

Student Name: _____

CHEMISTRY

Unit 2 – Written Examination 2



2009 Trial Examination

Reading Time: 15 minutes

Writing Time: 1 hour and 30 minutes

QUESTION AND ANSWER BOOK

Structure of book

<i>Section</i>	<i>Number of questions</i>	<i>Number of questions to be answered</i>	<i>Number of marks</i>	<i>Suggested times (minutes)</i>
A	20	20	20	30
B	6	6	60	60
			Total 80	90

- Students are permitted to bring into the examination room: pens, pencils, highlighters, erasers, sharpeners and rulers
- Students are NOT permitted to bring into the examination room: blank sheets of paper and/or white out liquid/tape.
- No calculator is permitted in this examination.

Materials supplied

- Question and answer book of 15 pages.

Instructions

- Print your name in the space provided on the top of this page.
- All written responses must be in English.

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

SECTION A – Multiple-choice questions

Instructions for Section A

Answer **all** questions.

Choose the response that is **correct** for the question.

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

Marks are **not** deducted for incorrect answers.

If more than 1 answer is completed for any question, no mark will be given.

Question 1

The process of oxidation can be best described as:

- A. The transfer of electrons between chemical species.
- B. The sharing of electrons between chemical species.
- C. The loss of electrons from a chemical species.
- D. The gain of electrons from a chemical species.

Question 2

The concentration of a solution made from 45.3 g of $(\text{NH}_4)_2\text{SO}_4$ dissolved in 85 mL would be:

- A. 0.042 M
- B. 0.048 M
- C. 4.04 M
- D. 4.8 M

Question 3

Which of the following measures will **increase** the rate of corrosion?

- i. Using a sacrificial anode with a less reactive metal
 - ii. Surface coating
 - iii. Immersion in saline (salt) solution
 - iv. Alloying
- A. i, ii and iii
 - B. i, ii and iv
 - C. iii
 - D. ii and iv

Question 4

What mass of KOH must be dissolved in 750 mL of deionised water to neutralise 0.50 L of 0.85 M HCl solution?

- A. 17.9 g
- B. 23.8 g
- C. 31.7 g
- D. 47.6 g

SECTION A - continued

Question 5

A dilute strong acid is best represented by:

- A. 25 mL of 1.0 M HCl
- B. 15 L of 4 M CH₃COOH
- C. 10 mL of 0.003 M HNO₃
- D. 3 drops of 6M HF

Question 6

If 25.0 g of ammonia (NH₃) reacts with 30.0 g of sulphuric acid (H₂SO₄) calculate the grams of fertilizer ((NH₄)₂SO₄) produced:

- A. 20.2
- B. 40.4
- C. 55.0
- D. 97.2

Question 7

Which of the following lists contains species that are amphiprotic?

- A. HCO₃⁻, HPO₄²⁻
- B. H₂CO₃, SO₄²⁻
- C. CO₃²⁻, HNO₃
- D. S²⁻, H₂O

Question 8

The standard hydrogen electrode (SHE) consists of a platinum electrode immersed in a solution containing hydronium ions at a pH of 0 and a temperature of 25 °C. What is the concentration of the hydronium ions in the SHE?

- A. -0.1 M
- B. -1.0 M
- C. 0.1 M
- D. 1.0 M

SECTION A - continued
TURN OVER

Question 9

Identify which of the following are principles of Green Chemistry:

- i. Use non-renewable raw materials
 - ii. Minimise potential for accidents
 - iii. Analyse in real time to prevent pollution
 - iv. Design for degradation
- A. i, ii and iv
B. ii, iii and iv
C. ii and iv only
D. iv only

Question 10

Carbon dioxide is considered a major contributor to the greenhouse gases which are responsible for global warming. Identify which of the following process are responsible for emitting carbon dioxide:

- i. Plant respiration
 - ii. Combustion of unleaded petrol
 - iii. Opening of fizzy drink bottles
 - iv. Bushfires across Australia
- A. i, ii and iv only
B. ii, iii and iv only
C. ii and iv only
D. i, ii, iii and iv

Question 11

Water is vital for living systems because:

- A. It is a polar molecule and insoluble in oils.
B. It is high specific heat capacity.
C. Water is liquid at room temperature and expands upon freezing.
D. It is a reactant in photosynthesis and a product in respiration.

Question 12

If the specific heat capacity of water is $4.2 \text{ J g}^{-1} \text{ }^\circ\text{C}^{-1}$, the energy required, in kJ, to raise the temperature of 18 moles of water from 25°C to 75°C is:

- A. 68
B. 136
C. 68040
D. 136080

SECTION A - continued

Question 13

Which of the following is **not** an assumption of the Kinetic Molecular Theory of Gases?

- A. Gas molecules move all the time in random curved directions.
- B. Gas molecules have negligible mass and move easily.
- C. Gas molecules experience minimal intermolecular forces of attraction or repulsion.
- D. Individual gas molecules occupy negligible volume and move in straight lines.

Question 14

Oxygen at 1 atmosphere freezes at $-218.79\text{ }^{\circ}\text{C}$. At what temperature in K will oxygen melt?

- A. -54.36 K
- B. 54.36 K
- C. 491.94 K
- D. Insufficient data to determine correct response.

Question 15

$100\,050\text{ Pa}$ is equal to how many mmHg?

- A. 0.75 mmHg
- B. $750 \times 10^3\text{ mmHg}$
- C. $750 \times 10^{-3}\text{ mmHg}$
- D. 750 mmHg

Question 16

An adjustable gas storage tank is able to store natural gas at various volumes. $8.50 \times 10^6\text{ L}$ of natural gas was stored at a temperature of $27\text{ }^{\circ}\text{C}$ and a pressure of 120 kPa . The pressure and temperature inside the storage tank were both halved. What is the new volume of the gas storage tank?

- A. $8.50 \times 10^6\text{ L}$
- B. $8.50 \times 10^{12}\text{ L}$
- C. $8.50 \times 10^3\text{ L}$
- D. $8.00 \times 10^6\text{ L}$

Question 17

The oxidation number of uranium in K_2UO_4 is.

- A. +2
- B. +3
- C. +6
- D. +7

SECTION A – continued
TURN OVER

Question 18

Fish gills are respiratory organs that enable fish to undergo respiration by extracting dissolved oxygen from water. If the temperature of the water is decreased and the pressure experienced by the gas is increased the concentration of dissolved oxygen will:

- A. Increase.
- B. Decrease.
- C. Remain the same.
- D. Insufficient information to answer the question.

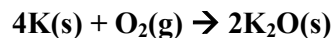
Question 19

Carbon dioxide is often used in fire extinguishers because:

- A. It is readily available.
- B. It is heavier than air.
- C. The carbon atoms will not react further with oxygen.
- D. All of the above.

Question 20

Potassium metal may combust with the oxygen gas in atmospheric air according to the equation:



Which is the reducing agent?

- A. Oxide ions
- B. Oxygen gas
- C. Potassium ions
- D. Potassium atoms

END OF SECTION A

SECTION B - Short-answer questions

Instructions for Section B

Answer all questions in the spaces provided.

Answer this section using a **pen**.

Question 1

a. A 54.0 g aluminium bar is dropped into a beaker containing an excess of nitric acid (HNO_3) at STP. A large volume of gas is produced.

i. Give a balanced chemical equation with states for the reaction of the aluminium with nitric acid.

ii. Calculate the volume of gas produced.

b. The acid in the beaker was replaced with 150 mL of a 3.0 M nitric acid solution.

i. Assuming complete ionisation, determine the pH of the nitric acid solution.

SECTION B – continued
TURN OVER

- ii. Discuss and account for any changes in the volume of gas produced when compared to the answer in **a part ii**. Use calculations to support your answer.

- c. The acid in the beaker was replaced with an excess of 0.0005 M ethanoic acid (CH_3COOH).

Theoretically the reaction should produce the same volume of gas as in **a. part ii**, but when the aluminium and ethanoic acid were mixed there was no observable gas formation. Explain this observation.

[3 + 3] + [1 + 2] + [2]

Total 11 marks

Question 2

- a. A 500 mL volumetric flask was used to prepare a standard solution of sodium carbonate. 1.456 g of Na_2CO_3 was dissolved in deionised water followed by the drop wise addition of deionised water to the 500 mL mark on the volumetric flask.

- i. Calculate the concentration of the Na_2CO_3 solution.

SECTION B – continued

- ii. Na_2CO_3 is considered to be a primary standard. Give two essential criteria of a primary standard.

- b. A 25.0 mL aliquot of the Na_2CO_3 standard solution was titrated against nitric acid HNO_3 using methyl red as an indicator. The titration results obtained are listed in the table below:

Titration Attempt	Volume of HNO_3 (mL)
1	28.34
2	25.93
3	25.88
4	26.45
5	25.90

- i. Give the equation for the reaction.

- ii. Determine the average titre of the acid used using **only appropriate** results.

- iii. Using the answer from a. i. calculate the concentration of the HNO_3 solution.

SECTION B – continued
TURN OVER

- c. 40.0 mL of 2.0 M nitric acid is diluted by the addition of 160.0 mL deionised water.

Calculate the concentration of the diluted solution.

[1+2] + [1+1+3] + [2]

Total 10 marks

Question 3

<i>Substance</i>	<i>Formula</i>	<i>Heat Capacity ($Jg^{-1}^{\circ}C^{-1}$)</i>
Water	H ₂ O	4.18
Ethanol	CH ₃ CH ₂ OH	2.39
Iron	Fe	0.45
Copper	Cu	0.13
Lead	Pb	0.39

- a. Using the data in the above Table to answer the following:
- i. Calculate the amount of energy required to boil 100 mL of water from a room temperature of 22.5 °C.
-
-
- ii. Calculate the amount of energy required for 100 g of copper to be raised by the same temperature difference as in i.
-
-
-

SECTION B – continued

- iii. Account for the difference in the values obtained in i and ii. with reference to intramolecular bonding in water.

- iv. In the Table the specific heat capacity value for ethanol is lower than water but higher than the listed metals. Give an explanation for this.

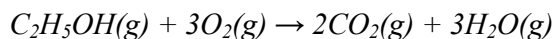
- b. What pH is produced when 235 mg of caesium hydroxide is dissolved in 310 mL of water?

[2 + 2 + 2 + 2] + [4]

Total 12 marks

Question 4

- a. In 2000, the Swedish company Scania introduced ethanol powered buses to Melbourne. Ethanol burns according to the equation:



The combustion of ethanol in excess oxygen produced 12.0 L of carbon dioxide at a temperature of 300 K and a pressure of 95.0 kPa

- i. Calculate the volume of ethanol consumed.

SECTION B – continued
TURN OVER

ii. Calculate the mass of ethanol consumed.

iii. Calculate the mass of carbon dioxide produced.

b. The 2009 Scania buses are considered to be environmentally friendly as they incorporate the ground-breaking third-generation ethanol engines that are able to cut carbon dioxide emissions by 90 %.

If 90 % less carbon dioxide is emitted, calculate the new mass of carbon dioxide produced from the combustion of the same mass of ethanol as in **part a**.

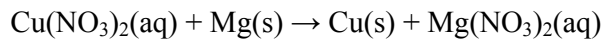
c. Carbon sequestration involves the capturing and storage of carbon dioxide deep below the Earth's surface.

If 5000 L of carbon dioxide at SLC is captured and stored underground at a temperature 5 °C and occupying a 5 % of the original volume, determine the minimum pressure required for the container to hold the carbon dioxide.

[1 + 2 + 2] + [1] + [2]
Total 8 marks

SECTION B – continued

Question 5



a. In the above redox reactions state the:

- i. Oxidant _____
- ii. Reducing Agent _____

b. In the above redox reactions give the:

- i. Oxidation half-equation

- ii. Reduction half-equation

c. Give the oxidation numbers for the following:

- i. Iron in metallic iron and iron(III) chloride.

- ii. Oxygen in phosphoric acid and ozone.

d. Galvanised metals are coated with zinc metal.

- i. Explain why a galvanised iron nail is protected from corrosion.

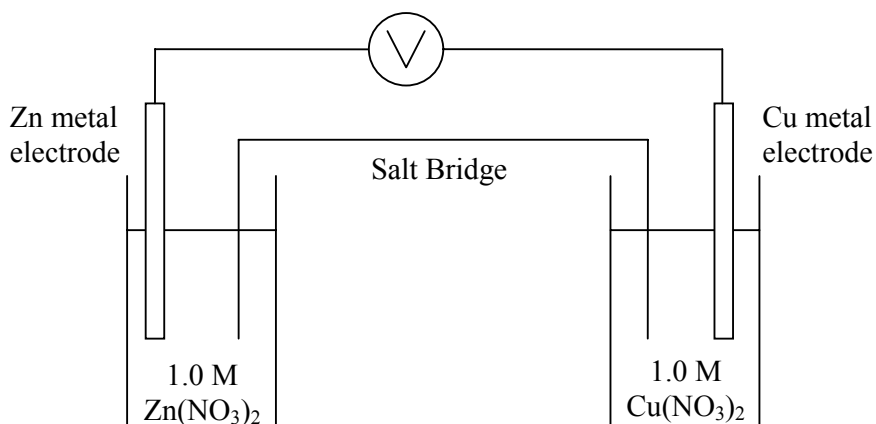
- ii. Explain the effects of coating an iron nail with tin metal.

[1+1] + [1+1] + [1+1] + [1+2]

Total 9 marks
TURN OVER

Question 6

a. A galvanic cell was set up as shown below.



- i. On the galvanic cell shown above, clearly indicate the
- Anode / Cathode
 - Electrode Polarity
 - Electrode where oxidation occurs
 - Electrode where reduction occurs
 - Direction of electron flow
 - Direction of anion and cation flow in the salt bridge
- b. The zinc electrode and the 1.0 M $\text{Zn}(\text{NO}_3)_2$ solution were replaced with a silver electrode and a 1.0 M AgNO_3 solution. Discuss any changes that you would expect to occur with the following:

i. The direction of electron flow

ii. The mass of the copper electrode

SECTION B – continued

iii. The colour of the blue $\text{Cu}(\text{NO}_3)_2$ solution

iv. The polarity of the copper electrode

[1+1+1+1+1+1] + [1+1+1+1]

Total 10 marks

END OF QUESTION AND ANSWER BOOK