END OF SECTION A

FUKIEN SECONDARY SCHOOL
S5 Final Examination (2020-2021)
Chemistry Paper 1
(2 hours 30 minutes)

Date: 17th June 2021 Name:_____
Time: 8:30a.m. - 11:00a.m. Class: _____ No.:_____

SECTION B : Question-Answer Book B

INSTRUCTIONS FOR SECTION B

1. Write your student name and class number in the spaces provided on this page.

2. Refer to the general instructions on the cover of the Question Book for Section A.

3. This section consists of TWO parts, Part I and Part II.

4. Answer ALL questions in each part. Write your answers in the spaces provided in this Question-Answer Book.

5. A Periodic Table is printed on the back of this Question-Answer Book. Atomic numbers and relative atomic masses of elements can be obtained from the Periodic Table.

6. An asterisk (*) has been put next to the questions where one mark will be awarded for effective communication.

PART I

Answer **ALL** questions. Write your answers in the spaces provided.

1. As rainwater is slightly acidic, it erodes rocks containing calcium carbonate.

   (a) Suggest a test to show the presence of each of the following ions in a rock sample.

   (i) Calcium ion

   (ii) Carbonate ion

   (2 marks)

   (b) Explain why rainwater is slightly acidic.

   (1 mark)

   (c) With the aid of a chemical equation, briefly explain how rainwater erodes rocks containing calcium carbonate.

   (2 marks)

Answers written in the margins will not be marked.

2. Thermite reaction is an exothermic redox reaction between iron(III) oxide and aluminium. It is commonly used to weld rail tracks.

(a) Describe the bonding in iron(III) oxide.

(2 marks)

(b) Given that the iron produced in thermite reaction is in molten state, write a chemical equation for the reaction between iron(III) oxide and aluminium.

(1 mark)

(c) In terms of change in oxidation number, deduce the reducing agent in thermite reaction.

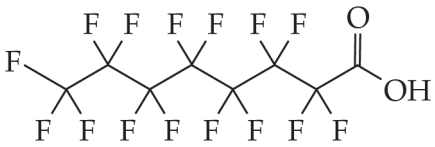
(2 marks)

(d) Suggest how thermite reaction is used to weld rail tracks.

(1 mark)

Answers written in the margins will not be marked.

3. Teflon is an addition polymer commonly used as coating for non-sticky cooking pans. The monomer of Teflon is tetrafluoroethene. At the temperature above 350°C, Teflon decomposes, releasing a toxic gas called pentadecafluorooctanoic acid (PFOA). The skeletal formula of PFOA is shown below.



(a) Draw the repeating unit of Teflon.

(1 mark)

(b) Suggest one property of Teflon that makes it suitable for making non-sticky cooking pans.

(1 mark)

(c) Explain why the melting point of Teflon is higher than that of polyethene.

(2 marks)

(d) Write the molecular formula of PFOA.

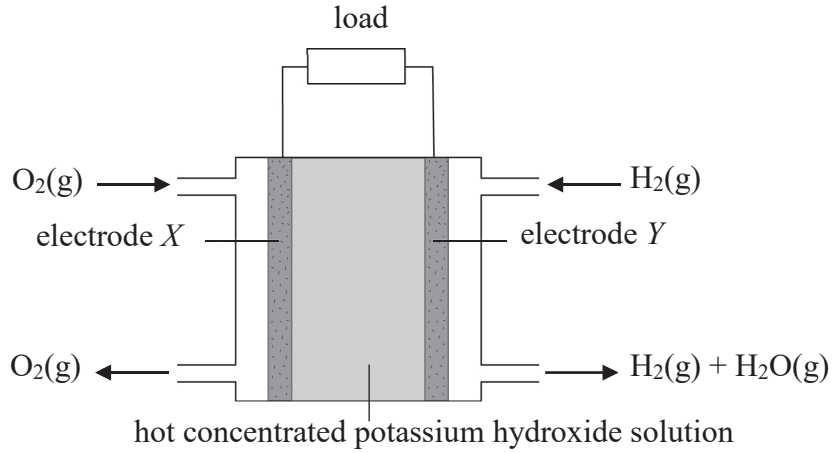
(1 mark)

(e) Suggest one safety precaution when using a frying pan with Teflon coating for cooking.

(1 mark)

Answers written in the margins will not be marked.

4. The diagram below shows the structure of a hydrogen-oxygen fuel cell.



(a) Which electrode (*X* or *Y*) is the negative pole? Explain briefly.

(1 mark)

(b) Write the half equation for the reaction occurring at each of the following electrodes.

(i) Electrode *X*

(ii) Electrode *Y*

(2 marks)

(c) Some cars are newly designed for using hydrogen-oxygen fuel cells as the energy source. The car company argued that using fuel cells is more environmentally friendly than using petrol. From each of the following perspectives, state one opposite argument of using fuel cells over petrol.

(i) Storage of fuel

(ii) Source of fuel

(2 marks)

Answers written in the margins will not be marked.

5. You are given two sample solutions of ethanoic acid and hydrochloric acid. They both have a pH of 3.0.

   (a) Calculate the concentration of hydrogen ions in a solution with pH 3.0.

   (1 mark)

   (b) After diluting the two sample solutions by 10 times, it is found that the pH of hydrochloric acid increases to 4.0. However, the pH of ethanoic acid is smaller than 4.0. Explain this phenomenon.

   (3 marks)

   (c) Can the two sample solutions be distinguished by adding equal masses and sizes of magnesium ribbon to the two solutions? Explain your answer.

   (1 mark)

Answers written in the margins will not be marked.

6. When phosphorus pentachloride dissolves in hot water, the following reaction occurs.

$$PCl_5(s) + 4H_2O(l) \rightarrow H_3PO_4(aq) + 5HCl(aq)$$

To determine the percentage purity of a sample of phosphorus pentachloride, 5.00 g of the sample is dissolved in distilled water and made up to a 250.0 cm^3 solution. 25.0 cm^3 portions of the diluted solution are then titrated with 0.50 M sodium hydroxide solution using phenolphthalein as an indicator. It requires an average volume of 16.00 cm^3 of the alkali for complete neutralization.

(a) Draw the three-dimensional structure of a phosphorus pentachloride molecule.

(1 mark)

(b) Draw a labelled diagram for the set-up of the titration.

(2 marks)

(c) State the colour change at the end point of the titration.

(1 mark)

Answers written in the margins will not be marked.

6. (d) Calculate the percentage by mass of phosphorus pentachloride in the sample.
(Relative atomic masses: P = 31.0, Cl = 35.5)

(3 marks)

Answers written in the margins will not be marked.

7. For each of the following experiments, state an expected observation and write an ionic equation for the reaction involved.

   (a) Adding a few drops of sodium hydroxide solution to iron(II) nitrate solution

(2 marks)

   (b) Adding a magnesium ribbon to concentrated nitric acid

(2 marks)

Answers written in the margins will not be marked.

8. Liquid hydrazine ($N_2H_4(l)$) can be used as a rocket propellant. In a rocket, it reacts with liquid hydrogen peroxide to give nitrogen and water vapour.

(a) Draw the electron diagram for a hydrazine molecule, showing electrons in the outermost shells only.

(1 mark)

(b) Write an equation for the reaction between liquid hydrazine and liquid hydrogen peroxide.

(1 mark)

(c) Given that standard enthalpy changes of formation of hydrazine, hydrogen peroxide and water vapour are +50.6 kJ mol^{-1}, −187.8 kJ mol^{-1} and −241.8 kJ mol^{-1} respectively. Calculate the standard enthalpy change for the reaction in (b).

(2 marks)

(d) With reference to your answer in (c), calculate the heat change (in kJ) of the reaction when 1.00 g of liquid hydrazine and 1.00 g of liquid hydrogen peroxide react under standard conditions.
(Relative atomic masses: H = 1.0, N = 14.0, O = 16.0)

(2 marks)

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

9. The reaction of bromine (dissolved in an organic solvent) with propane is regarded as a substitution reaction.

(a) What is the meaning of the term 'substitution reaction'?

(1 mark)

(b) State an expected observation for the reaction.

(1 mark)

(c) (i) Write an equation for the reaction involved in each of the following processes in the formation of 1-bromopropane during the substitution reaction.

(I) Propagation

(II) Termination

(ii) If 1-bromopropane is the desired product, which reagent, propane or bromine, should be used in excess?

(3 marks)

(d) Explain why 1-bromopropane is miscible with hexane.

(2 marks)

*10. Briefly describe what rusting is and explain how sacrificial protection can be used to protect ships from rusting.

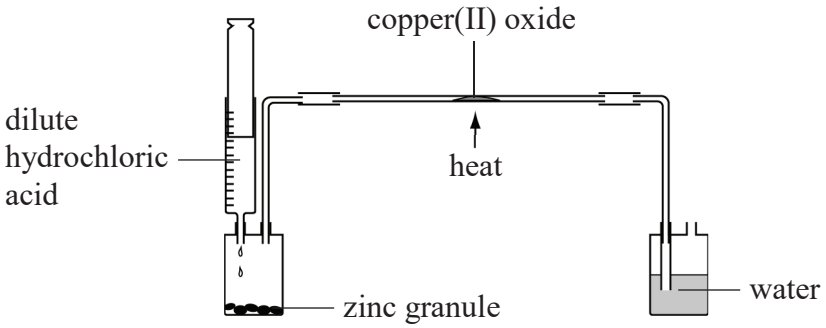
(5 marks)

END OF PART I

Answers written in the margins will not be marked.

PART II

11. In a microscale experiment, 15 cm^3 of 2.0 M hydrochloric acid is slowly added to 2.0 g of zinc granules. A colourless gas *P* is produced. The gas is then passed through a tube containing excess copper(II) oxide powder which is under strong heating.



(a) Determine whether zinc or hydrochloric acid is the limiting reactant.
(Relative atomic mass: Zn = 65.4)

(1 mark)

(b) Calculate the volume of gas *P* (in cm^3) produced at room temperature and pressure.
(Molar volume of gas at room temperature and pressure = 24 $dm^3\ mol^{-1}$)

(2 marks)

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

11. (c) Explain whether the following changes will affect the volume of gas *P* collected in the experiment.

(i) Using 20 cm^3 of 2.0 M hydrochloric acid

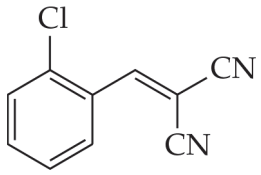
(ii) Using 2.0 g of zinc powder

(2 marks)

(d) State an observable change on the copper(II) oxide powder.

(1 mark)

12. 2-chlorobenzalmalononitrile is a compound that can cause tearing of the eyes. It is commonly used in making tear gas. Its structure is shown below.



(a) Explain whether 2-chlorobenzalmalononitrile exhibits *cis-trans* isomerism.

(1 mark)

(b) Predict, with explanation, whether 2-chlorobenzalmalononitrile is soluble in water.

(2 marks)

(c) A small amount of 2-chlorobenzalmalononitrile is added to bromine (dissolved in an organic solvent).

(i) State the expected observation.

(ii) Name the type of reaction involved.

(iii) The reaction gives two isomeric compounds. State the isomeric relationship of the two compounds and suggest a way to distinguish between the two compounds.

(4 marks)

Answers written in the margins will not be marked.

13. Carbon disulphide (CS_2) is a highly flammable liquid. The combustion of carbon disulphide produces carbon dioxide and sulphur dioxide.

(a) Write the chemical equation for the combustion of carbon disulphide.

(1 mark)

(b) 0.53 g of carbon disulphide was burnt to heat up 80 cm^3 of water. The temperature of water rose from 25.0°C to 33.8°C. Calculate the enthalpy change for the combustion of carbon disulphide. (The specific heat capacity and density of water are 4.2 J g^{-1} K^{-1} and 1.0 g cm^{-3} respectively; relative atomic masses: C = 12.0, S = 32.1)

(3 marks)

(c) The following table shows the values of standard enthalpy changes of formation of $CO_2(g)$, $SO_2(g)$ and $CS_2(l)$ found in the data book:

Compound	$\Delta H_f^\ominus$ (kJ mol^{-1})
$CO_2(g)$	–393.5
$SO_2(g)$	–297.0
$CS_2(l)$	+89.0

(i) Using the above data, calculate the standard enthalpy change of combustion of carbon disulphide.

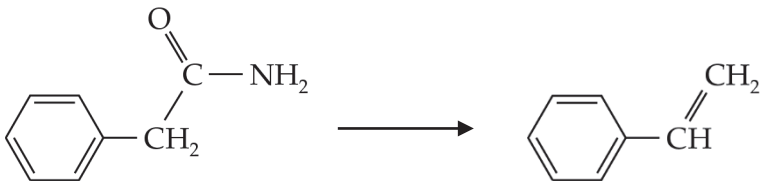
(2 marks)

(ii) Suggest why the answers in (b) and (c)(i) are different.

(1 mark)

Answers written in the margins will not be marked.

14. Outline a synthetic route, with *no more than three steps*, to accomplish the following conversion. For each step, give the reagent(s), reaction conditions (as appropriate) and structure of the organic product.



(3 marks)

Answers written in the margins will not be marked.

*15. In the presence of iron(II) ions, peroxodisulphate ions ($S_2O_8^{2-}$) react with iodide ions to produce iodine and sulphate ions. Write an ionic equation for the reaction between peroxodisulphate ions and iodide ions and illustrate THREE characteristic properties of transition metals exhibited by iron in this reaction.

(5 marks)

END OF SECTION B

END OF PAPER

Answers written in the margins will not be marked.

PERIODIC TABLE 週期表

GROUP 族

atomic number 原子序

relative atomic mass 相對原子質量

I	II											III	IV	V	VI	VII	0
				1 **H** 1.0													2 **He** 4.0
3 **Li** 6.9	4 **Be** 9.0											5 **B** 10.8	6 **C** 12.0	7 **N** 14.0	8 **O** 16.0	9 **F** 19.0	10 **Ne** 20.2
11 **Na** 23.0	12 **Mg** 24.3											13 **Al** 27.0	14 **Si** 28.1	15 **P** 31.0	16 **S** 32.1	17 **Cl** 35.5	18 **Ar** 40.0
19 **K** 39.1	20 **Ca** 40.1	21 **Sc** 45.0	22 **Ti** 47.9	23 **V** 50.9	24 **Cr** 52.0	25 **Mn** 54.9	26 **Fe** 55.8	27 **Co** 58.9	28 **Ni** 58.7	29 **Cu** 63.5	30 **Zn** 65.4	31 **Ga** 69.7	32 **Ge** 72.6	33 **As** 74.9	34 **Se** 79.0	35 **Br** 79.9	36 **Kr** 83.8
37 **Rb** 85.5	38 **Sr** 87.6	39 **Y** 88.9	40 **Zr** 91.2	41 **Nb** 92.9	42 **Mo** 95.9	43 **Tc** (98)	44 **Ru** 101.1	45 **Rh** 102.9	46 **Pd** 106.4	47 **Ag** 107.9	48 **Cd** 112.4	49 **In** 114.8	50 **Sn** 118.7	51 **Sb** 121.8	52 **Te** 127.6	53 **I** 126.9	54 **Xe** 131.3
55 **Cs** 132.9	56 **Ba** 137.3	57 * **La** 138.9	72 **Hf** 178.5	73 **Ta** 180.9	74 **W** 183.9	75 **Re** 186.2	76 **Os** 190.2	77 **Ir** 192.2	78 **Pt** 195.1	79 **Au** 197.0	80 **Hg** 200.6	81 **Tl** 204.4	82 **Pb** 207.2	83 **Bi** 209.0	84 **Po** (209)	85 **At** (210)	86 **Rn** (222)
87 **Fr** (223)	88 **Ra** (226)	89 ** **Ac** (227)	104 **Rf** (261)	105 **Db** (262)													

*	58 **Ce** 140.1	59 **Pr** 140.9	60 **Nd** 144.2	61 **Pm** (145)	62 **Sm** 150.4	63 **Eu** 152.0	64 **Gd** 157.3	65 **Tb** 158.9	66 **Dy** 162.5	67 **Ho** 164.9	68 **Er** 167.3	69 **Tm** 168.9	70 **Yb** 173.0	71 **Lu** 175.0
**	90 **Th** 232.0	91 **Pa** (231)	92 **U** 238.0	93 **Np** (237)	94 **Pu** (244)	95 **Am** (243)	96 **Cm** (247)	97 **Bk** (247)	98 **Cf** (251)	99 **Es** (252)	100 **Fm** (257)	101 **Md** (258)	102 **No** (259)	103 **Lr** (260)