

Student name

# CHEMISTRY

## Unit 3

### Trial Examination

#### QUESTION AND ANSWER BOOK

Total writing time: 1 hour 30 minutes

#### Structure of book

Section	Number of questions	Number of marks
A	20	20
B	9	66
	<b>Total</b>	<b>86</b>

- Students are permitted to bring into the examination room: pens, pencils, highlighters, erasers, sharpeners, rulers, one scientific calculator.
- Students are NOT permitted to bring into the examination room: blank sheets of paper and/or white out liquid/tape, mobile phones and/or any other unauthorised electronic devices.
- A copy of the official VCAA Data Book (printed or photocopied) can be brought into the trial examination.

#### Materials supplied

- Question and answer book of 17 pages, with a detachable answer sheet for multiple-choice questions inside the front cover.

#### Instructions

- Detach the answer sheet for multiple-choice questions during reading time.
- Write your **name** in the space provided above on this page and on the answer sheet for multiple-choice questions.
- All written responses should be in English.

#### At the end of the examination

- Place the answer sheet for multiple-choice questions inside the front cover of this book.
- You may keep your copy of the VCAA Data Book.

# STAV Publishing

2009

## CHEMISTRY Unit 3 Trial Examination MULTIPLE CHOICE ANSWER SHEET

STUDENT  
NAME:

### INSTRUCTIONS:

### USE PENCIL ONLY

- Write your name in the space provided above.
- Use a **PENCIL** for **ALL** entries.
- If you make a mistake, **ERASE** it – **DO NOT** cross it out.
- Marks will **NOT** be deducted for incorrect answers.
- **NO MARK** will be given if more than **ONE** answer is completed for any question.
- Mark your answer by **SHADING** the letter of your choice.

ONE ANSWER PER LINE				ONE ANSWER PER LINE					
1	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D	11	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D
2	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D	12	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D
3	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D	13	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D
4	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D	14	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D
5	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D	15	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D
6	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D	16	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D
7	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D	17	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D
8	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D	18	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D
9	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D	19	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D
10	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D	20	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D

## 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.

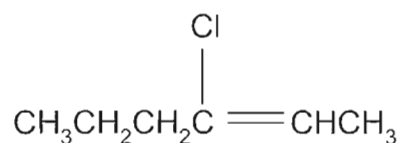
A correct answer scores 1, an incorrect answer scores 0.

Marks will **not** be deducted for incorrect answers.

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

## Question 1

The IUPAC name for the compound whose structure is given below is



- A. 4-chlorohex-4-ene
- B. 3-chlorohex-2-ene
- C. 4-chlorohex-5-ene
- D. 2-chlorohex-2-ene

## Question 2

The molecular formula of the amino acid, tyrosine is

- A.  $\text{C}_9\text{H}_9\text{O}_3\text{N}$
- B.  $\text{C}_9\text{H}_{10}\text{O}_3\text{N}$
- C.  $\text{C}_9\text{H}_{11}\text{O}_3\text{N}$
- D.  $\text{C}_9\text{H}_{12}\text{O}_3\text{N}$

## Question 3

DNA has an overall negative charge because of a negative charge on the

- A. deoxyribose groups
- B. nitrogen bases
- C. sugar groups
- D. phosphate groups

**Question 4**

The difference in molar mass between the bases guanine and cytosine is

- A. 12 g
- B. 26 g
- C. 28 g
- D. 40 g

**Question 5**

A **biofuel** formed from methanol and stearic acid would have the molecular formula

- A.  $\text{CH}_3(\text{CH}_2)_{16}\text{COOCH}_2\text{CH}_3$
- B.  $\text{HCOOCH}_2(\text{CH}_2)_{16}\text{CH}_3$
- C.  $\text{CH}_3(\text{CH}_2)_{16}\text{COOCH}_3$
- D.  $\text{CH}_3\text{COOCH}_2(\text{CH}_2)_{16}\text{CH}_3$

**Question 6**

An antacid is known to contain 400 mg of magnesium hydroxide,  $\text{Mg}(\text{OH})_2$  ( $M = 58.3 \text{ g mol}^{-1}$ ), per 10.0 mL. The number of mole of hydroxide ions in 1.0 L of the antacid would be closest to

- A.  $1.4 \times 10^{-3}$
- B.  $1.4 \times 10^{-2}$
- C.  $1.4 \times 10^{-1}$
- D. 1.4

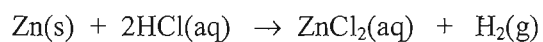
**Question 7**

The mass of  $\text{MgCl}_2$  that would contain 0.25 mole of chloride ions is closest to

- A. 11.9 g
- B. 14.9 g
- C. 23.8 g
- D. 95.2 g

The next three questions refer to the following information.

3.27 g of zinc metal is completely reacted in 250 mL of concentrated hydrochloric acid to give gaseous hydrogen according to the equation



**Question 8**

The volume in litres of hydrogen gas produced at 25 °C and 1.00 atm pressure is closest to

- A. 0.103
- B. 1.22
- C. 206
- D. 124

**Question 9**

The concentration of zinc ions in the solution after all of the zinc has reacted is closest to

- A. 0.050 M
- B. 0.100 M
- C. 0.200 M
- D. 0.013 M

**Question 10**

The reaction between zinc and hydrochloric acid is best described as

- A. an acid-base reaction
- B. a precipitation reaction
- C. a redox reaction
- D. a gravimetric reaction

The next two questions relate to the following information

Consider the molecule  $\text{CH}_3\text{CH}_2\text{COOCH}_2\text{CH}_3$

**Question 11**

The number of different  $^1\text{H}$  environments in this molecule would be

- A. 2
- B. 3
- C. 4
- D. 5

**Question 12**

The molecule is formed from

- A. ethanoic acid and ethanol
- B. ethanoic acid and 1-propanol
- C. propanoic acid and ethanol
- D. propanoic acid and 1-propanol

**Question 13**

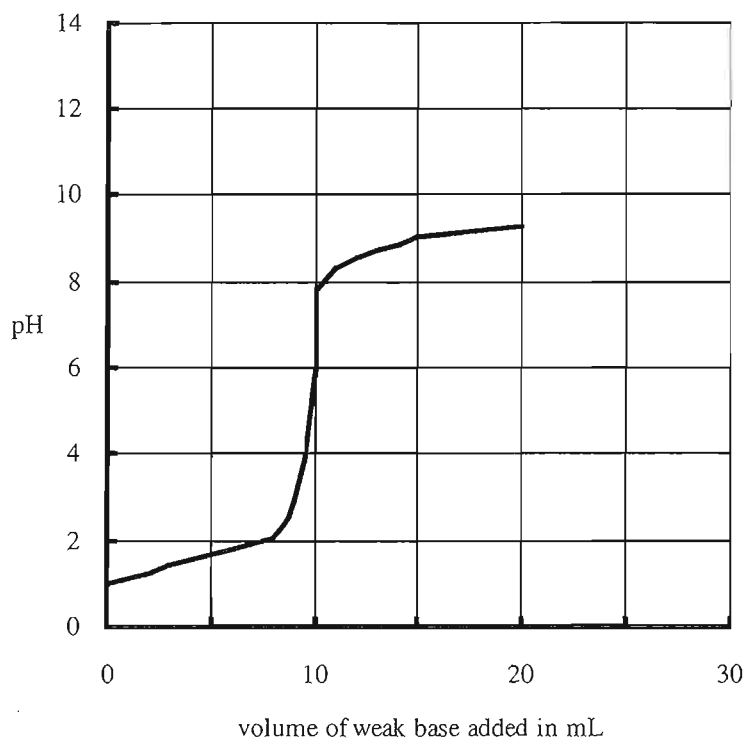
Which of the following statements about Atomic Absorption Spectroscopy (AAS) is correct?

- A. It is an effective qualitative technique but it cannot be used for quantitative analysis.
- B. It measures the wavelengths of light emitted when electrons fall back to their ground state.
- C. White light is shone through a vaporised sample to determine which wavelengths are absorbed.
- D. The wavelength of light used matches one of the wavelengths emitted when the sample is analysed by a flame test.

**Question 14**

Different indicators change colour over different pH ranges and it is important to choose the correct indicator to obtain an accurate result in a titration.

If a particular weak base is added to a strong acid, the following curve is obtained showing the variation of pH with the volume of weak base added.



Which of the indicators below would **not** be the best choice to use in the titration?

- A. methyl red
- B. bromothymol blue
- C. phenol red
- D. phenolphthalein

**Question 15**

Which aqueous solution turns phenolphthalein pink / red?

- A. HCl
- B. NaCl
- C. NaOH
- D. CH<sub>3</sub>OH

**Question 16**

When the oxide,  $\text{Cl}_2\text{O}_7$  is added to water, a reaction takes place which is **not** a redox process. The product(s) of the reaction could be

- A.  $\text{HClO}_4$
- B.  $\text{HOCl}$
- C.  $\text{Cl}_2$  and  $\text{O}_2$
- D.  $\text{HCl}$  and  $\text{O}_2$

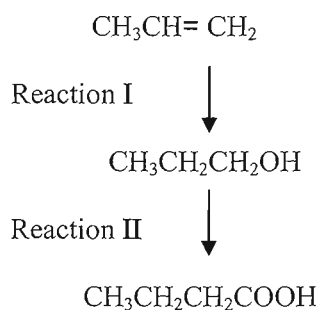
**Question 17**

The Avogadro Constant is the same as the number of

- A. molecules in 16 g of oxygen gas
- B. electrons in 1 g of hydrogen gas
- C. atoms in 24 g of carbon
- D. ions in 1 L of 1.0 M sodium chloride solution

**Question 18**

Which line in the table correctly describes reactions I and II?



	Reaction I	Reaction II
A.	hydration	oxidation
B.	hydration	reduction
C.	hydrolysis	oxidation
D.	hydrolysis	reduction



**Question 19**

The label of a brand of sauce states that it has 1051 mg of sodium per 100 g. Assuming all of the sodium ions in the sauce are from added sodium chloride, the mass (in grams) of sodium chloride in a 1.0 g serve of the sauce would be closest to

- A. 0.011
- B. 0.027
- C. 0.11
- D. 0.27

**Question 20**

In a titration of a strong base with a strong acid, the following procedure was used

1. A burette was rinsed with water and then filled with the standardised acid.
2. A pipette was rinsed with some base solution.
3. A conical flask was rinsed with some base solution.
4. A pipette was used to transfer a measured volume of base solution into the conical flask.
5. Indicator was added to the base sample and it was titrated to the endpoint with the acid.

Which of the following statements is correct?

- A. The calculated base concentration will be correct.
- B. The calculated base concentration will be too low.
- C. The calculated base concentration will be too high.
- D. No definite conclusion can be reached about the base concentration.

**END OF SECTION A**

**SECTION B – Short answer questions****Instructions for Section B**

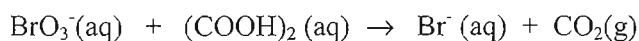
Answer **all** questions in the spaces provided.

To obtain full marks for your responses you should

- give simplified answers with an appropriate number of significant figures for 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**

The following **unbalanced** equation partially describes the process that occurs when potassium bromate solution,  $\text{KBrO}_3(\text{aq})$ , is mixed with a solution of oxalic acid,  $(\text{COOH})_2(\text{aq})$ .



- a. i. What is the oxidation number of bromine in  $\text{BrO}_3^-$ ?

---

- ii. Give the formula of the species being oxidised. Explain your response.

---

1 + 1 = 2 marks

- b. i. Write the balanced oxidation half-equation.

---

- ii. Write the balanced reduction half-equation

---

- iii. Write the balanced overall equation for the reaction

---

1 + 1 + 1 = 3 marks

Total 5 marks

**Question 2**

The mining industry makes extensive use of atomic absorption spectroscopy to analyse mineral samples. In an analysis of ore samples from a particular mine, the nickel content was to be determined.

Initially, some standardised nickel solutions were prepared and their absorbance measured. The following table shows the absorbance vs concentration of some standard samples containing nickel ions.

Absorbance	Nickel content ( $\text{mgL}^{-1}$ )
0	0
0.25	$5.00 \times 10^2$
0.50	$1.00 \times 10^3$
0.75	$1.50 \times 10^3$
1.0	$2.00 \times 10^3$

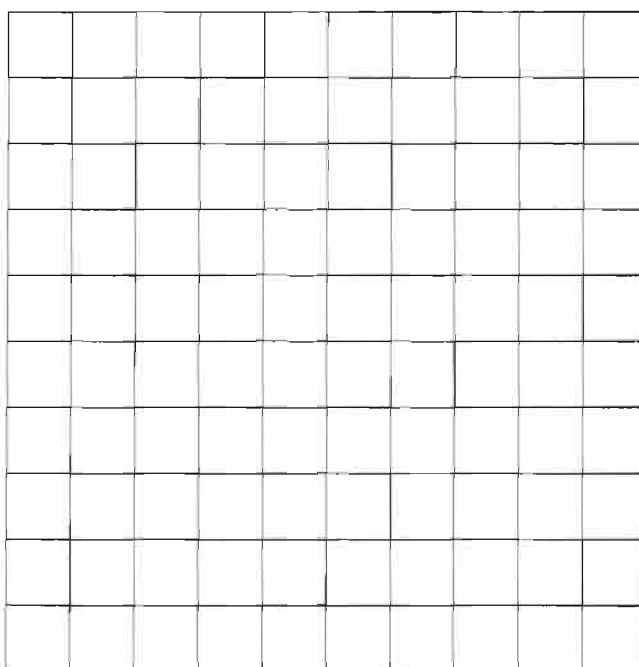
- a. Which of absorbance or nickel content is the dependent variable? Briefly explain your answer.

---

---

1 mark

- b. On the axes provided, plot a fully labelled graph of absorbance against concentration.



3 marks

- c. An ore sample was prepared for analysis by
- digestion of 1.35 g of ore in acid and made up to 10.0 mL.
  - this solution was then diluted with distilled water to 100 mL.

The diluted sample gave an absorbance reading of 0.62.

- i. Determine the concentration of nickel ions, in mg/L, in the diluted sample.

---

- ii. Determine the mass of nickel, in mg, in the ore sample

---

- iii. Calculate the percentage by mass of nickel in the sample.

---

1 + 2 + 1 = 4 marks

- d. Explain why the ore sample had to be diluted.

---

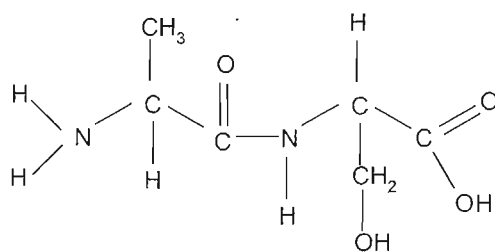
---

1 mark

Total 9 marks

**Question 3**

The structure of a dipeptide is shown below.



- a. Circle the peptide link. 1 mark
- b. Draw the structure of **and** name the amino acids from which it has been synthesised.

4 marks

- c. i. Draw the structure (showing all bonds) of one of these amino acids at neutral pH

1 mark

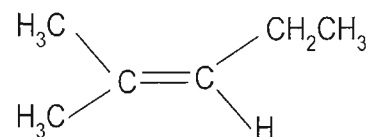
- ii. Draw the structure of the other amino acid (showing all bonds) at low pH.

1 mark

Total 7 marks

**Question 4**

An alkene has the following structure



- a. Give the systematic name of the alkene.

---

1 mark

- b. The alkene is reacted with  $\text{HBr(g)}$ . Name the type of reaction occurring.

---

1 mark

- c. Draw the structure of **and** name any possible product(s).

4 marks

Total 6 marks

**Question 5**

A triglyceride, with a molar mass of  $884 \text{ g mol}^{-1}$ , is formed by reacting glycerol with an excess of linoleic acid.

- a. How many peaks would be expected in the  $^{13}\text{C}$  NMR spectrum of glycerol? Explain your answer.

---

---

2 marks

- b. Draw a representation of the triglyceride showing all bonds except for the fatty acid residues.

2 marks

- c. How many C/C double bonds are present in each molecule of **linoleic acid**? Explain your answer.

---

---

1 mark

- d. 1.00 g of the triglyceride is reacted with excess  $\text{Br}_2$ , calculate the **mass** of  $\text{Br}_2$  needed for this reaction.

---

---

---

---

3 marks

- e. If the lipid had been made from oleic acid,  $\text{C}_{18}\text{H}_{34}\text{O}_2$ , without further calculation state how you expect the mass of  $\text{Br}_2$  to differ from your answer in d and explain your reasoning.

---

---

1 mark

Total 9 marks

**Question 6**

A student is provided with samples of 1-propanol and ethanol and is asked to synthesise a pure sample of the liquid ethyl propanoate.

- a. Create a reaction pathway to show how the student might produce this compound using semi-structural formulae of organic reactants and products. Include names of any inorganic reagents that would be required.

5 marks

- b. Give the name of the process which would enable the mixture of liquids at the end of the reaction to be treated so that pure ethyl propanoate can be obtained.

1 mark

- c. Explain how IR spectroscopy could be used to distinguish between pure ethyl propanoate and ethanol.

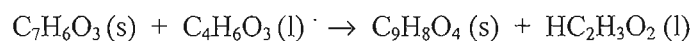
2 marks

Total 8 marks



**Question 7**

A student prepared a sample of aspirin,  $C_9H_8O_4$  by reacting salicylic acid,  $C_7H_6O_3$ , with acetic anhydride,  $C_4H_6O_3$ , according to the equation



The student used 3.00 g of salicylic acid with 4.00 g of acetic anhydride to obtain 2.0 g of aspirin.

- a. Calculate the theoretical mass of aspirin that should have been obtained.

---

---

---

---

---

---

---

5 marks

- b. Determine the percentage yield of aspirin in this experiment to the appropriate number of significant figures.

---

---

---

---

2 marks

Total 7 marks

**Question 8**

A compound is an ester with the empirical formula  $C_2H_4O$  and a molar mass of 88.

- a. Determine the molecular formula of the compound.

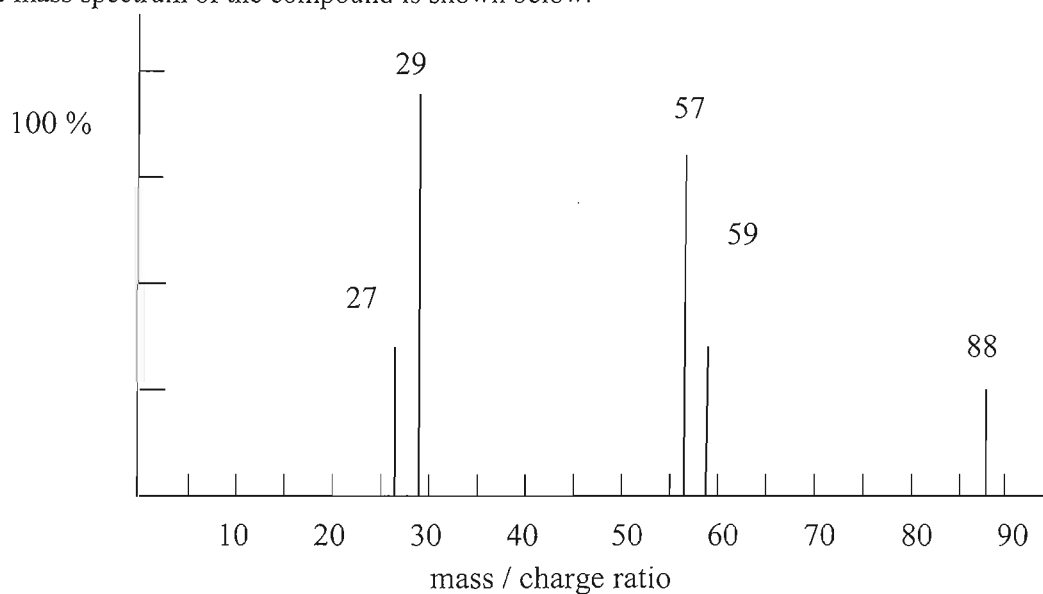
---

1 mark

- b. Draw four structures (show all bonds) for esters which satisfy these requirements.

The mass spectrum of the compound is shown below.

4 marks



- c. Circle any structure you drew in b which could give this mass spectrum. 2 marks
- d. Identify the fragments that give rise to the peaks at 29, 57 and 59.

---

---

---

3 marks

Total 10 marks

**Question 9**

Flowers produce nectar which contains a mixture of sugars such as glucose and sucrose.

- a. i. To which family of compounds do glucose and sucrose belong?

---

- ii. Name a digestible polymer which also belongs to this family.

---

1 + 1 = 2 marks

- b. Glucose can be broken down to produce alcohol.

- i. Name this **type** of chemical reaction.

---

- ii. Write a balanced equation for the reaction.

---

1 + 2 = 3 marks

Total 5 marks

**END OF EXAMINATION**