

2013 Trial Examination

STUDENT NUMBER

Figures

Words

Letter

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CHEMISTRY

Unit 2 – Written examination

Reading time: 15 minutes

Writing time: 1 hour and 30 minutes

QUESTION & 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>
A	20	20	20
B	7	7	54
			Total 74

- 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 14 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

In which list below is every substance likely to be soluble in water?

- A. $C_6H_{12}O_6$, HCl, C_3H_8
- B. SiO_2 , HNO_3 , O_2
- C. CH_3CH_3 , $NaNO_3$, NH_3
- D. HCl, $C_6H_{12}O_6$, $NaNO_3$

Question 2

A sheet of iron would **not** be protected from rusting by

- A. alloying it with a small amount of chromium
- B. painting it
- C. coating it with zinc
- D. keeping it moist

Question 3

An acid is **best** described as a substance that

- A. burns skin
- B. can donate a proton
- C. will turn red litmus paper blue
- D. can accept a proton

Question 4

The conjugate base for the ion HSO_4^- in aqueous solution is

- A. H_3O^+
- B. OH^-
- C. SO_4^{2-}
- D. H_2SO_4

SECTION A – continued

Question 5

When silver nitrate solution is mixed with potassium chloride solution, a precipitate forms. The precipitate would be

- A. silver chloride
- B. potassium nitrate
- C. potassium metal
- D. silver nitrate

Question 6

The solution that would be expected to have the lowest pH would be

- A. 0.001M CH_3COOH
- B. 1M CH_3COOH
- C. 1M HCl
- D. 1M H_2SO_4

Question 7

The pH of a sample of 0.5 M calcium hydroxide solution is approximately

- A. 0
- B. 0.3
- C. 13.7
- D. 14

Question 8

An oxidant is a substance that

- A. gives up electrons and thus decreases in oxidation number
- B. accepts electrons and thus decreases in oxidation number
- C. accepts electrons and thus increases in oxidation number
- D. gives up electrons and thus increases in oxidation number

SECTION A – continued
TURN OVER

Question 9

One of the products of the reaction of lithium hydrogen carbonate with hydrochloric acid would be

- A. hydrogen gas
- B. able to support combustion
- C. able to turn limewater cloudy
- D. a basic solution

Question 10

The reaction that is likely to occur spontaneously is

- A. silver metal in zinc nitrate solution
- B. nickel nitrate with copper solid
- C. copper sulphate with iron solid
- D. iron metal with calcium sulphate

Question 11

Which of the following is **not** directly contributing to the enhanced greenhouse effect?

- A. The clearing of forests
- B. Cattle breeding
- C. Rising sea levels
- D. The burning of fossil fuels

Question 12

Which of the following statements is **incorrect**?

- A. Acid rain is linked to respiratory illness in humans
- B. The use of hydrochloric acid in cleaning, is contributing to the acid rain problem
- C. Sulfur dioxide is involved in the formation of acid rain
- D. Acid rain reacts with marble monuments and thus, wears them away

Question 13

Water returns to the ground via

- A. evaporation
- B. photosynthesis
- C. transpiration
- D. precipitation

SECTION A – continued

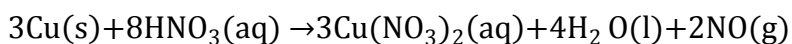
Question 14

The property of water not directly due to the strong hydrogen bonds found between water molecules is

- A. high solubility of a range of substances
- B. high heat capacity
- C. high latent heat values compared with other molecules
- D. high melting temperature compared with similar sized molecules

The following information relates to Questions 15 & 16

The equation for the production of nitrogen(II) oxide in the laboratory is



Question 15

The percentage atom economy for the production of nitrogen(II) oxide is nearest to

- A. 9%
- B. 47%
- C. 26%
- D. 32%

Question 16

When 11 g of copper reacts with excess nitric acid at SLC, the volume of nitrogen(II) oxide produced is, in L,

- A. 4.0
- B. 2.8
- C. 6.4
- D. 5.9

Question 17

If the pressure of a sample of neon gas needs to be increased from 25.0 kPa to 0.700 atm, then its original volume of 700.0 mL would need to be:

- A. decreased by 246.8 mL
- B. increased by 246.8 mL
- C. decreased by 453.2 mL
- D. increased by 453.2 mL

**SECTION A – continued
TURN OVER**

Question 18

The sample that would produce the largest volume of gas at STP would be

- A. 0.02 mol of helium
- B. 9.03×10^{22} carbon dioxide molecules
- C. 2.88 g of oxygen gas
- D. 0.11 mol of hydrogen gas

Question 19

A 7.3 L sample of gas is at 20°C. When the temperature is reduced to -3.0°C, the gas occupies a volume of, in L,

- A. 6.7
- B. 81.9
- C. 8.2
- D. 29.1

Question 20

When 2.00 g of methane is combusted, the amount of molecules produced is, in mol,

- A. 0.375
- B. 0.125
- C. 1.00
- D. 0.500

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**.

To obtain full marks for your response 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, $H_2(g)$; $NaCl(s)$

Question 1

Barium nitrate is a toxic, white solid at room temperature that is soluble in water.

Experimentally, the water solubility values it has are listed in the table below.

Table 1: Solubility of barium nitrate in 100g of water

Solubility (g/100g water)	Temperature
4.95g	0°C
10.50g	25°C
34.40g	100°C

- a. Using the data above, how much barium nitrate would be in a 75 mL saturated solution at 25°C?

1 mark

- b. 250 mL of water at 0°C has 11.1 g of barium nitrate dissolved in it. Would the solution be considered saturated? Explain your answer.

2 marks

SECTION B – Question 1 - continued
TURN OVER

- c. 50mL of barium nitrate solution is kept at 100°C. What mass of barium nitrate would crystallise out when the solution is cooled to 25°C?

2 marks

- d. Ethanol is another soluble compound in water. Using reference to the bonds made, explain the difference between how ethanol dissolves in water compared with barium nitrate.

2 marks

Total 8 marks

Question 2

- a. Carbonic acid, H_2CO_3 , is a weak diprotic acid. Using equations, show the successive ionization steps for this acid.

2 marks

- b. Write a balanced chemical equation for the reaction between solid zinc and dilute hydrochloric acid

1 mark

SECTION B – Question 2 - continued

- c. The pH of 0.25M sulfuric acid is tested in a laboratory at 25°C and is found not to be 0.3 as theoretically calculated. Explain why it is difficult to calculate an accurate pH for this solution.

2 marks

- d. Calculate the $[H^+]$ and $[OH^-]$ values for a sodium hydroxide solution with a pH of 12.6.

2 marks

- e. Solution A has a pH of 2, whilst solution B has a pH of 5. How many more times acidic is Solution A compared to solution B?

1 mark

Total 8 marks

Question 3

50mL of 0.25M lithium hydroxide is completely neutralised with 80mL of nitric acid.

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

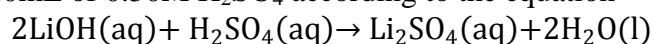
1 mark

SECTION B – Question 3 - continued
TURN OVER

- b. Calculate the concentration of nitric acid needed in this reaction to completely neutralise the lithium hydroxide.

3 marks

- c. Another sample of lithium hydroxide of the same volume and concentration as above is then mixed with 120mL of 0.30M H_2SO_4 according to the equation



- (i) Calculate the number of moles of each of the reactants and state which reactant is the limiting reagent

- (ii) What mass of water would be produced from this reaction?

3 + 2 = 5 marks

Total 9 marks

SECTION B - continued

Question 4

- a. 7.50×10^{23} glucose molecules are dissolved in 100.0 mL water. Calculate the molarity of the solution.

- b. A 200.0 mL sample of 1.50 M hydrochloric acid needs to be diluted to a concentration of 0.90 M. What volume of water must be added to the sample?

2 marks

2 marks

Total 4 marks

Question 5

- a. A gas exerts a pressure of 1.8 atm, at 25°C, in an 8.0 L container. For the same gas to exert a pressure of 200.0 kPa at 35°C, what volume would the container need to have?

3 marks

SECTION B – Question 5 - continued
TURN OVER

- b. What will the volume of a balloon be if it contains 50.0 g of oxygen gas stored at 30.0°C and 3.5 atm?

3 marks

- c. Using the kinetic molecular theory of gases, explain the following.

i. Helium gas can be easily compressed in a gas syringe

ii. Gases will spread out to occupy all of the space of the given container

1 + 1 = 2 marks
Total 8 marks

SECTION B – continued

Question 6

- a. Water has a range of unusual and useful properties. For the properties of water listed below, complete the table.

Property	Explanation in terms of structure and bonding	Importance in sustaining life
A very good solvent		
Less dense as a solid than a liquid		
High Specific Heat Capacity		

6 marks

- b. A reaction occurs between an aqueous solution of X and an aqueous solution of Y that produces a barium sulphate precipitate. Name two aqueous solutions that X and Y could be to create this product.

2 marks

Total 8 marks

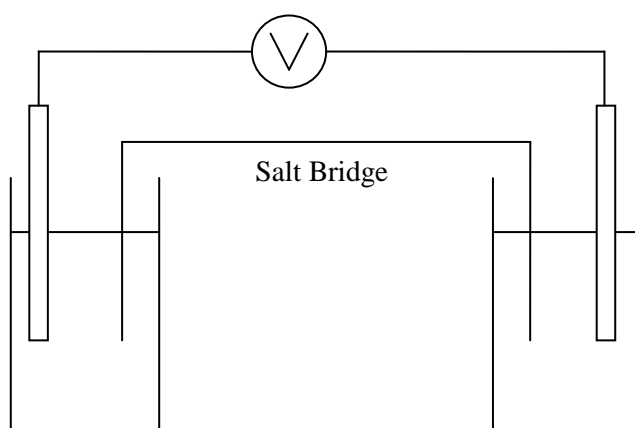
**SECTION B – continued
TURN OVER**

Question 7

a. A galvanic cell is to be set up for the reaction between zinc and lead (II) nitrate, which uses a potassium nitrate salt bridge.

i. Using the diagram of a galvanic cell below, label the following:

- the materials used for the electrodes
- the polarity of the electrodes
- the direction of electron flow
- the solutions to be used
- the direction of flow of the ions in the salt bridge.



ii. Write the half-cell equation for the reaction happening at the anode

iii. Write the overall equation for the reaction happening in the galvanic cell

5 + 1 + 2 = 8 marks

b. State the oxidation number for the underlined species in the following:

i. $\text{H}_2\underline{\text{S}}\text{O}_4$ _____

ii. $\underline{\text{N}}_2\text{H}_4$ _____

2 marks

Total 10 marks

END OF QUESTION AND ANSWER BOOK