FUKIEN SECONDARY SCHOOL

S4 Final Examination (2020-2021)

Chemistry

(1 hour 30 minutes)

Date: 9th June 2021 Name:_____

Time: 8:30a.m. - 10:00a.m. Class: _____ No.:_____

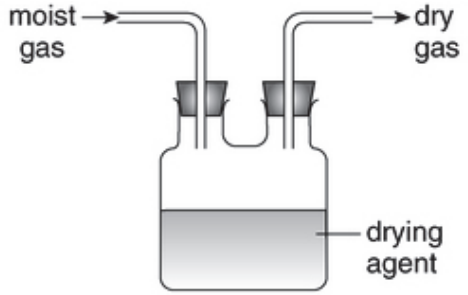
Instructions to students:

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 70.

I. Multiple Choice Questions (20 marks)

1. Which of the following set-ups can be used to dry a moist gas?

(1)



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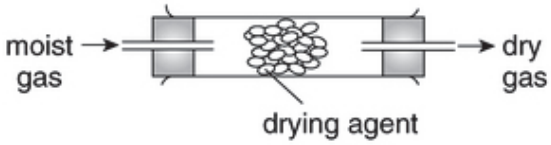

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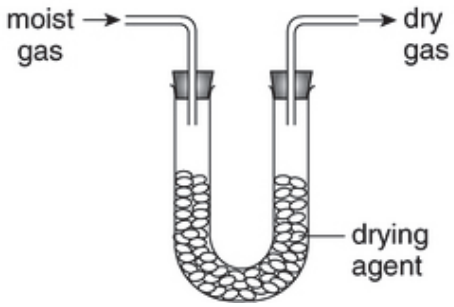


A (1) and (2) only

B (1) and (3) only

C (2) and (3) only

D (1), (2) and (3)

2. Which of the following substances has a sharp boiling point?
   A Liquid air
   B Molten copper
   C Red wine
   D Soft drink

3. Which of the following statements describe the chemical properties of carbon dioxide?
   (1) It is colourless.
   (2) It turns limewater milky.
   (3) It dissolves in water to give an acidic solution.
   A (1) and (2) only
   B (1) and (3) only
   C (2) and (3) only
   D (1), (2) and (3)

4. Which of the following compounds does NOT give a characteristic flame colour in flame test?
   A Aluminium sulphate
   B Copper(II) sulphate
   C Potassium sulphate
   D Sodium sulphate

5. When calcium carbonate is strongly heated, a solid is obtained. Which of the following statements concerning the solid is correct?
   A It is black in colour.
   B It reacts with water to give slaked lime.
   C It is calcium hydroxide.
   D It is a mixture.

6. Which of the following oxides has the *highest* melting point?
   A ClO_2
   B H_2O
   C K_2O
   D NO_2

7. Which of the following substances have giant ionic structures?
   (1) Silver
   (2) Copper(II) chloride
   (3) Sodium hydride
   A (1) and (2) only
   B (1) and (3) only
   C (2) and (3) only
   D (1), (2) and (3)

8. Which of the following substances are acidic?
   (1) Window cleanser
   (2) Gastric juice
   (3) Soft drink
   A (1) and (2) only
   B (1) and (3) only
   C (2) and (3) only
   D (1), (2) and (3)

9. Which of the following substances will NOT react with dilute hydrochloric acid?
   A Magnesium chloride
   B Copper(II) hydroxide
   C Silver nitrate solution
   D Sodium hydrogencarbonate

10. Which of the following should NOT be used with dilute hydrochloric acid to prepare hydrogen?
   A Zinc
   B Magnesium
   C Sodium
   D Calcium

11. Which of the following statements about acids is / are correct?
   (1) Dilute solutions of acids turn litmus solution red.
   (2) All pure acids are liquids under room conditions.
   (3) All pure acids are ionic compounds.
   A (1) only
   B (2) only
   C (1) and (3) only
   D (2) and (3) only

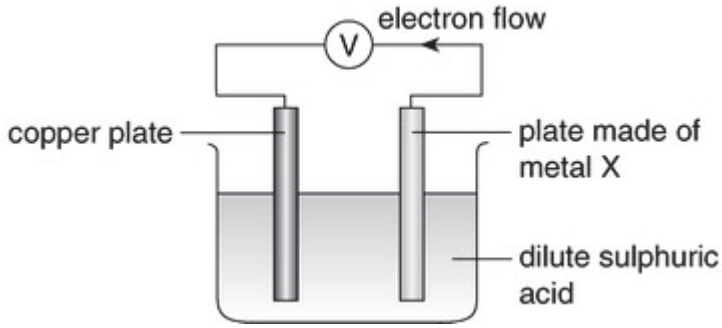
12. Which of the following hydroxides is soluble in excess dilute aqueous ammonia?
    A $Pb(OH)_2$
    B $Mg(OH)_2$
    C $Fe(OH)_3$
    D $Zn(OH)_2$

13. Which of the following dry cells is a secondary cell?
    A Zinc-carbon cell
    B Nickel metal hydride cell
    C Silver oxide cell
    D Alkaline manganese cell

14. Which of the following combinations is correct for a zinc-carbon cell?

	Positive electrode	Negative electrode	Electrolyte
A	Carbon	zinc	manganese(IV) oxide
B	Carbon	zinc	ammonium chloride
C	Zinc	carbon	manganese(IV) oxide
D	Zinc	carbon	ammonium chloride

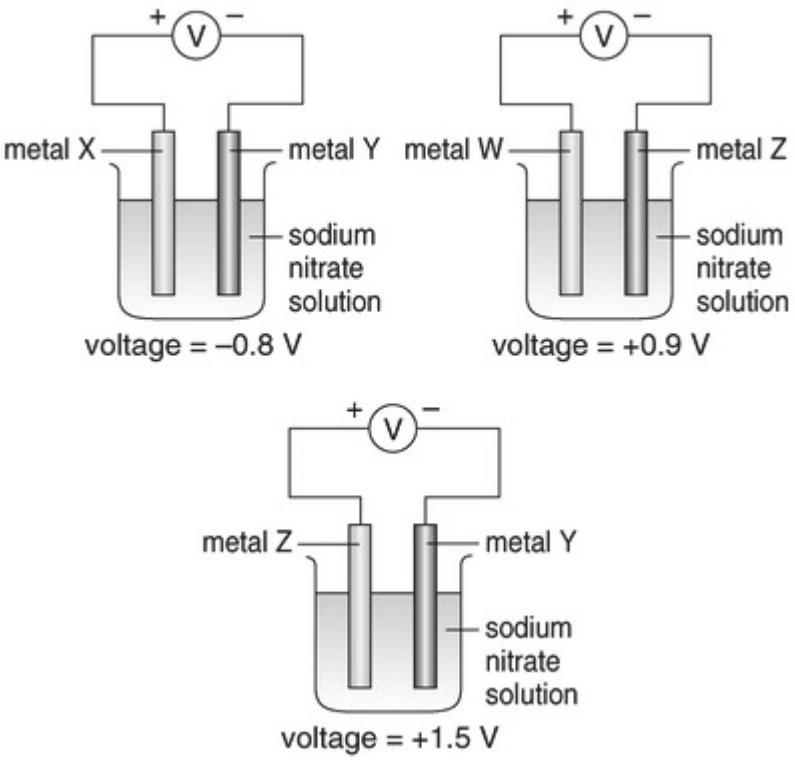
15.



Which of the following statements concerning the above set-up is correct?
    A The copper plate is the cathode.
    B Both metal plates gradually dissolve.
    C The sulphuric acid turns blue gradually.
    D The position of copper in the electrochemical series is higher than that of X.

16. Which of the following statements concerning an oxidizing agent is INCORRECT?
    A An oxidizing agent is oxidized in a redox reaction.
    B An oxidizing agent can oxidize other species in a redox reaction.
    C An oxidizing agent is an electron acceptor.
    D The oxidation number of a certain element in an oxidizing agent decreases in a redox reaction.

17.



Which of the following represents the correct order of reactivity of metals W, X, Y and Z?

A X > Y > Z > W

B W > Z > Y > X

C Y > Z > W > X

D X > W > Z > Y

18. What is the oxidation number of Cl in $HClO_2$?

A –1

B +1

C +3

D –3

19. In which compound does iodine have an oxidation state of +3?

A HIO_3

B NaI_3

C CrI_3

D $NaIO_2$

20. Which of the following processes is a redox reaction?

A $BaCl_2(aq) + Na_2CrO_4(aq) \rightarrow BaCrO_4(s) + 2NaCl(aq)$

B $Fe_2(SO_4)_3(aq) + H_2S(g) \rightarrow 2FeSO_4(aq) + S(s) + H_2SO_4(aq)$

C $CH_3COOH(aq) + NaOH(aq) \rightarrow CH_3COONa(aq) + H_2O(l)$

D $Al(OH)_3(s) + NaOH(aq) \rightarrow NaAl(OH)_4(aq)$

II. Structured Questions (50 marks)

1. A student tried to extract lead from lead(II) oxide. He placed 10.0 g of lead(II) oxide and 10.0 g of carbon powder in a crucible and heated the mixture with a Bunsen flame.

(a) Draw an experimental set-up for the extraction of lead(II) oxide. (2 marks)

(b) (i) Write a chemical equation for the reaction involved. (1 mark)

(ii) Suggest ONE observation of the experiment. (1 mark)

(c) (i) Determine which reagent is in excess. (3 marks)
(Relative atomic masses: C = 12.0, O = 16.0, Pb = 207.2)

(ii) Calculate the maximum mass of lead that could be obtained. (1 mark)

(d) In fact, the student only obtained 7.10 g of lead.

(i) Calculate the percentage yield of lead. (1 mark)

(ii) Suggest ONE reason why the student cannot get the maximum mass of lead. (1 mark)

(e) Another oxide of lead has a chemical formula Pb_3O_4.
Pb_3O_4 is known to be a mixed oxide composed of PbO and PbO_2. Deduce the mole ratio of PbO to PbO_2 in Pb_3O_4. (2 marks)

2. Consider the following information on three reactions involving magnesium ribbons of the same shape:

	Reaction mixture
Reaction 1	1.5 g of Mg + 100 cm^3 of 1.0 mol dm^{-3} HCl(aq)
Reaction 2	1.5 g of Mg + 100 cm^3 of 1.0 mol dm^{-3} CH_3COOH(aq)
Reaction 3	1.5 g of Mg + 100 cm^3 of 1.0 mol dm^{-3} H_2SO_4(aq)

(a) Write a chemical equation to show the ionization of each of the following acids in water:

(i) hydrochloric acid; (1 mark)

(ii) ethanoic acid. (1 mark)

(b) Calculate whether magnesium or hydrochloric acid was in excess in Reaction 1. (3 marks)
(Relative atomic mass: Mg = 24.3)

(c) Reaction 1 required 200 s to complete.

(i) How could you know when the reaction was complete? (1 mark)

(ii) Would you expect the time required for the completion of Reaction 2 to be shorter or longer than that for Reaction 1? Explain your answer. (3 marks)

(d) Besides their reactions with magnesium, suggest ONE other method to distinguish between 1.0 mol dm^{-3} HCl(aq) and 1.0 mol dm^{-3} CH_3COOH(aq). State also the expected observations. (2 marks)

(e) Explain why the initial rate of Reaction 3 was higher than that of Reaction 1. (2 marks)

3. A household ammonia solution was analyzed to determine its ammonia content. 9.97 g of the household ammonia solution was placed in a volumetric flask and made up to 250.0 cm^3 of solution. Four portions of the diluted solution of volume 25.0 cm^3 each were titrated against 0.150 mol dm^{-3} hydrochloric acid using methyl orange as indicator. The table below lists the titration results obtained:

Burette reading	1st	2nd	3rd	4th
Final reading (cm^3)	19.50	19.80	22.00	23.90
Initial reading (cm^3)	0.00	1.00	3.20	5.20

(a) A 25.0 cm^3 portion of the above diluted solution was transferred to a clean conical flask. Briefly describe how the titration of this portion of the diluted solution should be carried out.

(3 marks)

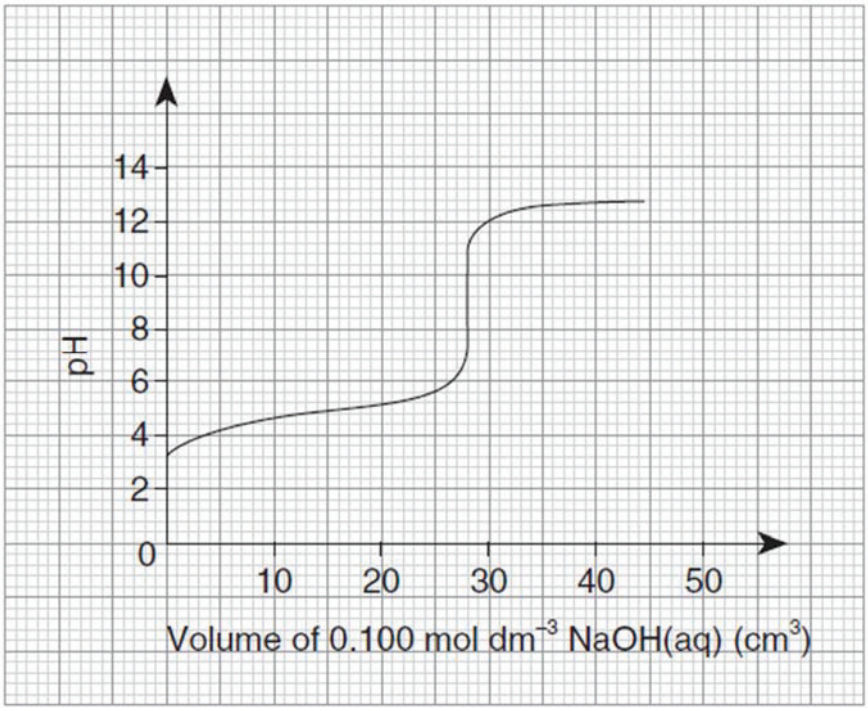
(b) Based on the titration results, calculate

(i) a reasonable average for the volume of the hydrochloric acid used, and (2 marks)

(ii) the percentage by mass of ammonia in the household ammonia solution. (3 marks)

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

4. The graph below shows the variation of pH when 25.0 cm^3 of an aqueous solution of a monobasic acid HA were titrated against 0.100 mol dm^{-3} sodium hydroxide solution using a pH meter. The pH was recorded throughout, and the results were plotted as shown below.



(a) What is the meaning of the term 'monobasic acid'? (1 mark)

(b) (i) Use the graph to determine the pH of the aqueous solution of the acid HA. (1 mark)

(ii) Calculate the concentration of hydrogen ions in the aqueous solution of the acid HA.

(2 marks)

(c) Calculate the concentration of the acid HA used. (2 marks)

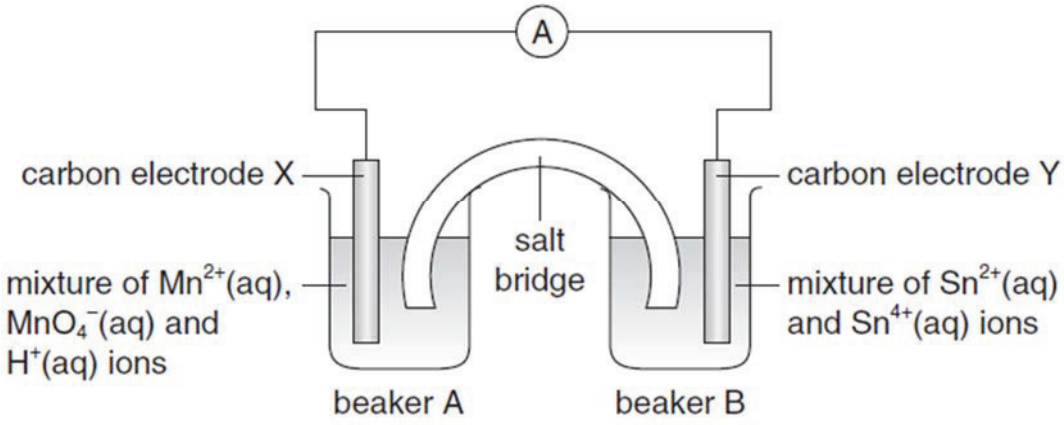
(d) The table lists the pH range for colour change of three acid-alkali indicators:

Indicator	pH range
Bromophenol blue	3.0 – 4.6
Methyl red	4.8 – 6.0
Thymol blue	8.0 – 9.6

Choose, from the above table, a suitable indicator for the titration. Explain your answer.

(2 marks)

5. The following diagram shows the set-up of a chemical cell.



It is known that MnO_4^-(aq) ion is a stronger oxidizing agent than Sn^{4+}(aq) ion.

(a) (i) Write an ionic half-equation for the chemical change that occurs in beaker A. (1 mark)

(ii) What would be observed in the mixture in beaker A after some time? Explain your answer.

(2 marks)

(b) (i) Write an ionic half-equation for the chemical change that occurs in beaker B. (1 mark)

(ii) Explain, in terms of change in oxidation number, whether an oxidation or a reduction occurs in beaker B. (2 marks)

(c) Identify the direction of electron flow in the external circuit. (1 mark)

(d) What are the functions of the salt bridge in the set-up? (2 marks)

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PERIODIC TABLE 週期表

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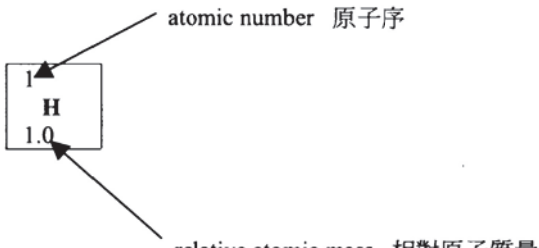

I	II											III	IV	V	VI	VII	0
																	2 **He** 4.0
3 **Li** 6.9	4 **Be** 9.0											5 **B** 10.8	6 **C** 12.0	7 **N** 14.0	8 **O** 16.0	9 **F** 19.0	10 **Ne** 20.2
11 **Na** 23.0	12 **Mg** 24.3											13 **Al** 27.0	14 **Si** 28.1	15 **P** 31.0	16 **S** 32.1	17 **Cl** 35.5	18 **Ar** 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)

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