

STUDENT:

TEACHER:

CSE TEST – MAY 2009

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	7	7	53
			Total 73

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

Materials supplied

- Question and answer book of 15 pages.
- Data book
- Answer sheet for multiple-choice questions.

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 examination

- 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 examination room.

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

Which of the following has the greatest mass of methane?

- A. 4.0×10^{24} molecules
- B. 6.0 mol
- C. 100 g
- D. 120 L at STP

Question 2

In gravimetric analysis, silver chloride is often used as the precipitate. Which statement is **not** correct?

- A. Silver chloride has a high molar mass.
- B. Silver chloride has a known formula.
- C. Silver cations react with a narrow range of anions.
- D. Silver chloride has a high solubility in water.

Question 3

A sample of hydrogen gas in a sealed container has a pressure of 48 kPa at 20°C. When the temperature is raised by 20°C, the pressure would be

- A. 24 kPa
- B. 48 kPa
- C. 51 kPa
- D. 96 kPa

Question 4

A gas sample weighs 0.020 g and occupies 245.0 mL at 100 kPa and 25°C. The gas is

- A. Hydrogen
- B. Helium
- C. Oxygen
- D. Nitrogen

- b. Complete the sketch of a fragment of single strand DNA shown below, with a matching strand showing the base pairs indicated by the letters A, G, T and C.

Strand i C T A T C G G A

1 mark

- c. Sketch another fragment of DNA, strand ii, in the same style as the diagram above, that would have a higher melting temperature than strand i.

Strand ii - _____ -

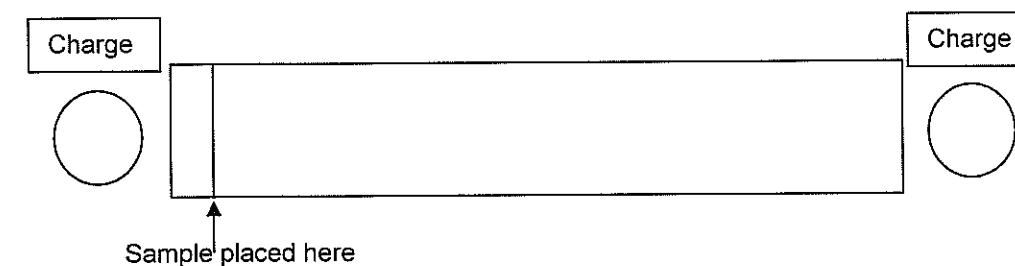
1 mark

- d. Sketch another fragment of DNA, strand iii, in the same style as the diagram above, that would travel further than the fragment strand i on the gel electrophoresis

Strand iii

1 mark

- e. Gel electrophoresis is used in forensic chemistry to separate fragments of DNA. Sketch the relative positions of strands (i), (ii) and (iii) on the following diagram of a gel electrophoresis of a mixture of all three fragments, after separation has occurred. Label the negative terminal of the gel on the diagram.



2 marks

Total 7 marks

c. Complete the following table for protein structures:

Structure	Type(s) of bonding
Primary	
Secondary	
Tertiary	

3 marks

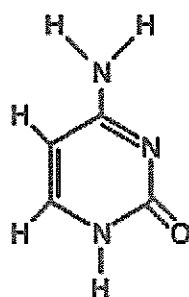
d. A fragment of protein containing a large number of aspartic acid residues had to be purified by electrophoresis. The protein was dissolved in a solution at pH 10. Draw the semi-structural formula of the aspartic acid.

2 marks

Total 7 marks

Question 7

a. Below is the structural formula for cytosine. Sketch the base pair that cytosine forms in DNA. Indicate the hydrogen bonds within the base pair.



2 marks

Question 5

Hydrochloric acid reacted with 10.0 g of calcium carbonate to produce 2.00 L of carbon dioxide gas at STP. This data indicates that

- A. the calcium carbonate was in excess.
- B. the hydrochloric acid was in excess.
- C. the reaction did not go to completion.
- D. there were equal moles of reactants.

Question 6

The oxidation number of vanadium in VO_2NO_3 is

- A. -3
- B. +3
- C. +4
- D. +5

Question 7

Occasionally there are exceptions to the rule that in compounds hydrogen has an oxidation number of +1 and oxygen has an oxidation number of -2. The oxidation numbers for hydrogen and oxygen in the two compounds, LiAlH_4 and K_2O_2 are respectively

- A. -1 and -1
- B. +1 and -1
- C. -4 and +2
- D. -4 and +1

Question 8

Saturated fats are likely to be solids at room temperature because

- A. they have extra hydrogen atoms and therefore are heavier.
- B. they have longer alkyl chains than unsaturated fats.
- C. they consist of straight chains and these can pack more closely together.
- D. they are branched and therefore are more tangled.

Question 9

Which of the following statements about chromatography is **true**?

- A. R_f values allow identification of components in a gas chromatograph.
- B. In high performance liquid chromatography, the more strongly adsorbed a component is, the higher the R_f value.
- C. The eluent is the stationary phase in thin layer chromatography.
- D. In gas chromatography, retention times are greater for lighter components.

Question 10

Histidine is an essential amino acid. The molar mass of histidine is

- A. 155 and the formula of the side chain is $C_4H_5N_2$.
 B. 153 and the formula of the side chain is $C_4H_3N_2$.
 C. 117 and the formula of the side chain is $C_3H_3N_2$.
 D. 117 and the formula of the side chain is $C_1H_3N_2$.

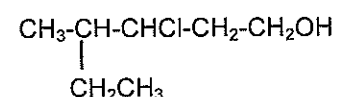
Question 11

Milk curdles when it is poured on some stewed fruits. The process that is occurring to the casein in the milk is

- A. enzyme catalysed hydrolysis.
 B. denaturation.
 C. condensation.
 D. reduction.

Question 12

The molecule



is called

- A. 3-chloro-4-ethylpentan-1-ol
 B. 2-ethyl-3-chloropentan-5-ol
 C. 3-chloro-4-methylhexan-1-ol
 D. 3-methyl-4-chlorohexan-5-ol

Question 13

In the ethene molecule, the total number of bonding electrons is

- A. 4
 B. 8
 C. 10
 D. 12

Question 14

Considerable interest has developed into biofuels and especially those derived from sugar cane. Enzymes catalyse the breakdown of sucrose and the products are further catalysed to produce ethanol. Which of the following chemical equations best represents this second process?

- A. $C_6H_{12}O_6(aq) + 6O_2(g) \rightarrow 6CO_2(g) + 6H_2O(l)$
 B. $C_{12}H_{22}O_{11}(aq) + 6O_2(g) \rightarrow 12CO_2(g) + 11H_2O(l)$
 C. $C_{12}H_{22}O_{11}(aq) + H_2O(l) \rightarrow 2C_6H_{12}O_6(aq)$
 D. $C_6H_{12}O_6(aq) \rightarrow 2C_2H_5OH(aq) + 2CO_2(g)$

Question 5

Complete the table for each of the following:

Semi-structural formula of all the reactant(s) needed for the reaction	Semi-structural formula of organic product	Name of organic product	Type of reaction
		ethanol	addition
$CH_3CH_3 + Br_2 \rightarrow$			
$CH_3CH_2CH_2OH + Cr_2O_7^{2-}/H^+ \rightarrow$			
	$-(CH_2CHCl)_n-$	polyvinyl chloride	
$CH_3CH_2CH_2Cl + NH_3 \rightarrow$		1-aminopropane	
	$HCOOCH_3$		condensation reaction
		2-methylpropane	hydrogenation

Total 7 marks

Question 6

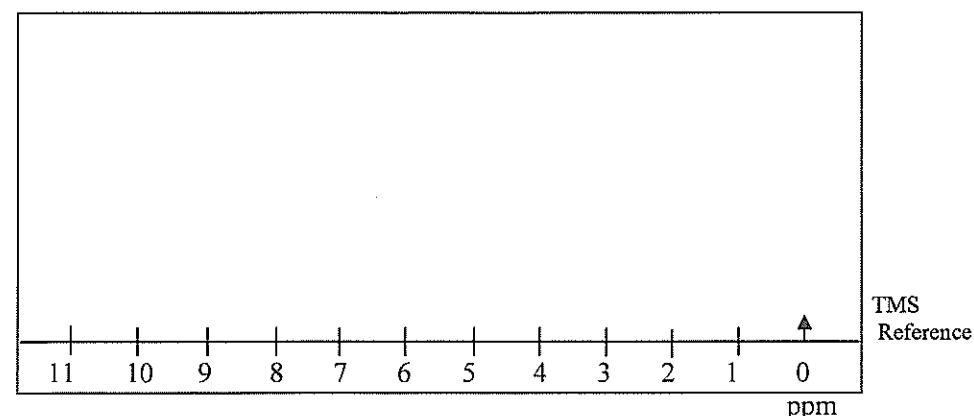
- a. Asparagine is an amino acid that can be produced in the human body. Draw the structural formula of asparagine at pH 2.

1 mark

- b. A dipeptide forms between asparagine and alanine. Draw one of the two possible dipeptides assuming that they are at pH 7.

1 mark

- e. On the high resolution ^1H NMR spectrum axes below, sketch the peak for the methyl group expected when the compound identified in c. above is dissolved in a suitable solvent with tetramethylsilane used as the reference standard.



2 marks

- f. How many peaks will compound identified in c. above have in a ^{13}C spectrum?

1 mark

Total 7 marks

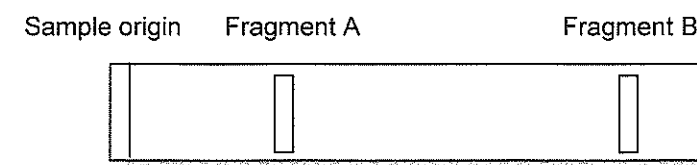
Question 15

During fractional distillation, a mixture of hydrocarbons can be separated according to their

- A. melting temperatures.
- B. boiling temperatures.
- C. molar masses.
- D. functional groups.

Question 16

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

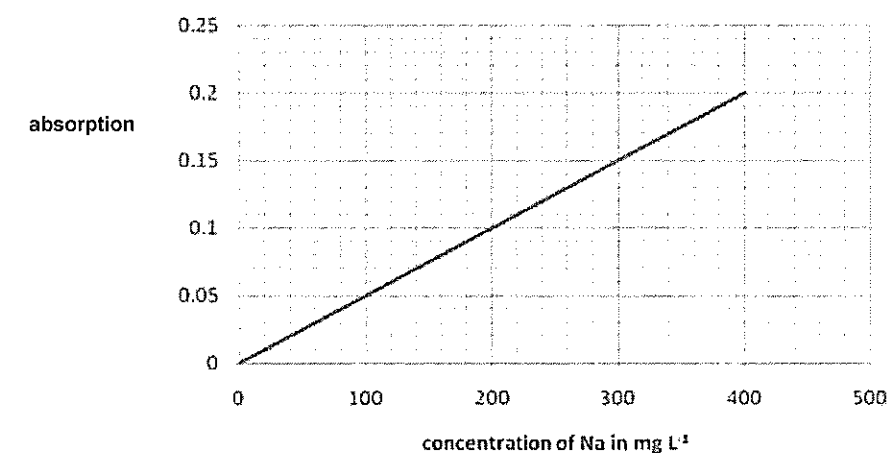


Which of the following statements is correct?

- A. Fragment A contains more adenine bases than fragment B.
- B. Fragment A contains more guanine bases than fragment B.
- C. Fragment A is larger than fragment B.
- D. Fragment A is more positively charged than fragment B.

Question 17

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 20.0 mL of a tomato sauce sample with water in a 250.0 mL volumetric flask. The dilute solution was then analysed. The absorbance was found to be 0.116. The mass of sodium ions in the original 20.0 mL tomato sauce sample is therefore

- A. 4.60 mg
- B. 29.0 mg
- C. 58.0 mg
- D. 230 mg

Question 18

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

1. Immersion in radioactive probes.
2. Restriction enzymes break DNA into fragments.
3. Separation by electrophoresis.

- A. 1, 2, 3
 B. 1, 3, 2
 C. 2, 1, 3
 D. 2, 3, 1

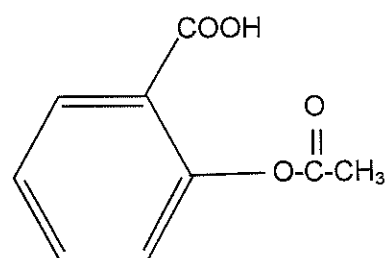
Question 19

The number of phosphate groups in a DNA sample is

- A. twice the number of nitrogenous bases.
 B. equal to the number of nitrogenous bases.
 C. twice the number of hexose sugar molecules.
 D. half the number of hexose sugar molecules.

Question 20

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



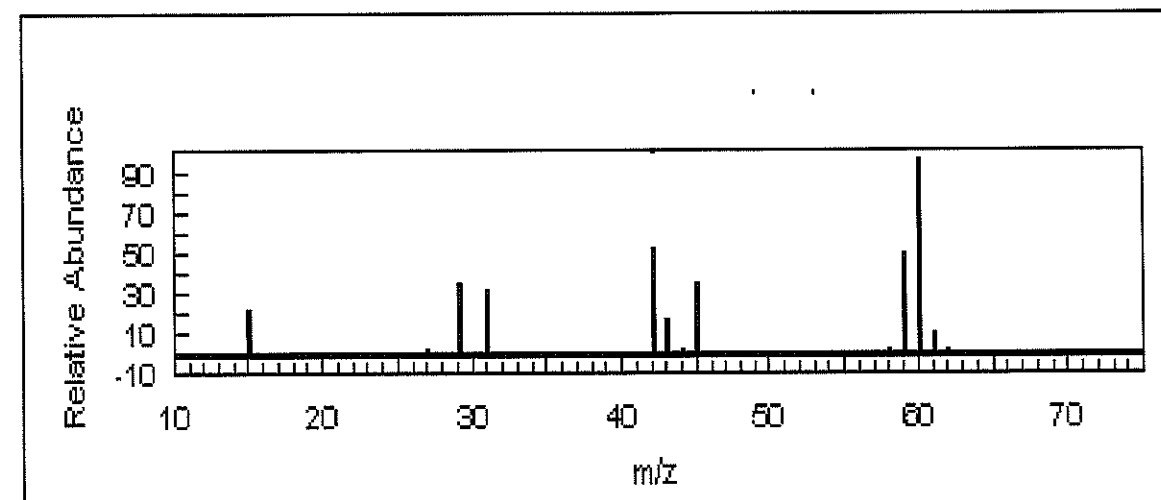
The molecular formula of an organic product produced from the hydrolysis of aspirin is

- A. $C_7H_6O_3$
 B. $C_7H_8O_3$
 C. $C_9H_8O_4$
 D. $C_9H_{10}O_4$

END OF SECTION A

Question 4

Below is a mass spectrum of an unknown organic compound.



- a. The mass spectrum above is that of an organic molecule containing carbon, hydrogen and oxygen atoms. The parent molecular ion lies at the m/z ratio of 60. What might cause the two tiny peaks at 61 and 62?

1 mark

- b. Give the formula for the fragment at the m/z ratio of 31?

1 mark

- c. Both propan-1-ol and ethanoic acid have relative molecular masses of 60. Which compound do you think is represented by this mass spectrum? Justify your answer.

1 mark

- d. What specific data from an IR spectrum would confirm your suspicions?

1 mark

Question 3

- a. Both paper chromatography and thin layer chromatography are commonly used to separate components in a mixture. Explain why a more polar organic compound might adsorb more strongly in paper chromatography.

1 mark

- b. Sketch a diagram of a gas chromatograph. On your sketch label the source of the carrier gas, the injection port, the oven, the coil, the detector and chart recorder.

3 marks

- c. Imported wines are sometimes checked for two contaminants, methanol (CH_3OH) and ethane-1,2-diol ($\text{HOCH}_2\text{CH}_2\text{OH}$) both of which are toxins. If a wine contained both contaminants then three peaks would appear on the chromatogram. One peak is that for ethanol ($\text{CH}_3\text{CH}_2\text{OH}$). In what order would the three components emerge? Give a reason for your answer.

2 marks

- d. Explain why gas chromatography is unsuitable for measuring the concentration of glucose in a urine sample.

1 mark

- e. A student runs an unknown saccharide through a High Performance Liquid Chromatograph. The retention time matches the retention time of galactose recorded the previous week. Why cannot it be assumed that the sample is indeed galactose?

1 mark

Total 8 marks

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, $\text{H}_2(\text{g})$; $\text{NaCl}(\text{s})$

Question 1

To monitor greenhouse gases, levels of carbon dioxide in the atmosphere have been examined over many years. In a simple experiment, the percentage of carbon dioxide in air was calculated using the following method.

At SLC, 500.0 L of clean, dry air was slowly bubbled through 100.0 mL of 0.108 mol L^{-1} barium hydroxide solution. The barium carbonate precipitate formed was filtered and the remaining barium hydroxide solution was titrated with $0.0968 \text{ mol L}^{-1}$ hydrochloric acid solution, requiring 26.80 mL for neutralisation. States and significant figures are required in the solving of this problem.

- a. Write a balanced full equation for the reaction of the barium hydroxide solution with carbon dioxide.

1 mark

- b. Write a balanced full equation for the reaction of the barium hydroxide solution with the hydrochloric acid solution.

1 mark

- c. Calculate the amount, in mole, of barium hydroxide in the original solution.

1 mark

- d. Calculate the amount, in mole, of the hydrochloric acid used to neutralise the barium hydroxide solution.

1 mark

- e. Calculate the amount, in mole, of the barium hydroxide solution that reacted with the hydrochloric acid solution.

1 mark

- f. Calculate the amount, in mole, of carbon dioxide in the air sample.

2 marks

- g. Calculate the volume, in Litres, of carbon dioxide in the air sample.

1 mark

- h. Calculate the percentage v/v of carbon dioxide in the air sample.

1 mark

In an alternative method of analysis, the barium carbonate precipitate from the experiment was washed, dried and weighed, giving a yield of 1.550 g.

- i. Using this figure, calculate the percentage v/v of carbon dioxide in the air.

3 marks

- j. Explain likely reasons why the answers in h. and i. are different.

1 mark

Total 13 marks**Question 2**

2.50 g of lithium metal is reacted with 100.0 mL of water, producing hydrogen gas and lithium hydroxide solution.

- a. Write a balanced full equation for this reaction.

1 mark

- b. Calculate the molarity of the lithium hydroxide solution produced.

2 marks

- c. What is the concentration of the lithium hydroxide solution in units of g L⁻¹?

1 mark

Total 4 marks

CENTRE FOR STRATEGIC EDUCATION – YEAR 12 CHEMISTRY 2009

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.

A	☒	C	D
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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

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