## FUKIEN SECONDARY SCHOOL

## S5 First Term Uniform Test (2021-2022)

## Chemistry

(1 hour)

Date: 10<sup>th</sup> November 2021

Time: 10:00a.m. - 11:00a.m.

Name:		
Class:	No.:	

## **Instructions to students:**

- 1. Write your name, class and class number on both the question paper and the answer sheets.
- 2. Answer ALL questions.
- 3. Write down all the answers on the answer sheets.
- 4. Hand in the question paper and the answer sheets at the end of the examination.
- 5. The total mark of the paper is 60.

## I. Multiple Choice Questions (20 marks)

- 1. Which of the following substances does NOT give any new product on heating?
  - A. Calcium carbonate
  - B. Iodine
  - C. Silver oxide
  - D. Zinc
- 2. Each of the following substances is burnt in oxygen and its product(s) is/are mixed with water or bubbled into water. Which of the substances will give the highest pH?
  - A. Carbon
  - B. Iron
  - C. Potassium
  - D. Sulphur
- 3. The atomic numbers of both elements *X* and *Y* are less than 20. When elements *X* and *Y* are chemically combined, a covalent compound with a chemical formula of  $XY_2$  forms. The atomic numbers for *X* and *Y* are likely to be:

	<u>X</u>	<u>Y</u>
А.	3	9
В.	10	15
C.	6	16
D.	11	18

- 4. Which of the following molecules has/have a planar structure?
  - (1)  $BeCl_2$
  - (2) Cl<sub>2</sub>O
  - (3) NOBr
  - A. (1) only
  - B. (2) only
  - C. (1) and (3) only
  - D. (2) and (3) only
- 5. Three solutions without labels on their reagent bottles are given:

sodium hydroxide, potassium hydroxide, barium hydroxide

Which of the following methods can be used to identify barium hydroxide solution?

- A. Test with limewater
- B. Test with red litmus paper
- C. Test with dry cobalt(II) chloride paper
- D. Test with sodium carbonate solution
- 6. Consider the following experimental set-up:



Metal X is most probably

- A. copper.
- B. iron.
- C. mercury.
- D. silver.
- 7. The conversion of vanadium metal, V(s), to  $VO_2^+(aq)$  is shown below:

 $\begin{array}{ccc} \text{Step I} & \text{Step II} & \text{Step III} & \text{Step IV} \\ V(s) \rightarrow V^{2+}(aq) \rightarrow V^{3+}(aq) \rightarrow VO^{2+}(aq) \rightarrow VO_2^{+}(aq) \end{array}$ 

In which step is the change of oxidation number of vanadium the greatest?

- A. Step I
- B. Step II
- C. Step III
- D. Step IV

8. Consider the following experimental set-up:



Which of the following statements about the experiment is/are correct?

- (1) The electrode made of metal *Y* is the positive electrode.
- (2) Nickel is at a position lower than metal *Y* in the Electrochemical Series.
- (3) The mass of the nickel electrode decreases gradually.
- A. (1) only
- B. (2) only
- C. (1) and (3) only
- D. (2) and (3) only
- 9. When a Group II metal undergoes a reaction, its atom *X* becomes ion  $X^{2+}$ . Which of the following statements about *X* and  $X^{2+}$  is/are correct?
  - (1) The diameter of  $X^{2+}$  is larger than X.
  - (2) The number of electrons in  $X^{2+}$  is less than that in *X*.
  - (3) The positive charge of the nucleus in  $X^{2+}$  is greater than that of the nucleus in X.
  - A. (1) only
  - B. (2) only
  - C. (1) and (3) only
  - D. (2) and (3) only
- 10. Which of the following properties of Group I elements increase(s) down the group?
  - (1) Electronegativity
  - (2) Reducing power
  - (3) Reaction with water
  - A. (1) only
  - B. (2) only
  - C. (1) and (3) only
  - D. (2) and (3) only

### Page 4 of 18 pages

- 11. What is the pH of the resultant solution when 20.0 cm<sup>3</sup> of 0.04 M HCl(aq) and 40.0 cm<sup>3</sup> of 0.005 M NaOH(aq) are mixed together?
  - A. 2.0
  - B. 3.5
  - C. 7.0
  - D. 8.0
- 12. Consider the following experimental set-up:



After a period of time, the concentration of sodium sulphite solution drops to 0.05 M. What is the concentration of acidified potassium permanganate solution at that time?

- A. 0 M
- B. 0.02 M
- C. 0.03 M
- D. 0.07 M
- 13. x g of an oxide,  $M_2O_3$ , is reduced to y g of metal M. The expression for the relative atomic mass of M in terms of x and y is

(Relative atomic mass of O = 16.0)

A. 
$$\frac{16(x-y)}{y}$$
.  
B. 
$$\frac{x-y}{16x}$$
.  
C. 
$$\frac{x-y}{24y}$$
.  
D. 
$$\frac{24y}{x-y}$$
.

14. What are the values of a, b and c respectively in the following equation?

 $Pb(s) + aPbO_2(s) + 2H_2SO_4(aq) \rightarrow bPbSO_4(s) + cH_2O(l)$ 

A. 1, 2, 2
B. 1, 2, 4
C. 2, 3, 4
D. 3, 2, 4

**Directions:** Question 15 to Question 17 refer to the following experiment:

Different volumes of a calcium nitrate solution were added to six beakers, each containing  $50.0 \text{ cm}^3$  of 0.05 M sulphuric acid. The precipitate obtained in each beaker was dried and weighed. Below is a plot of mass of precipitate against volume of calcium nitrate solution added.



- 15. Estimated from the graph above, what is the volume of calcium nitrate solution that completely reacted with 50.0 cm<sup>3</sup> of 0.05 M sulphuric acid?
  - A.  $17.5 \text{ cm}^3$
  - B.  $19.0 \text{ cm}^3$
  - C.  $20.0 \text{ cm}^3$
  - D.  $30.0 \text{ cm}^3$
- 16. What is the molarity of the calcium nitrate solution?
  - A. 0.083 M
  - B. 0.125 M
  - C. 0.132 M
  - D. 0.143 M

- 17. Which of the following statements concerning the experiment is/are correct?
  - (1) The precipitate is white in colour.
  - (2) A measuring cylinder is used to measure the different volumes of calcium nitrate solution added to the beakers.
  - (3) The mass of precipitate formed at the end of the experiment would be halved if 25.0 cm<sup>3</sup> of 0.05 M sulphuric acid were used instead of 50.0 cm<sup>3</sup> of 0.05 M sulphuric acid.
  - A. (1) only
  - B. (2) only
  - C. (1) and (3) only
  - D. (2) and (3) only
- 18. Consider the following set-ups of electrolysis:



In which of the above set-ups will the pH of the electrolyte decrease?

- A. I only
- B. II only
- C. I and III only
- D. II and III only

- **Directions:** Each question below (Questions 19 and 20) consists of two separate statements. Decide whether each of the two statements is true or false; if both are true, then decide whether or not the second statement is a *correct* explanation of the first statement. Then select one option from A to D according to the following table:
- A. Both statements are true and the 2nd statement is a correct explanation of the 1st statement.
- B. Both statements are true and the 2nd statement is NOT a correct explanation of the 1st statement.
- C. The 1st statement is false but the 2nd statement is true.
- D. Both statements are false.

	1st statement	2nd statement
19.	In forming lithium oxide, each of the two	The chemical formula of lithium oxide is $Li_2O$ .
	lithium atoms transfers one electron to an	
	oxygen atom.	
20.	Silver cannot displace zinc ion from the	The reducing power of silver is weaker than that
	aqueous solution of zinc compound.	of zinc.

## **END OF PART I**

## **II.** Structured Questions (40 marks)

- Magnesium is oxidized when it is exposed to air for a long time. A student performed an experiment to determine the percentage by mass of magnesium oxide in a magnesium sample.
   0.150 g of the magnesium sample was added to 25.0 cm<sup>3</sup> of 1.0 M hydrochloric acid. When the reaction was completed, the resultant solution was diluted to 250.0 cm<sup>3</sup> with distilled water. 25.0 cm<sup>3</sup> of the diluted solution was then titrated against 0.08 M sodium hydroxide solution. The mean titre was 18.75 cm<sup>3</sup>.
- (a) Draw the electron diagram of magnesium oxide, showing electrons in the outermost shells only.

(1 mark)

- (b) Write the chemical equations for the reaction between hydrochloric acid and the following substances.
  - (i) Magnesium
  - (ii) Magnesium oxide (2 marks)
- (c) Suggest a suitable indicator for the reaction. (1 mark)
- (d) Calculate the percentage by mass of magnesium oxide in the sample. (4 marks) (Relative atomic masses: O = 16.0, Mg = 24.3)

- 2. A student carried out the electrolysis of 2 M hydrogen peroxide solution at pH = 10. Oxygen and hydrogen were collected at the anode and the cathode respectively.
- (a) Write the half equations for the reaction taking place at the anode and the cathode respectively.
  - (2 marks)
- (b) Write the overall equation for the electrolysis of hydrogen peroxide. (1 mark)
- (c) Hence, deduce the theoretical volume ratio of hydrogen to oxygen. (1 mark)
- (d) State and explain the change in pH of the resultant solution after electrolysis. (2 marks)
- (e) The student stated that the products of the electrolysis of hydrogen peroxide are the same as those of the decomposition of hydrogen peroxide. Comment on the statement. (1 mark)
- 3. Consider the following set-up.



(a) Write the half equations for the reactions occurred at electrodes P and Q respectively.

(2 marks)

- (b) State and explain the electron flow between electrodes Q and R. (1 mark)
- (c) With the aid of a half equation, state the observable change at electrode *R*. (2 marks)
- (d) If  $3.01 \times 10^{21}$  electrons are passed to electrode *S*, calculate the mass of silver deposited on electrode *S*. (Relative atomic mass: Ag = 107.9; Avogadro constant =  $6.02 \times 10^{23} \text{ mol}^{-1}$ )

(2 marks)

- 4. Ammonia (NH<sub>3</sub>) and phosphine (PH<sub>3</sub>) are hydrides of Group V elements.
- (a) Explain, in terms of electronic arrangement, the meaning of Group V elements. (1 mark)
- (b) Ammonia solution reacts with nitric acid to form a salt.
  - (i) Name the salt formed. (1 mark)
    (ii) Calculate the percentage by mass of nitrogen in this salt. (2 marks)

(Relative atomic masses: H = 1.0, N = 14.0, O = 16.0)

- (c) Draw a labelled diagram to illustrate the intermolecular forces form between TWO ammonia molecules in liquid phase.(2 marks)
- (d) Phosphine is a gas at room temperature and pressure.
  - (i) Draw the three-dimensional structure of a phosphine molecule. (1 mark)
  - (ii) Predict, with explanation, whether ammonia or phosphine can be liquefied more easily.

(2 marks)

5. Titanium can be extracted from its ore through the following steps.



- (a) Titanium(IV) oxide obtained from step 1 is also known as titanium dioxide.
  - (i) Give its chemical formula. (1 mark)
  - (ii) What is the oxidation number of Ti in titanium(IV) oxide? (1 mark)
- (b) In Step 2, titanium(IV) oxide reacts with excess chlorine to form titanium(IV) chloride and gas A.
  - (i) What is gas A? Give a chemical test for gas A. (2 marks)
  - (ii) Write a chemical equation for the reaction in Step 2. (1 mark)
  - (iii) A student said that titanium(IV) oxide loses two oxygen atoms and so it is reduced. Explain, in terms of oxidation number, why the student's view is incorrect. (1 mark)
  - (iv) Coke, a form of carbon, is added to remove gas A to form carbon monoxide. Write a chemical equation for this process. (1 mark)
- (c) The following equation shows the reaction involved in Step 3:

$$2Mg + TiCl_4 \rightarrow 2MgCl_2 + Ti$$

With reference to the above equation, discuss the reactivity of titanium and magnesium.

(2 marks)

# **End of paper**

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PERIODIC TABLE 週期表

GROUP 族

103 Lr (260)

102 No (259)

101 Md (258)

100 **Fm** (257)

99 Es (252)

98 Cf (251)

97 **Bk** (247)

96 **Cm** (247)

95 Am (243)

94 **Pu** (244)

93 Np (237)

92 U 238.0

91 **Pa** (231)

90 **Th** 232.0

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