sample.

21) A graph of the relationship between absorbance and concentration of Fe is shown below. What is the concentration of Fe if the absorbance of the solution is 1?

a) 60 ppm
b) 6 ppm
c) 6.0×10^{-4} g/mL
d) Cannot be calculated without knowing the volume of the sample.



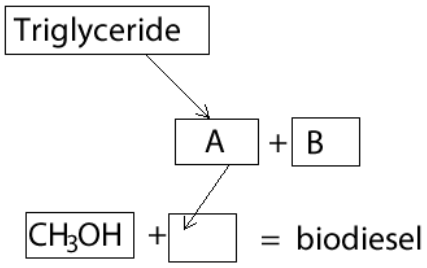
22) A student was given colourless liquids that were labelled A, B, C and D. They were known to be ethanol, ethanoic acid, pentane and hexene, but the exact identity of each liquid was unknown.
The student tested the properties of three of the liquids and obtained the results shown below. Identify each of the liquids.

	A	B	C
Solubility in water	insoluble	soluble	soluble
Addition of red-coloured bromine (Br_2) solution	colour disappears	no immediate reaction	no immediate reaction
Addition of sodium carbonate (Na_2CO_3) powder	no reaction	gas evolved	no reaction

a) A is hexane, B is ethanoic acid and C is ethanol
b) A is hexane, B is ethanol and C is ethanoic acid
c) A is ethanoic acid, B is hexane and C is ethanol
d) A is ethanoic acid, B is ethanol and C is hexane

23) The formation of biodiesel is summarised in the diagram below.
Which comment is true?

a) A is most likely glycerol.
b) B is most likely an ester.
c) The reaction to form A and B from a triglyceride is known as a hydrolysis reaction.
d) The reaction that produces biodiesel is an oxidation reaction.



24) An ether link is most likely found in:

a) nucleic acids and is formed between two carboxyl functional groups;
b) proteins and is formed in an esterification reaction ;
c) carbohydrates and is formed in a condensation reaction;
d) proteins and is formed in an oxidation reaction.

25) A compound was analysed and was found to contain the following composition by mass. Carbon 47.62%, hydrogen 4.76%, nitrogen 22.22% and oxygen 25.40%. This compound has the empirical formula:

a) $C_5H_6N_2O_2$
b) $C_5H_5NO_2$
c) $C_5H_7N_2O_2$
d) $C_5H_5NO_3$

SECTION B –Short answer questions

Question 1

The amount of vitamin C in a brand of orange juice can be determined by titration with a standard iodine solution. Iodine reacts with vitamin C according to the equation below.

$$C_6H_8O_6\ (aq) + I_2(aq) \Rightarrow C_6H_6O_6\ (aq) + 2H^+(aq) + 2I^-(aq)$$

A 25.00 mL sample of juice is placed in a 250 mL volumetric flask and made to the mark with distilled water. 20.00 mL aliquots are then placed in a conical flask and titrated against a 1.45 X 10^{-3} mol/L I_2 solution. Four titrations are carried out and the results recorded in the table below.

	1	2	3	4
Titre	18.95	19.05	18.99	17.01

a) Write a balanced half equation for the oxidation of vitamin C.

2 marks

b) What is the average titre?

1 mark

c) Calculate the amount, in mol, of vitamin C present in the 20.00 mL aliquot.

2 marks

d) Calculate the amount, in mol, of vitamin C in the original orange 25.00 mL sample.

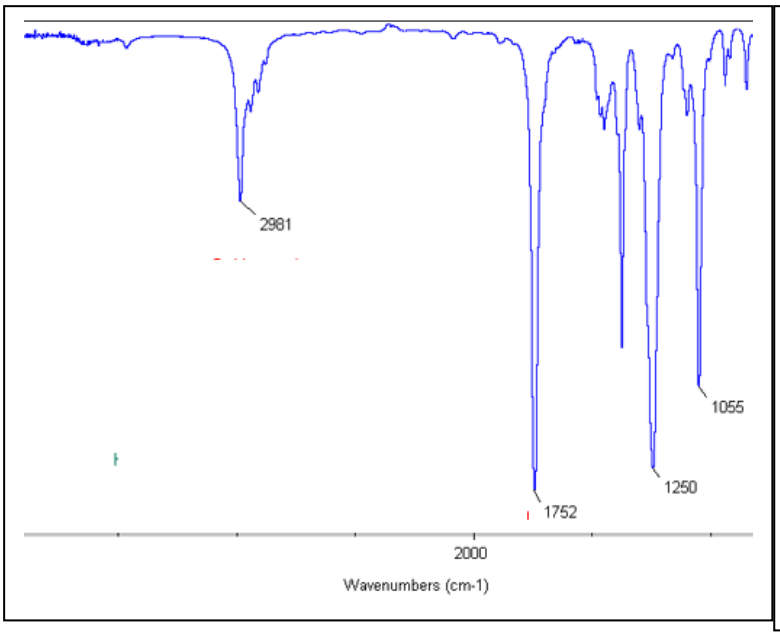
1 mark

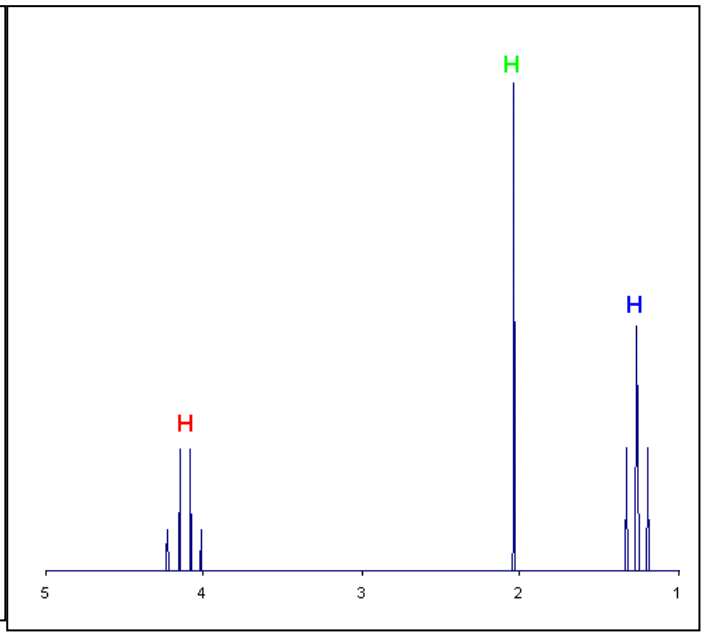
e) Calculate the concentration, in grams/Litre, of vitamin C in the original juice, to the right number of significant figures.

2 marks

Question 2

A molecule with the formula $C_4H_8O_2$ is analysed using IR spectroscopy and ^1H NMR spectroscopy as shown below.





Analysts suspect the presence of three isomers. Isomer "A" reacts with Na_2CO_3 to produce carbon dioxide while isomer "B" and "C" are synthesised when a primary alcohol and a carboxylic acid react.

a) Draw the structural formulae of the three isomers, showing all bonds.

Isomer A	Isomer B	Isomer C

2+2+2= 6 marks

b) i) Consider the IR spectrum of this molecule. What bond is indicated at wavenumber 1752?

1 mark

ii) The IR spectrum can be used to exclude which isomer ?

1 mark

SECTION B Question 2 -continued

c) i) Which alkyl group gave rise to the triplet in the ^{1}H NMR spectrum?

1 mark

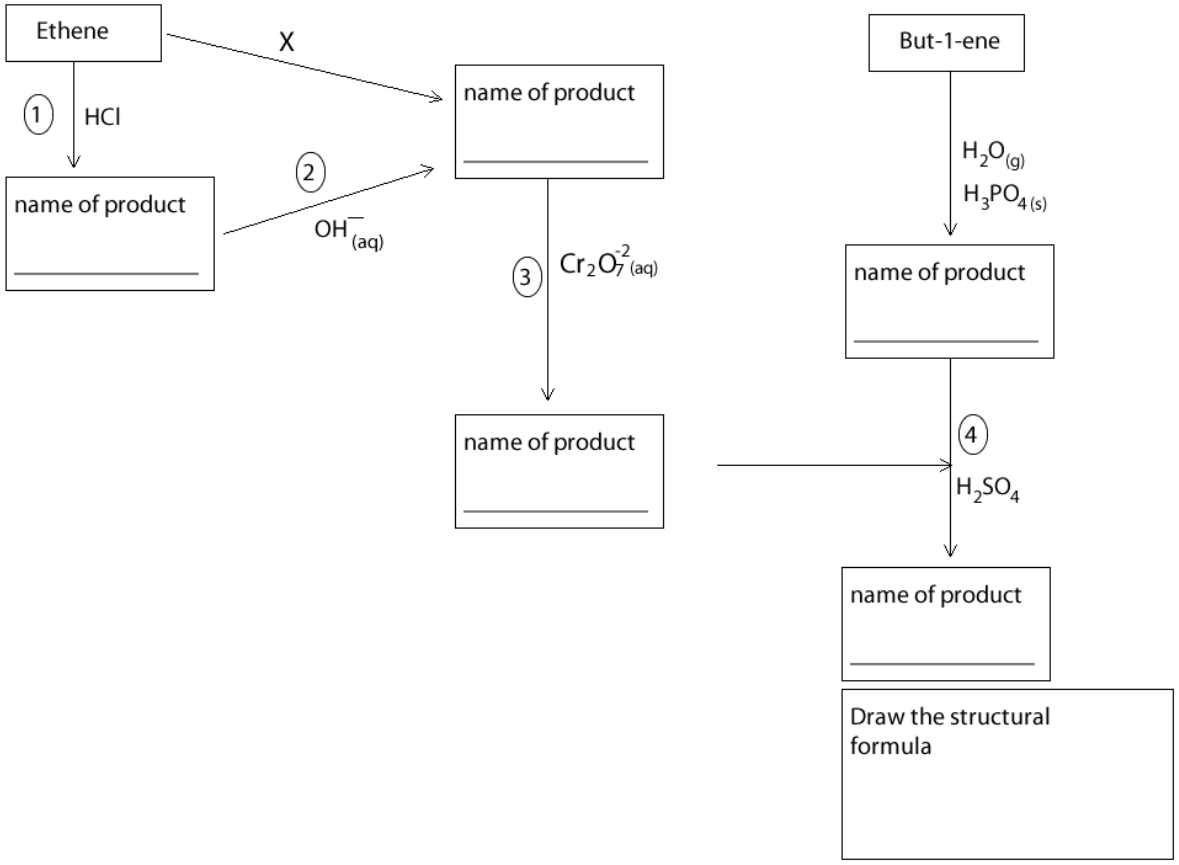
ii) Which alkyl group gave rise to the quartet in the ^{1}H NMR spectrum?

1 mark

d) Using your knowledge of *chemical shift, nuclear shielding* and the ^{1}H NMR spectrum above identify the isomer present. Give a reason

2 marks

Question 3



a) Fill the boxes on the diagram above. 6 marks

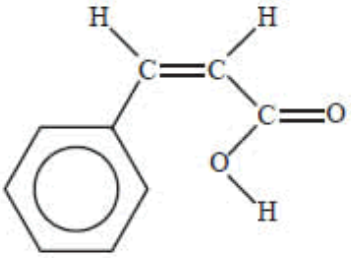
b) Using the words , condensation, addition, oxidation, reduction, or substitution label the numbered reactions.

1) _____ 2) _____ 3) _____ 4) _____

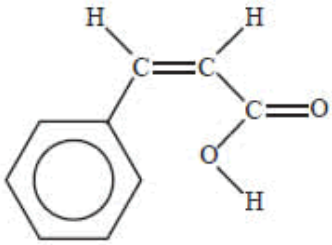
4 marks

SECTION B Question 3-continued

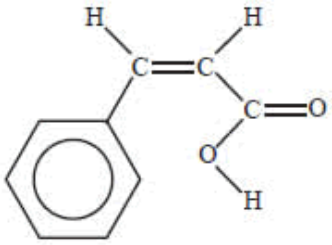
c) Cinnamic acid is an organic acid that contributes to the flavour of cinnamon. Its structure is shown below. Draw structural formulae for the organic products and chemical formulae for all other products formed in the following reactions.



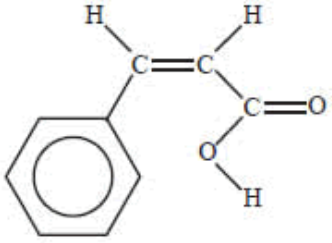
i)



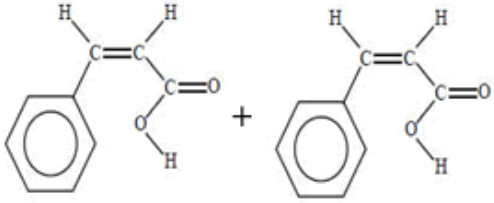
ii)



iii)



iv)



2+2+2+2=8 marks

i) Ethanol is a carbon neutral source of energy. It is formed naturally from glucose, a product of photosynthesis.
What is meant by the term carbon neutral?

1 mark

ii) Give three balanced equations of reactions that show ethanol as being carbon neutral

a) Production of glucose through photosynthesis

b) Production of ethanol in fermentation

c) Complete combustion of liquid ethanol

d) How many CO_2 molecules are consumed per glucose molecule?

e) How many CO_2 molecules are produced per glucose molecule in the formation and burning of ethanol?

2+2+2+1+1=8 marks

Question 4

0.415 g of a pure acid, $H_2X(s)$, is added to exactly 100 mL of 0.105 M NaOH(aq). A reaction occurs according to the equation

$H_2X(s) + 2NaOH(aq) \rightarrow Na_2X(aq) + 2H_2O(l)$

The NaOH is in excess. This excess NaOH requires 25.21 mL of 0.197 M HCl(aq) for neutralisation. Calculate

i. the amount, in mol, of NaOH that is added to the acid H_2X initially.

2 marks

ii. the amount, in mol, of NaOH that reacts with the acid H_2X

2 marks

iii. The molar mass, in g/mol, of the acid H_2X.

2 marks

Question 5

Potassium permanganate ($KMnO_4$) is a strong oxidant. In a certain reaction 5.78 grams of chromium(II) sulphate reacted exactly with 37.60 mL of 0.265 M $KMnO_4$. During this reaction the Cr^{2+} ions were oxidised to Cr^{3+}.

a) To what oxidation state was Mn^{7+} converted to?

3 marks

b) MnO_4^- is used as an oxidant to convert propan-1-ol, in solution, to propanoic acid and in the process forming Mn^{2+} ions.

   i) Give the oxidation half equation for this reaction.

   ii) Give the reduction half equation for this reaction.

   iii) Give the balanced overall equation for this reaction

1+1+1=3 marks

End of question and answer book