

STUDENT:

TEACHER:

YEAR 11 – OCTOBER 2006

CHEMISTRY

Written test 2

Reading time: 15 minutes
Writing time: 1 hour 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	24
B	8	8	55	66
			Total 75	90

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

Materials

- Question and answer book of 14 pages with a detachable data sheet in the centrefold.
- Answer sheet for multiple choice questions.

Instructions

- Detach the data sheet from the centre of this book during reading time.
- Write your **name** in the space provided above **and** on the multiple choice answer sheet.
- 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 other electronic communication devices into the test 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

In which pair of substances is one of the species amphoteric, and the other species diprotic?

- A. OH^- and O^{2-} .
- B. H_2SO_4 and SO_4^{2-} .
- C. H_2PO_4^- and HPO_4^{2-} .
- D. CH_3COOH and CH_3COO^- .

Question 2

1.0M ethanoic acid is considered to be a weak acid because it

- A. has a pH value greater than 7.
- B. will only react with strong bases.
- C. ionises extensively in aqueous solution.
- D. exists mainly as molecules in aqueous solution.

Question 3

The number of atoms present in 1.0 mole of ammonia, NH_3 , is

- A. 4.0.
- B. 1.0×10^{23} .
- C. 6.0×10^{23} .
- D. 2.4×10^{24} .

Question 4

The amount, in mole, of carbon atoms in 10.4g of styrene, C_8H_8 , is

- A. 0.10.
- B. 0.80.
- C. 6.0×10^{22} .
- D. 4.8×10^{23} .

Question 5

A beaker contains 100 mL of HCl solution with a pH of 2.0. What is the concentration of hydrogen ions in the solution?

- A. 0.01M.
- B. 0.001M.
- C. 1.0M.
- D. 2.0M.

Question 6

The pH of a sodium hydroxide solution is 11. What is the concentration of hydroxide ions in the solution?

- A. 3M.
- B. 11M.
- C. 10^{-3} M.
- D. 10^{-11} M.

Question 7

Which one of the following formulas is an empirical formula?

- A. C_2H_6 .
- B. H_2O_2 .
- C. CH_3Cl .
- D. $C_6H_{12}O_6$.

Question 8

A beaker contains 10 mL of 0.1M HCl solution. What volume of water must be added to this solution to change its concentration to 0.005M?

- A. 5 mL.
- B. 20 mL.
- C. 190 mL.
- D. 200 mL.

Question 9

Which one of the following quantities will have the greatest mass?

- A. 0.20 mol of zinc.
- B. 12.0g of $CuSO_4 \cdot 5H_2O$.
- C. 2.4×10^{23} oxygen molecules.
- D. 120L of hydrogen gas at STP.

Question 10

Which one of the following gases is most abundant by volume in the earth's atmosphere?

- A. Ozone.
- B. Oxygen.
- C. Nitrogen.
- D. Carbon dioxide.

Question 11

Nitrogen is a relatively unreactive element. Its lack of reactivity is due to

- A. its very low boiling point of -196°C .
- B. nitrogen atoms having a full outer shell of electrons.
- C. the difficulty in removing it from the nitrogen cycle.
- D. the presence of a strong triple covalent bond within nitrogen molecules.

Question 12

Which one of the following statements best represents Boyle's Law?

- A. The temperature of a gas is a measure of the average kinetic energy of particles in the sample.
- B. The volume of a given amount of gas at constant temperature is inversely proportional to its pressure.
- C. The pressure exerted by a given amount of gas at constant volume is directly proportional to the absolute temperature.
- D. At constant temperature and volume, the total pressure exerted by a mixture of gases is equal to the partial pressures of the constituent gases.

Question 13

Which one of the following statements is consistent with the kinetic molecular theory of gases?

- A. Gases consist of a large lattice of small discrete molecules.
- B. The forces of attraction between gas molecules are negligible.
- C. There is considerable energy loss in collisions between gas molecules.
- D. The volume occupied by a gas is negligible compared with the volume of a gas molecule.

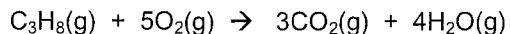
Question 14

What is the volume occupied by 5.60g of nitrogen gas (N_2) at STP?

- A. 200 mL.
- B. 4.48L.
- C. 5.60L.
- D. 22.4L.

Question 15

The complete combustion of propane gas can be represented by the equation



A 400 mL sample of propane is combusted in 3.0 L of oxygen, producing carbon dioxide and water.

Assuming that all volumes are measured under the same conditions of temperature and pressure, the total volume of gases at the completion of the reaction is

- A. 2.8L.
- B. 3.0L.
- C. 3.4L.
- D. 3.8L.

Question 16

Which one of the following processes does not return carbon dioxide to the atmosphere as part of the carbon-oxygen cycle?

- A. Volcanic eruptions.
- B. Combustion of fossil fuels.
- C. Photosynthesis by green plants.
- D. Respiration by plants and animals.

Question 17

A series of chemical equations is given to represent the following reactions.

i.	$\text{CuCO}_3(\text{s}) \rightarrow \text{CuO}(\text{s}) + \text{CO}_2(\text{g})$
ii.	$\text{HCO}_3^-(\text{aq}) + \text{NH}_4^+(\text{aq}) \rightarrow \text{H}_2\text{CO}_3(\text{aq}) + \text{NH}_3(\text{aq})$
iii.	$\text{Fe}_2\text{O}_3(\text{s}) + 3\text{CO}(\text{g}) \rightarrow 2\text{Fe}(\text{s}) + 3\text{CO}_2(\text{g})$
iv.	$\text{PbCl}_2(\text{aq}) + 2\text{KI}(\text{aq}) \rightarrow \text{PbI}_2(\text{s}) + 2\text{KCl}(\text{aq})$

From this list of equations

- A. reaction i is acid-base, and reaction ii is redox.
- B. reaction ii is acid-base, and reaction iii is redox.
- C. reaction iii is acid-base, and reaction iv is redox.
- D. reaction iv is acid-base, and reaction i is redox.

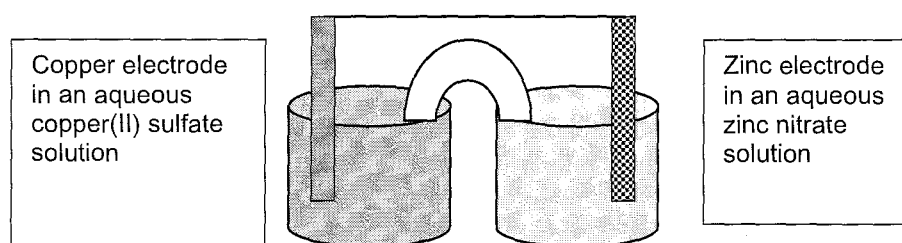
Question 18

In the redox reaction $\text{Mg(s)} + \text{Cu}^{2+}(\text{aq}) \rightarrow \text{Mg}^{2+}(\text{aq}) + \text{Cu(s)}$

- A. magnesium atoms lose electrons and are oxidised.
- B. magnesium atoms gain electrons and are oxidised.
- C. copper(II) ions lose electrons and are oxidised.
- D. copper(II) ions gain electrons and are oxidised.

The next two questions refer to the following information:

An electrochemical cell is set up as shown in the following diagram. The solutions are connected by a salt bridge. When the electrodes are connected by a piece of conducting wire, it is found that the copper electrode is positive and the zinc electrode is negative.

**Question 19**

Which one of the following statements about the electrochemical cell is correct?

- A. The zinc electrode is acting as the anode.
- B. The copper electrode is undergoing oxidation.
- C. Electrons are flowing in the salt bridge from the Cu^{2+}/Cu half cell to the Zn^{2+}/Zn half cell.
- D. Electrons are flowing along the conducting wire from the copper electrode to the zinc electrode.

Question 20

The purpose of the salt bridge is to

- A. allow the solutions to mix readily.
- B. maintain the electrical neutrality of both aqueous solutions.
- C. provide additional positive ions for the zinc nitrate solution.
- D. provide the electrons with an alternate pathway between the electrodes.

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 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

Write chemical equations to represent the following reactions.

Ionic equations are acceptable where appropriate.

- a. The production of hydrogen gas from the reaction between zinc metal and dilute sulfuric acid.

2 marks

- b. The production of carbon dioxide gas by reaction between solid sodium carbonate and dilute hydrochloric acid.

2 marks

- c. The formation of ammonia, NH_3 , from nitrogen gas and hydrogen gas.

2 marks

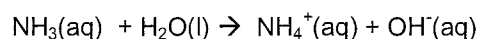
- d. The neutralisation of barium hydroxide solution by dilute nitric acid.

2 marks

Total 8 marks

Question 2

- a. Ammonia ionises in water forming a solution that contains ammonium ions and hydroxide ions. This reaction can be represented by the equation



- (i) Ammonia solution is a **weak base**. Explain what the terms **weak** and **base** mean in this context.

- (ii) Is water acting as an acid or a base in this reaction? Give a reason with your answer.

2 + 2 = 4 marks

- b. Hydrogen sulfide in solution, H_2S , is a **diprotic acid**. Explain, using two equations, what the term **diprotic acid** means in this context.

2 marks

- c. The hydrogen carbonate ion, HCO_3^- is **amphiprotic**. Write the chemical formula of the

- (i) conjugate acid of the hydrogen carbonate ion.

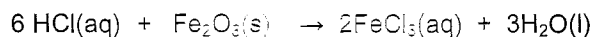
(ii) conjugate base of the hydrogen carbonate ion.

1 + 1 = 2 marks

Total 8 marks

Question 3

- a. Pickling of steel is a process in which rust in the form of iron(III) oxide is removed by reaction with hydrochloric acid. The equation representing the reaction is



- (i) 3.20g of iron(III) oxide covers a sheet of steel. Calculate the amount, in moles, of iron(III) oxide present.

- (ii) Calculate the amount, in mole, of hydrochloric acid that is needed to react with all of the iron(III) oxide.

- (iii) Calculate the volume of hydrochloric acid required if its concentration is 2.00M

1 + 1 + 1 = 3 marks

- b. Show by means of calculation which of the following two compounds contains the higher percentage of oxygen by mass; potassium dichromate, $\text{K}_2\text{Cr}_2\text{O}_7$, or glucose, $\text{C}_6\text{H}_{12}\text{O}_6$.

2 marks

Total 5 marks

Question 4

- a. Vitamin C has the following percentage by mass:

carbon 40.91%; hydrogen 4.54%; oxygen 54.55%

- (i) Calculate the empirical formula of this compound.

- (ii) If the molar mass of this compound is 176 g mol^{-1} , what is its molecular formula?

3 + 1 = 4 marks

- b. The metal antimony, Sb, consists of two isotopes. Their isotopic masses are 121.0 and 123.0 respectively. The relative atomic mass of antimony is 121.8. Calculate the percentage abundance of each isotope of antimony.

3 marks

Total 7 marks

Question 5

- a. A student performs a chemical experiment in a test tube in which a gas is produced. He is unsure if the gas is carbon dioxide or oxygen.

(i) Describe a simple and safe laboratory test that could be used to identify oxygen.

(ii) Describe a simple chemical test that could be used to identify carbon dioxide.

1 + 1 = 2 marks

- b. List a commercial/industrial use made of argon, and describe the property of argon that makes it suitable for that purpose.

2 marks

- c. Describe two properties of carbon dioxide that make it suitable to be used in fire extinguishers.

2 marks

- d. What mass of carbon dioxide must be contained in a fire extinguisher if it delivers 4.90×10^3 L of carbon dioxide at STP?

2 marks

Total 8 marks

Question 6

- a. State Charles' Law.

2 marks

- b. A sample of argon in a syringe occupies a volume of 30.0 mL at 22°C. At what temperature, in degrees Celsius, will the same amount of argon have doubled its volume when heated? Assume the pressure remains constant during the experiment.

2 marks

- c. Use the kinetic theory of gases to explain why it is dangerous to throw an aerosol can into a fire.

2 marks

- d. The gas in an expandable balloon at 20°C occupies a volume of 340 mL at a pressure of 102 kPa. What will be the volume of the gas in the balloon if the temperature rises to 40°C and the pressure to 105 kPa? Assume that the amount of gas remains constant.

3 marks

Total 9 marks

Question 7

The following table contains the results recorded by a student who was trying to determine the order of reactivity of metals. The experiment consisted of placing a small piece of metal in the aqueous solutions of the nitrates of the other metals in the test. An observed reaction is recorded as a tick (✓). A cross means no reaction was observed.

	Ag	Cu	Pb	Zn
Ag ⁺		✓	✓	✓
Cu ²⁺	X		✓	✓
Pb ²⁺	X	X		✓
Zn ²⁺	X	X	X	

- a. From the results in this table, which metal is the strongest reductant? Give an explanation for your choice.

2 marks

- b. List the remaining metals in order of decreasing reducing strength.

1 mark

- c. Write an ionic equation for the reaction between Ag⁺ and Zn

1 mark

- d. Sometimes when this experiment is performed the results don't match the published table of reactivity of metals. Give a reason why this might occur.

1 mark

Total 5 marks

Question 8

- a. Painting a large iron or steel object is an effective means of corrosion protection. What is a disadvantage of using paint for this purpose?

1 mark

- b. A steel pipeline carries gas over a long distance, and it is important that it does not corrode.
- (i) One option is to use sacrificial anodes. Explain how this method provides corrosion protection, including the name of a suitable metal to use as the anode.

- (ii) Another option is to use an impressed current. Explain how this method provides corrosion protection.

2 + 2 = 4 marks

Total 5 marks**END OF SECTION B****END OF QUESTION AND ANSWER BOOK**