

Student Name: _____

STAV *Publishing* 2002

CHEMISTRY

Unit 2 Trial Examination

Total writing time: 1 hour 30 minutes

QUESTION AND ANSWER BOOK

Structure of book

<i>Section</i>	<i>Number of marks allocated</i>	<i>Style of questions</i>
A	20	Multiple choice
B	50	Written response

Directions to students

Materials

Question and answer book of 14 pages with a detachable Multiple Choice Answer Sheet inside the front cover and a detachable Data Sheet in the centrefold.

You should have at least one pencil and an eraser. An approved calculator may be used.

The task

Please ensure that you write your **name** in the space provided on the cover of this book and in the space provided on the Multiple Choice Answer Sheet.

This paper consists of two sections, Section A and Section B.

Answer **all** questions from Section A. Section A is worth 20 marks.

Section A questions should be answered in pencil on the Multiple Choice Answer Sheet provided.

Answer **all** questions from Section B. Section B is worth 50 marks.

Section B questions should be answered in ink or ball point pen in the spaces provided in this book.

There is a total of 70 marks available. Working space is provided throughout this book.

All written responses should be in English.

At the end of the task

Place the Multiple Choice Answer Sheet inside the front cover of this book.

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2002

CHEMISTRY

Unit 2 Trial Examination

MULTIPLE CHOICE ANSWER SHEET

STUDENT NAME:	
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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 placing a **CROSS** through the letter of your choice.

1.	A	B	C	D
2.	A	B	C	D
3.	A	B	C	D
4.	A	B	C	D
5.	A	B	C	D
6.	A	B	C	D
7.	A	B	C	D
8.	A	B	C	D
9.	A	B	C	D
10.	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
16.	A	B	C	D
17.	A	B	C	D
18.	A	B	C	D
19.	A	B	C	D
20.	A	B	C	D

SECTION A**Specific instructions for Section A**

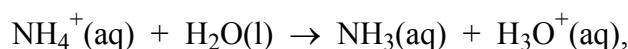
Section A consists of 20 multiple choice questions. Section A is worth approximately 29 per cent of the marks available. You should spend approximately 26 minutes on Section A.

Choose the response that is **correct** or **best answers the question**, and mark your choice on the multiple choice answer sheet according to the instructions on that sheet.

A correct answer is worth 1 mark, an incorrect answer is worth no marks. No mark will be given if more than one answer is shown for any question. Marks will **not** be deducted for incorrect answers. You should attempt every question.

Question 1

In the reaction,



the ammonium ion, NH_4^+ , acts as

- A. an acid
- B. a base
- C. an oxidant
- D. a reductant

Question 2

Which **one** of the following is **not** an example of an acid/base reaction?

- A. $6\text{HNO}_3(\text{aq}) + \text{Fe}_2\text{O}_3(\text{s}) \rightarrow 2\text{Fe}(\text{NO}_3)_3(\text{aq}) + 3\text{H}_2\text{O}(\text{l})$
- B. $\text{HCl}(\text{aq}) + \text{NH}_3(\text{aq}) \rightarrow \text{NH}_4\text{Cl}(\text{aq})$
- C. $\text{H}_2\text{SO}_4(\text{aq}) + \text{Mg}(\text{s}) \rightarrow \text{MgSO}_4(\text{aq}) + \text{H}_2(\text{g})$
- D. $2\text{HCl}(\text{aq}) + \text{Mg}(\text{OH})_2(\text{aq}) \rightarrow \text{MgCl}_2(\text{aq}) + 2\text{H}_2\text{O}(\text{l})$

Question 3

Assuming complete ionisation, which of the following can provide the most hydronium ions?

- A. 1.0 L of 4.0 M sulfuric acid
- B. 2.0 L of 1.5 M sulfuric acid
- C. 1.0 L of 6.0 M hydrochloric acid
- D. 2.0 L of 3.5 M hydrochloric acid

Question 4

Which of the following compounds will not act as an acid when dissolved in water?

- A. NH_4Cl

- B. NaCl
- C. HCl
- D. H₃PO₄

Question 5

The conjugate acid of the H₂PO₄⁻ ion is

- A. H₃PO₄
- B. H₂O
- C. OH⁻
- D. HPO₄²⁻

Question 6

The average mass, in gram, of one atom of oxygen would be

- A. 2.66×10^{-23}
- B. 5.33×10^{-23}
- C. 3.75×10^{-22}
- D. 16.0

Question 7

A ¹²C atom has a mass of approximately 2.04×10^{-27} kg. The mass of a ²⁷Al atom would therefore be most nearly

- A. $27 \times 2.04 \times 10^{-27}$ kg
- B. 27×10^{-27} kg
- C. $\frac{27}{12} \times 10^{-27}$ kg
- D. $\frac{27}{12} \times 2.04 \times 10^{-27}$ kg

Question 8

The compound with the highest percentage, by mass, of nitrogen is

- A. NH₄NO₃
- B. (NH₂)₂CO
- C. NH₄Cl
- D. (NH₄)₂SO₄

Question 9

2.00 g of sodium hydroxide (NaOH) was dissolved in 20.0 mL of distilled water and then more distilled water was added to make a total volume of 50.0 mL. The concentration of sodium hydroxide in the final solution was

- A. 0.0500 M
- B. 0.100 M
- C. 0.500 M
- D. 1.00 M

The following information refers to Questions 10 and 11.

The mass of 0.20 mol of an element is 12.8 g.

Question 10

The molar mass of the substance is

- A. 13 g mol⁻¹
- B. 32 g mol⁻¹
- C. 64 g mol⁻¹
- D. 320 g mol⁻¹

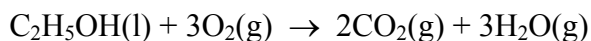
Question 11

The identity of the substance could be

- A. SO₂
- B. SiH₄
- C. O₂
- D. S₂

Question 12

For the equation;



Which one of the following statements is correct?

- A. $3 \times n(\text{C}_2\text{H}_5\text{OH}) = 2 \times n(\text{CO}_2)$
- B. $2 \times n(\text{CO}_2) = 3 \times n(\text{H}_2\text{O})$
- C. $n(\text{CO}_2) = 3 \times n(\text{O}_2)$
- D. $n(\text{O}_2) = 3 \times n(\text{C}_2\text{H}_5\text{OH})$

Question 13

When 44.0 g of propane, C_3H_8 , are completely combusted in air, the volume of carbon dioxide, produced at STC, would be

- A. 24.5 L
- B. 49.0 L
- C. 73.5 L
- D. 98.0 L

Question 14

The major use of nitrogen gas is

- A. as a fire extinguisher.
- B. to make fertiliser.
- C. as a refrigerant.
- D. as a filler for fluorescent light tubes.

Question 15

Gases are more easily compressed than liquids or solids. The reason for this behaviour is that

- A. gas molecules move with greater speeds than the molecules of liquids or solids, permitting gases to adjust more rapidly to a change in volume.
- B. gas molecules undergo elastic collisions with the walls of a container and elastic substances are easily compressed.
- C. the average distance between gas molecules is much greater than that between particles in liquids or solids, so the volume may be more easily reduced.
- D. attractive forces between gas molecules are much smaller than those between particles in solids and liquids, and these forces are more easily overcome during compression.

Question 16

A student closes the outlet of a bicycle pump with their finger and pushes down the plunger. When the volume of air in the pump is reduced to 20 mL, the student's finger is forced off the outlet. The pump originally held 90 mL of air at 101 kPa. Assuming constant temperature, the maximum pressure (in kPa) needed to force their finger off the pump outlet would be

- A. $\frac{70 \times 101}{20}$
- B. $\frac{20 \times 101}{70}$
- C. $\frac{90 \times 101}{20}$
- D. $\frac{20 \times 101}{90}$

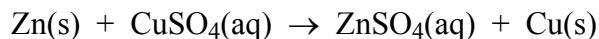
Question 17

Which **one** of the following is correct about equal volumes of CO (g) and C₄H₈ (g) at 298 K and 1.0 atm?

- A. The number of CO molecules is half that of C₄H₈.
- B. The average kinetic energy of the CO molecules is half that of the C₄H₈ molecules.
- C. The average velocity of the C₄H₈ molecules is half that of the CO molecules
- D. The C₄H₈ sample has a mass twice that of the CO sample.

Question 18

When zinc metal is added to an aqueous solution of copper(II) sulfate, the following reaction occurs



In this reaction, the most accurate representation of the oxidant is

- A. $\text{SO}_4^{2-}(\text{aq})$
- B. Zn(s)
- C. $\text{Cu}^{2+}(\text{aq})$
- D. $\text{CuSO}_4(\text{aq})$

Question 19

Steel pipelines buried in the soil often have zinc blocks attached at regular intervals. The purpose of the zinc blocks is to

- A. reduce the Fe^{2+} ions formed to iron.
- B. be reduced in preference to the iron.
- C. promote formation of a protective coating on the pipeline.
- D. continually provide electrons for the iron.

Question 20

In which of the following would you anticipate that an appreciable reaction will occur?

- A. A solution of lead(II) nitrate was added to a solution of copper(II) nitrate.
- B. A solution of chromium(II) nitrate was added to a solution of silver nitrate.
- C. Copper metal was added to a solution of tin(II) chloride.
- D. A solution containing silver ions was placed in a copper container.

END OF SECTION A

SECTION B**Specific instructions for Section B**

Section B consists of nine short answer questions numbered 1 to 9; you must answer all of these questions. This section is worth 50 marks which is approximately 71 per cent of the total. You should spend approximately 64 minutes on this section.

The marks allotted to each question and the suggested times are shown at the end of each question.

Questions must be answered in the spaces provided in this book.

To obtain full marks for your response 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 all 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

Rubidium is a member of Group 1 in the Periodic Table. A sample of naturally occurring rubidium consists of two isotopes of relative isotopic masses 85.0 and 87.0 respectively.

- a) Name the instrument that chemists use to determine the relative isotopic mass of an isotope.

- b) The relative isotopic mass of ^{87}Rb is recorded as 87.0 in a data book. Using ^{87}Rb as an example, explain the difference between mass number and relative isotopic mass.

- c) Calculate the percentage abundance of the ^{87}Rb isotope in naturally occurring rubidium.

1 + 2 + 2 = 5 marks
(Suggested time: 6 minutes)

Question 2

A sample of water was taken from a storm water drain outlet along the Yarra River. The concentration of hydronium ions in the water sample was found to be 5.0×10^{-5} M.

- a) Determine the pH of the water

- b) State whether the water is acidic, basic or neutral. Briefly explain your answer.

- c) Calculate the concentration of hydroxide ions in the water sample.

- d) Water from the Yarra at Southbank was found to have a pH of 7.0. Given a 100 mL sample of the water from the drain and de-ionised water, explain, including calculations, how you could obtain a water sample with the same pH as at Southbank.

1 + 1 + 1 + 3 = 6 marks
(Suggested time: 8 minutes)

Question 3

Carboxylic acids are organic acids capable of donating hydrogen ions during chemical reactions. A carboxylic acid, known to contain only the elements carbon, hydrogen and oxygen, was purified and its chemical composition analysed.

- a) To determine the empirical formula of the carboxylic acid, 1.20 g of the acid was burnt completely in excess oxygen. The only products formed were 1.76 g of carbon dioxide and 0.72 g of water vapour.

Calculate

- (i) the amount, in mol, of carbon dioxide, produced from the complete combustion of 1.20 g of the acid.

- (ii) the amount, in mol, of water produced from the complete combustion of 1.20 g of the acid.

- b) Use your answer to (a) to calculate

- (i) the mass of carbon present in 1.20 g of the acid.

- (ii) the mass of hydrogen present in 1.20 g of the acid.

- c) Hence, determine the mass of oxygen present in 1.20 g of the acid.

- d) Hence determine the empirical formula of the acid.

Question 3 continues on the next page

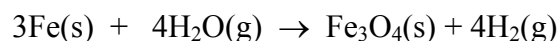
- e) Another sample of the carboxylic acid was used to determine its molar mass. The molar mass was found to be 60.0 g mol^{-1} . Determine the molecular formula of the acid.

2 + 3 + 1 + 2 + 2 = 10 marks

(Suggested time: 13 minutes)

Question 4

Under certain conditions, iron reacts with water to produce an oxide of iron and hydrogen gas according to the equation



If 279 g of iron is consumed in a particular reaction, what mass of hydrogen gas would be released?

3 marks

(Suggested time: 4 minutes)

Question 5

Balance the following chemical equations using whole number co-efficients.

- a) $\underline{\quad} \text{CaCO}_3\text{(s)} + \underline{\quad} \text{HCl(aq)} \rightarrow \underline{\quad} \text{CaCl}_2\text{(aq)} + \underline{\quad} \text{H}_2\text{O(l)} + \underline{\quad} \text{CO}_2\text{(g)}$
- b) $\underline{\quad} \text{C}_2\text{H}_4\text{(g)} + \underline{\quad} \text{O}_2\text{(g)} \rightarrow \underline{\quad} \text{CO(g)} + \underline{\quad} \text{H}_2\text{O(l)}$
- c) $\underline{\quad} \text{CO}_2\text{(g)} + \underline{\quad} \text{H}_2\text{O(l)} \rightarrow \underline{\quad} \text{C}_6\text{H}_{12}\text{O}_6\text{(aq)} + \underline{\quad} \text{O}_2\text{(g)}$

1 + 1 + 1 = 3 marks
(Suggested time: 4 minutes)

Question 6

During a practical class, a student generated sufficient rotten egg gas, H_2S , to fill a 3.0 L container at a pressure of 101.1 kPa and a temperature of 25.0 °C. The container was opened by another student and the gas quickly filled the laboratory which had a volume of 6.00×10^5 L and a temperature of 17.0 °C.

- a) Calculate the pressure, in kPa, of hydrogen sulfide gas in the room.

- b) H_2S gas is considered to be toxic at concentrations greater than 5.0×10^{-4} M.

- (i) Calculate the amount of H_2S , in mol, in the room.

- (ii) Determine whether the molar concentration of H_2S gas in the room would be at toxic concentrations.

2 + 2 = 4 marks
(Suggested time: 5 minutes)

Question 7

Write the formula for the following chemicals

- a) phosphoric acid _____
- b) calcium hydroxide _____

- c) iron(III) oxide _____
- d) sodium carbonate _____

4 marks
(Suggested time: 5 minutes)

Question 8

During an acid-base titration of 0.300 M NaOH with 0.200 M HCl, a chemistry student made a mistake in titrating and went well beyond the end-point. The student started with a 10.00 mL sample (aliquot) of the sodium hydroxide solution and the titre of hydrochloric acid was 40.0 mL.

- a) Write the balanced equation for the neutralisation reaction between sodium hydroxide and hydrochloric acid solution.

- b) Which solution did the student place in the burette? _____

- c) What amount, in mol, of hydrochloric acid was needed to neutralise the sodium hydroxide?

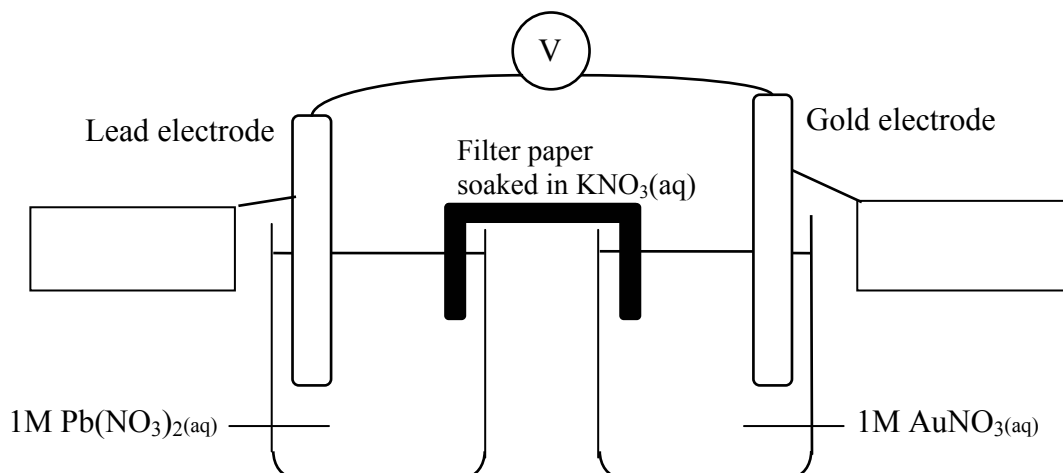
- d) What amount, in mol, of hydrochloric acid was in excess in the solution after their mistake?

- e) Explain why titrations are usually repeated until three concordant titres are obtained.

1 + 1 + 1 + 2 + 1 = 6 marks
(Suggested time: 8 minutes)

Question 9

In an experiment, two half-cells were set up to construct the illustrated galvanic cell.



- a) For the galvanic cell, write balanced ionic equations to represent:
- the oxidation half-cell reaction

 - the reduction half-cell reaction

 - the overall cell reaction

- b) Indicate on the diagram above:
- the direction of electron flow through the external connecting wire;
 - the polarity of each electrode;
 - the cathode and the anode [place the label in the boxes provided].
- c) For this galvanic cell, write the chemical formula of the oxidant _____
- d) What change (if any) would you expect in the concentration of the nitrate ion, NO_3^- , in the Au^+/Au half-cell after the cell has been operating for a considerable length of time? Explain your response.
- _____
- _____

3 + 3 + 1 + 2 = 9 marks

(Suggested time: 12 minutes)

END OF EXAMINATION