CSE CENTRE FOR STRATEGIC EDUCATION
Leading educational thinking and practice

IARTV

STUDENT:	TEACHER:

CSE TEST – MAY 2012

YEAR 12 CHEMISTRY

Written test 1

Reading time: 15 minutes
Writing time: 1 hour 30 minutes

QUESTION AND ANSWER BOOK

Structure of book

Section	*Number of questions*	*Number of questions to be answered*	*Number of marks*
A	20	20	20
B	8	8	60
			Total 80

- Students are permitted to bring into the test room: pens, pencils, highlighters, erasers, sharpeners, rulers and one scientific calculator.
- Students are NOT permitted to bring into the test room: blank sheets of paper and/or white out liquid/tape.

Materials supplied

- Question and answer book of 17 pages.
- Data book.
- A detachable answer sheet for multiple-choice questions. You may remove this during reading time

Instructions

- Write your name and that of your teacher in the space provided above on this page AND on the answer sheet for multiple-choice questions.
- All written responses must be in English.

At the end of the test

- Place the answer sheet for multiple-choice questions inside the front cover of this book.

Students are NOT permitted to bring mobile phones and/or any other unauthorised electronic devices into the test room.

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SECTION A – Multiple choice questions

Instructions for Section A

Answer all questions in pencil on the answer sheet provided for multiple-choice questions.

Choose the response that is correct or that best answers the question.

A correct answer scores 1, an incorrect answer scores 0.

Marks will not be deducted for incorrect answers.

No marks will be given if more than one answer is completed for any question.

Question 1

Arachidic acid is a fatty acid found in peanuts and corn.
The mass of one molecule of arachidic acid is

A. 312 g

B. 5.18×10^{-20} g

C. 5.18×10^{-22} g

D. 5.18×10^{-23} g

Question 2

A sealed 250 mL flask contains carbon dioxide gas at 25°C and 101.3 kPa.
The mass of the gas is

A. 0.23 g

B. 0.45 g

C. 2.2 g

D. 6.1 g

Question 3

The photo on the right shows a burette after an endpoint was reached in a titration between 0.02 M nitric acid and 0.01 M sodium hydroxide.
If the initial reading was 0.15 mL, what was the titre?

A. 27.45 L

B. 27.45 mL

C. 27.75 mL

D. 28.25 mL

Question 4

The molecular formula for aminoethane (ethanamine) is

A. $CH_3CH_2NH_2$

B. CH_3NHCH_3

C. C_2H_8N

D. C_2H_7N

Question 5

In the process of fractional distillation, hot gases are passed through a vertical column. Which of these statements is correct?

A. The temperature of the column is coolest at the top; here the components with the higher boiling temperatures condense first.

B. The temperature of the column is coolest at the top; here the components with the lower boiling temperatures condense first.

C. The temperature of the column is coolest at the bottom; here the components with the higher boiling temperatures condense first.

D. The temperature of the column is coolest at the bottom; here the components with the lower boiling temperatures condense first.

Question 6

Which observation of the following is correct when ammonium nitrate solution is tested for acid-base properties?

A. Bromothymol blue appears blue.

B. Phenolphthalein appears red.

C. Phenol red appears red.

D. Methyl red appears red.

Question 7

Referring to the infrared absorption data in your data booklet, which of the following is true?

A. The IR wave number for bond stretching in a C-C bond is lower than for a C=C bond because the C=C bond is stronger than the C-C bond.

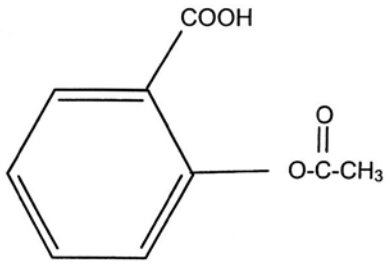
B. The IR wave number for bond stretching in a C-C bond is lower than for a C=C bond because the C=C bond is weaker than the C-C bond.

C. Infrared absorption data is useful in distinguishing alkene functional groups from C=O functional groups.

D. C-H stretch is located in the fingerprint region.

Question 8

Aspirin is an analgesic that is widely used in society. The structural formula of aspirin is shown below.



Comparison of the ^{1}H NMR of aspirin with the major organic product arising from the hydrolysis of aspirin would show

A. the absence of a quartet peak at 2.0 ppm.

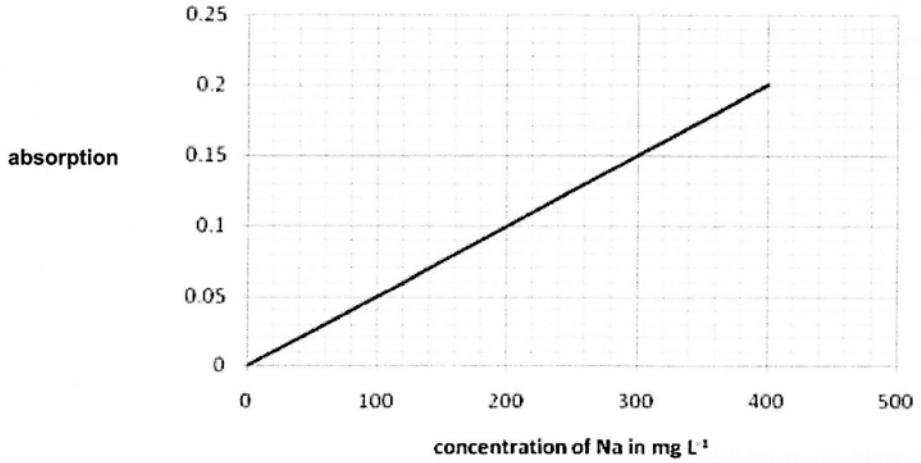
B. the presence of a singlet peak at 2.0 ppm.

C. the presence of a singlet peak at 2.3 ppm.

D. the presence of a doublet peak at 7.3 ppm.

Question 9

A sample of tomato sauce is analysed using atomic absorption spectroscopy. The following calibration graph was obtained using five standard solutions of sodium ions.



The sample was prepared by diluting 10.0 mL of a tomato sauce sample with water in a 50.0 mL volumetric flask. The dilute solution was then analysed. The absorbance was found to be 0.17. The concentration of sodium ions in the original tomato sauce sample is therefore

A. 17 mg L^{-1}

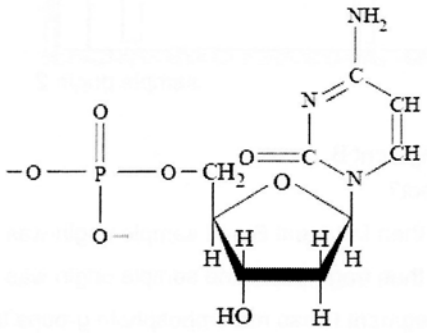
B. 68 mg L^{-1}

C. 340 mg L^{-1}

D. 1.7 g L^{-1}

Question 10

Strands of DNA are produced by condensation reactions between the four different types of nucleotides. One of the nucleotides is shown in the diagram.



The reactants that have combined to form this nucleotide are

A. phosphate group, cysteine and deoxyribose sugar.

B. phosphate group, guanine and deoxyribose sugar.

C. phosphate group, cytosine and deoxyribose sugar.

D. phosphite group, cytosine and deoxyribose sugar.

Question 11

Which of the following has the steps for DNA finger printing in the correct order?

1. Immersion in radioactive dyes
2. Restriction enzymes break DNA into fragments
3. Separation by electrophoresis
4. Treat the DNA to a PCR reaction to increase the sample size

A. 4, 2 , 3, 1

B. 1, 4, 3, 2

C. 4, 2, 1, 3

D. 2, 3, 4, 1

Question 12

Which substance could be analysed by AAS?

A. Steroids in urine

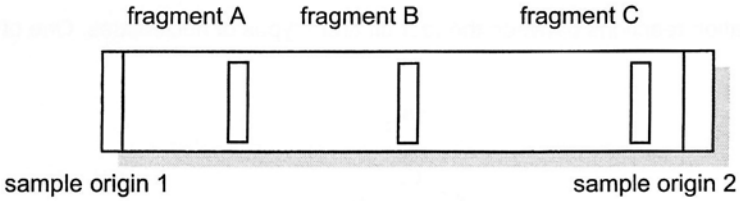
B. Growth hormone in blood

C. Bromine in sea water

D. Arsenic in hair

Question 13

The gel electrophoresis on DNA fragments is shown below and was obtained from a separation experiment carried out at pH = 7.



Fragment A has fewer base pairs than fragment B.

Which of the following statements is correct?

A. Fragment C has more base pairs than fragment B and sample origin was 1.

B. Fragment C has more base pairs than fragment A and sample origin was 2.

C. If the sample origin was 1, then fragment C has more phosphate groups than sample B.

D. If the fragment C has more base pairs than fragment A then the positive electrode was at origin 2.

Question 14

Tetrantimony pentoxide dichloride, $Sb_4O_5Cl_2$, is a compound with interesting electrical properties. Which element in bold below has the same oxidation number as the element in bold in $\mathbf{Sb}_4O_5Cl_2$?

A. $MgH\mathbf{P}O_4$

B. $K_2\mathbf{C}_2O_4$

C. $Pb(\mathbf{Cl}O_4)_2$

D. $K\mathbf{Mn}O_4$

Question 15

Concern is often shown about the high level of both caffeine and sucrose in some sports drinks. The most appropriate technique for determining the level of caffeine in these drinks is

A. paper chromatography.

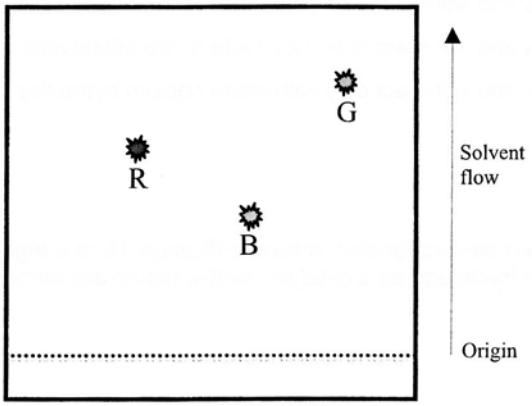
B. thin layer chromatography.

C. gas chromatography.

D. high performance liquid chromatography.

Question 16

The diagram below represents a paper chromatogram showing the separation of colours, red (R), blue (B) and green (G) that have been extracted from a well-known brand of sweets.



From this it can be deduced that

A. red has an R_f value that lies between those of green and blue.

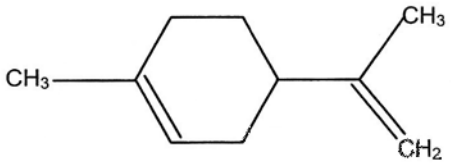
B. blue has the greatest R_f value and is the most strongly adsorbed.

C. green has the greatest R_f value and is most strongly adsorbed.

D. blue is more soluble in the mobile phase than red or green.

Question 17

Limonene is a major component of lemon and lime oils giving them their citrus smell. It is often used to flavour sweets but is also a useful solvent. The structural formula of limonene is shown below.



What is the molecular formula for limonene?

A. C_9H_{15}

B. $C_{10}H_{15}$

C. $C_{10}H_{16}$

D. $C_{10}H_{18}$

Question 18

In one preparation of industrial ethanol, grain is treated with enzymes to break down the starch present into glucose and the glucose is then broken down using yeasts. The processes involved may be described as

A. hydrolysis and fermentation and the products finally formed are ethanol and carbon dioxide.

B. condensation and fermentation and the products finally formed are ethanol and carbon dioxide.

C. hydrolysis and fermentation and the products finally formed are methanol and carbon dioxide.

D. hydrolysis and fermentation and the products finally formed are ethanol and oxygen.

Question 19

The amino acid methionine has

A. a total of 3 functional groups and will react with both dilute hydrochloric acid and dilute sodium hydroxide.

B. a total of 2 functional groups and will react with both dilute hydrochloric acid and dilute sodium hydroxide.

C. a total of 2 functional groups and will react only with dilute hydrochloric acid.

D. a total of 3 functional groups and will react only with dilute sodium hydroxide.

Question 20

Biodiesel is made by a process called base-catalysed transesterification. Here a triglyceride such as canola oil is reacted with methanol using sodium hydroxide as a catalyst. Methyl esters are formed. The by-product of this process is

A. H_2O

B. $C_3H_8O_3$

C. C_2H_5OH

D. $C_6H_{12}O_6$

END OF SECTION A

CENTRE FOR STRATEGIC EDUCATION – YEAR 12 CHEMISTRY 2012
Written test 1 – May

ANSWER SHEET

STUDENT NAME:

INSTRUCTIONS:

Use a **PENCIL** for **ALL** entries. For each question, shade the box which indicates your answer.
All answers must be completed like **THIS** example:
Marks will not be deducted for incorrect answers.
NO MARK will be given if more than **ONE** answer is completed for any question.
If you make a mistake, **ERASE** the incorrect answer – **DO NOT** cross it out.

	ONE ANSWER PER LINE					ONE ANSWER PER LINE				
1	A	B	C	D		11	A	B	C	D
2	A	B	C	D		12	A	B	C	D
3	A	B	C	D		13	A	B	C	D
4	A	B	C	D		14	A	B	C	D
5	A	B	C	D		15	A	B	C	D
6	A	B	C	D		16	A	B	C	D
7	A	B	C	D		17	A	B	C	D
8	A	B	C	D		18	A	B	C	D
9	A	B	C	D		19	A	B	C	D
10	A	B	C	D		20	A	B	C	D

SECTION B – Short answer questions

Instructions for Section B

Answer **all** questions in the spaces provided.

To obtain full marks for your responses you should

- give simplified answers with an appropriate number of significant figures to all numerical questions; unsimplified answers will not be given full marks.
- show all working in your answers to numerical questions. No credit will be given for an incorrect answer unless it is accompanied by details of the working.
- make sure chemical equations are balanced and that the formulas for individual substances include an indication of state; for example, $H_2(g)$; NaCl(s)

Question 1

Potassium dichromate, $K_2Cr_2O_7$, is an oxidant commonly used in the laboratory and in industry.
0.355 g of an impure sample of solid potassium dichromate was dissolved in water, sulfuric acid was added and the solution titrated with 26.5 mL of 0.105 M $Sn(NO_3)_2$ solution until the colour was green, indicating that all of the $Cr_2O_7^{2-}$ ions had been converted to Cr^{3+} ions and the Sn^{2+} ions had been converted to Sn^{4+} ions

a. Write a balanced ionic half-equation for the oxidation reaction.

1 mark

b. Write a balanced ionic equation for the overall reaction.

2 marks

c. Calculate the amount, in moles, of Sn^{2+} ions used in the titration.

1 mark

d. Calculate the amount, in moles, of $Cr_2O_7^{2-}$ that reacted with the Sn^{2+} ions.

1 mark

e. Calculate the mass of pure $K_2Cr_2O_7$ in the original impure sample.

2 marks

f. Calculate the percentage of $K_2Cr_2O_7$ in the original impure sample.

1 mark

g. Explain why, if the contaminant was sodium sulfate, it would not affect the analysis but iron(II) nitrate would.

1 mark

Total 9 marks

Question 2

23.5 g of powdered aluminium metal is dissolved in 100.0 mL of 1.50 M HCl.

a. Write a balanced overall equation for the reaction.

1 mark

b. Calculate the mass of aluminium left after the reaction.

2 marks

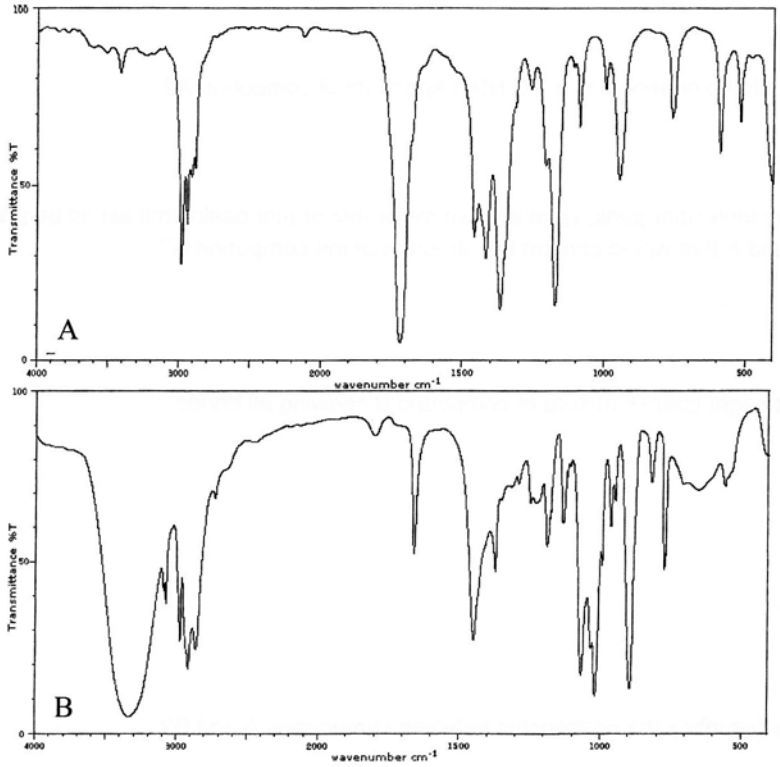
c. Calculate the volume of gas produced at SLC.

2 marks

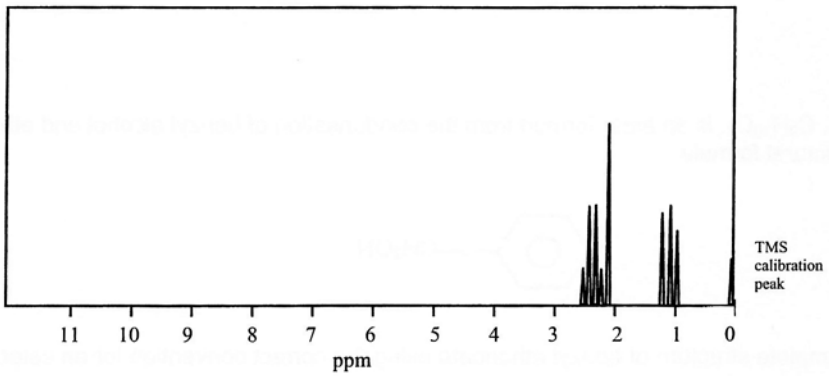
Total 5 marks

Question 3

A chemist isolated two organic compounds, A and B, from a chemical reaction. Both compounds had a molecular formula of C_4H_8O. The chemicals were analysed by IR and ^1H NMR spectroscopy and the results are shown below.



A NMR spectroscopic analysis was only carried out on compound A and it is shown below.



a. What type of analysis was used to determine the molecular formula of C_4H_8O?

1 mark

b. What two functional groups were present in compound B?

1 mark

c. What simple chemical test would detect a functional group present in compound B that was not present in compound A?

1 mark

d. Draw the semi-structural formula of compound A.

2 marks

e. How many peaks would be observed in a ^{13}C NMR spectrum of compound A?

1 mark

f. Other than the parent molecular peak, what are two major m/z or m/e peaks that would be present in the mass spectrum of compound A that would confirm the structure of the compound A?

2 marks

g. Draw one possible straight chain structure of compound B showing all bonds.

2 marks

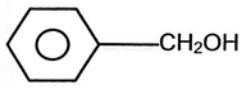
h. What chemical term describes the relationship between compounds A and B?

1 mark

Total 11 marks

Question 4

Benzyl ethanoate, $C_9H_{10}O_2$, is an ester formed from the condensation of benzyl alcohol and ethanoic acid. Benzyl alcohol has a structural formula



a. Draw the complete structure of benzyl ethanoate using the correct convention for an ester.

2 marks

b. What other molecule is produced in the reaction?

1 mark

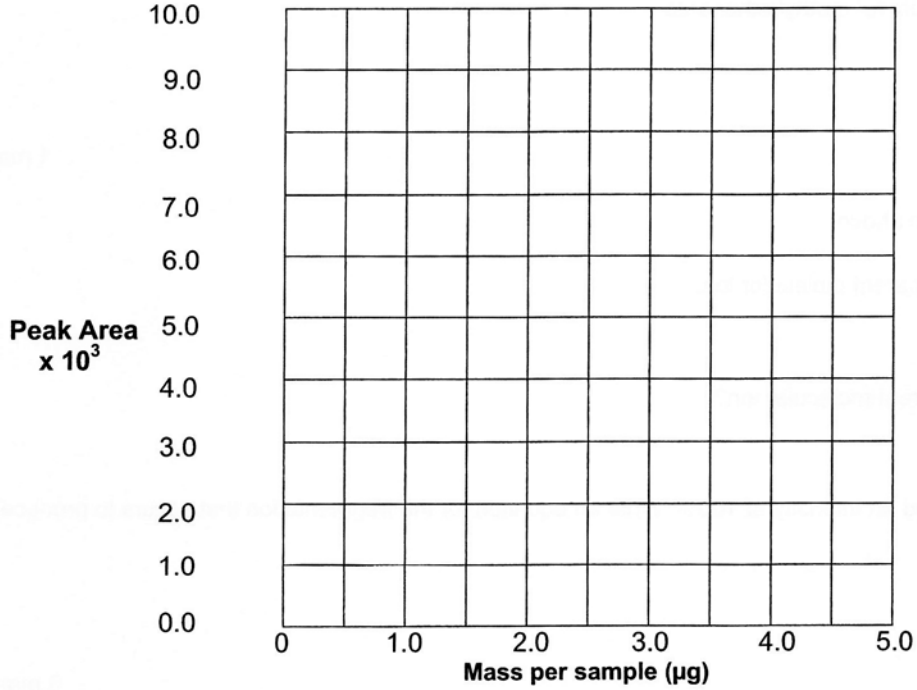
c. Benzyl ethanoate is widely used in making perfumes because it is one of the components of jasmine oil. Analysis of benzyl ethanoate is usually carried out using gas chromatography using a flame ionisation detector. Why would gas chromatography be suitable?

1 mark

d. Samples of various concentrations of benzyl ethanoate were run through the chromatograph and the areas under their peaks recorded. An unknown sample was also measure. The results are listed below.

Mass per sample (µg)	Area under the peak
0.00	0
0.32	750
0.96	2005
2.24	4750
3.20	6750
unknown sample	3450

On the grid below prepare a calibration curve and from it determine the mass in the unknown sample.



What was the mass of the unknown sample?

2 marks

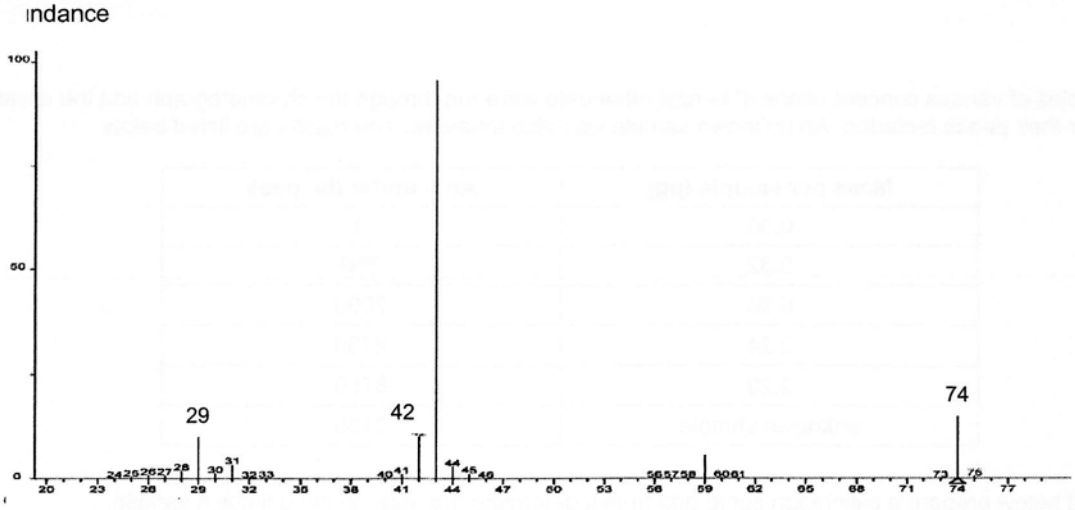
e. How could the analyst know that the unknown sample was benzyl ethanoate?

1 mark

Total 7 marks

Question 5

a. The mass spectrum for methyl ethanoate is shown below.



Write the semi-structural formula for methyl ethanoate.

1 mark

b. Using the mass spectrum above

i. write the formula for the parent molecular ion.

ii. what is the *m/z* of the parent molecular ion?

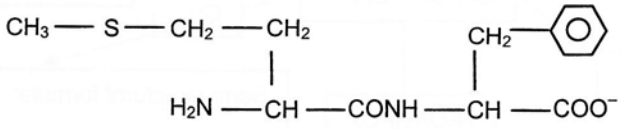
iii. the base peak is assigned an intensity of 100%. Write an equation for the fragmentation that occurs to produce this ion.

3 marks

Total 4 marks

Question 6

a. A dipeptide is drawn below.



i. Circle the word that best describes the environment in which this dipeptide is found.

acidic neutral basic amphiprotic

1 mark

ii. Name the two amino acids that make up this dipeptide.

2 marks

b. *Prialt* is a peptide painkiller developed in the Philippines by Baldomero Olivera, from the deadly cone shell toxin. It consists of 25 amino acids. It works by blocking calcium channels preventing pain signals being sent to the brain. It is only used when all other pain relief drugs have failed because it can cause some serious adverse reactions. The amino acid sequence is shown below.

H – Cys – Lys – Gly – Lys – Gly – Ala – Lys – Cys – Ser – Arg – Leu – Met – Tyr – Asp – Cys – Cys – Thr – Gly – Ser – Cys – Arg – Ser – Gly – Lys – Cys–NH_2

Using the sequence above explain the meaning of, and the bonding occurring in the

i. primary structure.

ii. secondary structure.

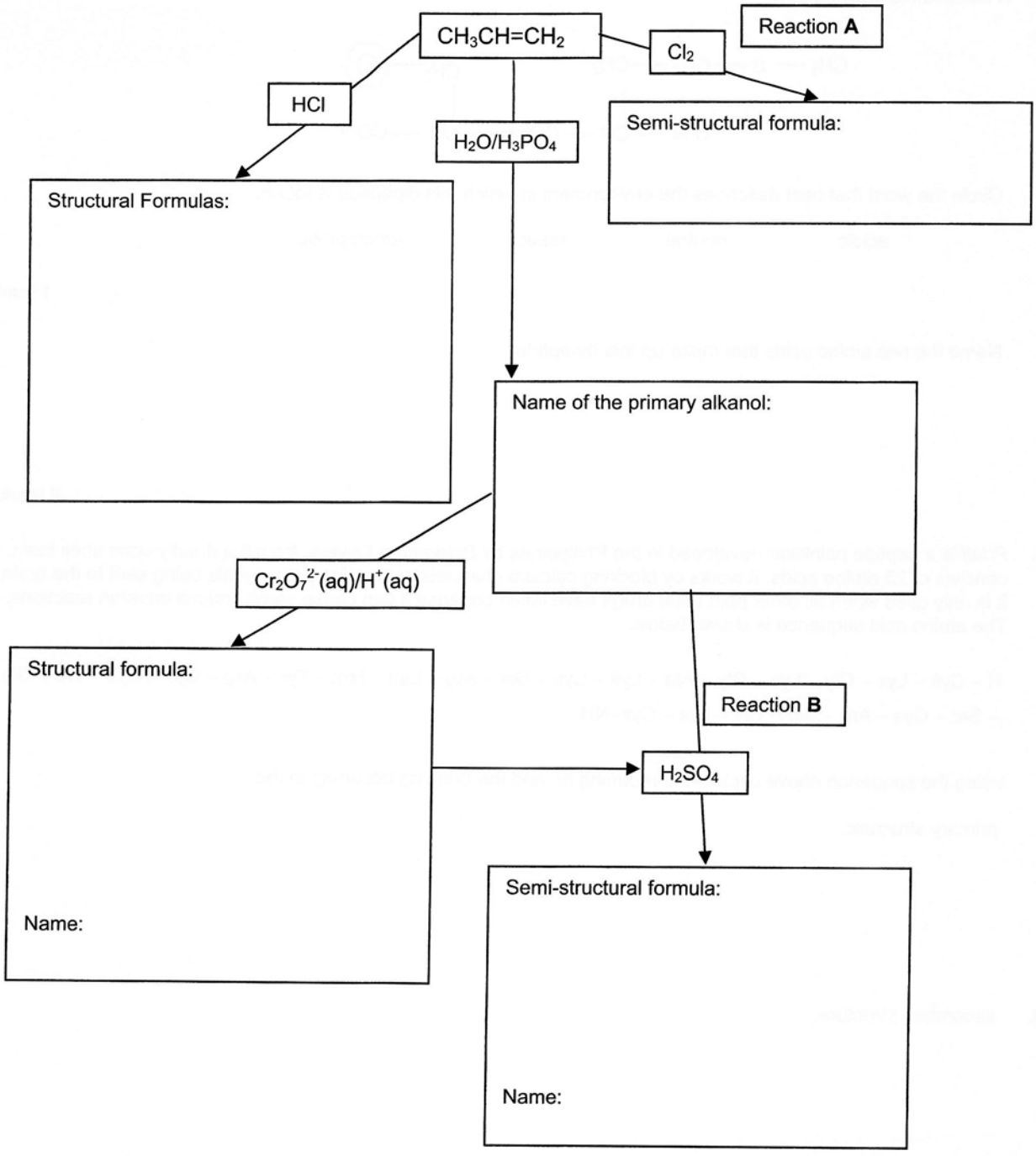
iii. tertiary structure.

6 marks

Total 9 marks

Question 7

a. Complete the following flow chart.



8 marks

b. What type of reaction occurs at **A**?

1 mark

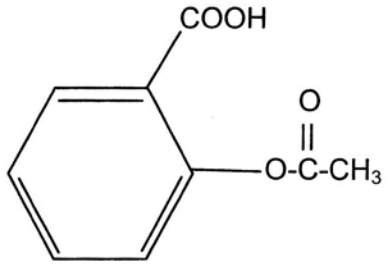
c. What type of reaction occurs at **B**?

1 mark

Total 10 marks

Question 8

Organic molecules are re-designed in order to maximise the pharmacological potency of that molecule. Aspirin is an analgesic with widespread medicinal use. The structure of aspirin is shown below.

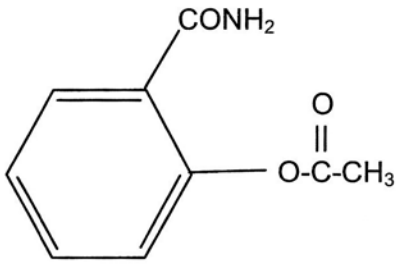


A chemist attempted to design a new analgesic by replacing the carboxylic acid in aspirin with different groups.

a. In one experiment the carboxylic acid functional group was modified to a methyl group. Explain whether an oxidant or reductant was needed to make this chemical modification.

1 mark

b. In another experiment the carboxlic acid functional group was replaced with an amide, $-CONH_2$, functional group. 1.80 g of aspirin was converted into the amide compound. 1.10 g of product was obtained.



What was the percentage yield of the reaction?

2 marks

c. Suggest two reasons why the percentage yield was not 100%.

1 mark

d. Explain, in terms of bonding, why the chemist expected the amide compound to be more potent or effective as an analgesic than when carboxylic acid functional group was modified to a methyl group.

1 mark

Total 5 marks

END OF QUESTION AND ANSWER BOOK