FUKIEN SECONDARY SCHOOL

S5 First Term Examination (2020-2021)

Chemistry

(1 hour 30 minutes)

Date: 6th January 2021 Name:_____

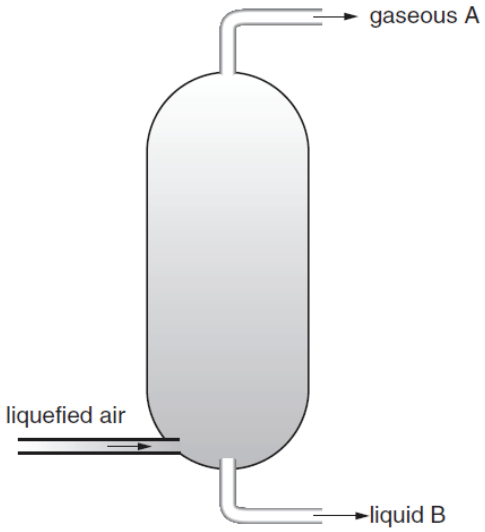
Time: 10:30a.m. - 12:00nn Class: _____ No.:_____

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)

Directions: Questions 1 and 2 refer to the diagram showing a column for separating oxygen and nitrogen in the air.



1. Arrange the steps for separating oxygen and nitrogen in the air in order.

   (1) Liquefaction
   (2) Fractional distillation
   (3) Purification

   A (1) → (2) → (3)
   B (3) → (1) → (2)
   C (3) → (2) → (1)
   D (2) → (1) → (3)

2. Which of the following statements about A and B are correct?

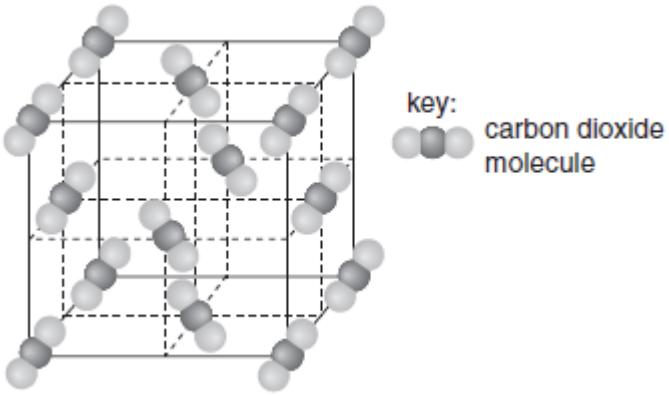
   (1) Gas A takes the greatest percentage of air by volume.
   (2) Gas A gives a 'pop' sound when tested with a burning splint.
   (3) The boiling point of B is higher than that of A.

   A (1) and (2) only
   B (1) and (3) only
   C (2) and (3) only
   D (1), (2) and (3)

3. To identify an unknown powder, a student heated the powder in a Bunsen flame. A brick-red flame was observed. When the powder was added to dilute hydrochloric acid, it dissolved without any observable changes. What might the powder be?

   A Calcium carbonate
   B Sodium carbonate
   C Calcium chloride
   D Sodium chloride

4. The diagram below shows the structure of dry ice:



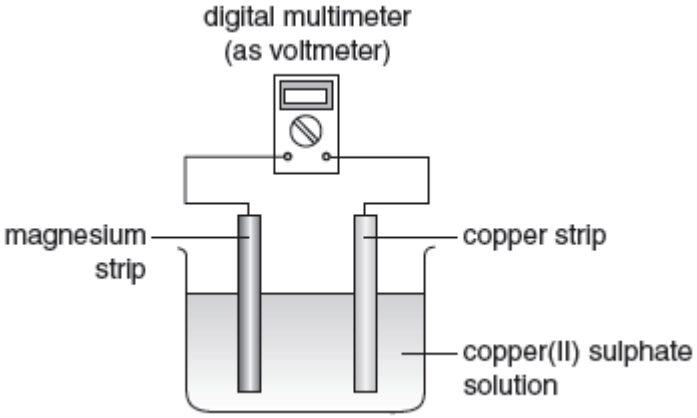
   Which of the following statements about dry ice is correct?

   A It can sublime.
   B It has a giant covalent structure.
   C The atoms in its molecules are held together by van der Waals' forces.
   D Its molecules are held together by covalent bonds.

5. Tin-plating can prevent iron from rusting because

   A tin protects iron from air and water.
   B tin corrodes instead of iron.
   C tin is higher than iron in the reactivity series.
   D tin is less reactive than iron.

6. Consider the following simple chemical cell:



Which of the following statements about the chemical cell is correct?

A The mass of the magnesium strip increases.

B The mass of the copper strip decreases.

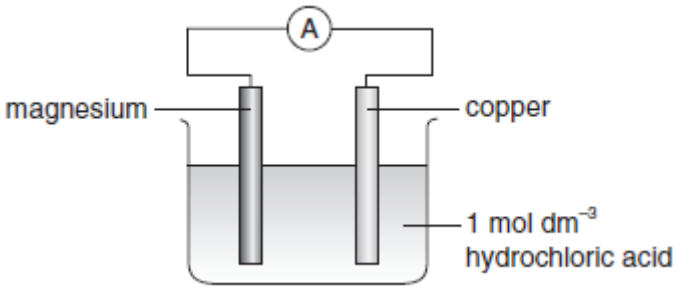
C Electrons flow from the copper strip to the magnesium strip in the external circuit.

D Chemical energy is converted into electrical energy.

7. Which of the following combinations about a lithium ion secondary cell is correct?

	Anode	Cathode	Electrolyte
A	lithium metal oxide	lithium atoms between graphite sheets	lithium salt
B	lithium metal oxide	lithium atoms between graphite sheets	potassium hydroxide
C	lithium atoms between graphite sheets	lithium metal oxide	lithium salt
D	lithium atoms between graphite sheets	lithium metal oxide	potassium hydroxide

8.



Which of the following changes will lead to an increase in the ammeter reading?

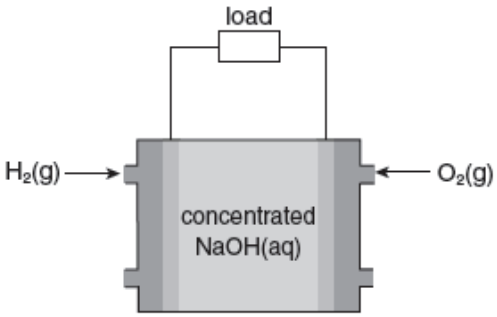
A Magnesium is replaced by zinc.

B Copper is replaced by iron.

C The 1 mol dm^{-3} hydrochloric acid is replaced by 1 mol dm^{-3} ethanoic acid.

D The 1 mol dm^{-3} hydrochloric acid is replaced by 1 mol dm^{-3} sulphuric acid.

9. The following diagram shows a hydrogen-oxygen fuel cell. Hydrogen and oxygen are passed into the fuel cell.



Which of the following ionic half-equations represents the chemical change that occurs at the anode?

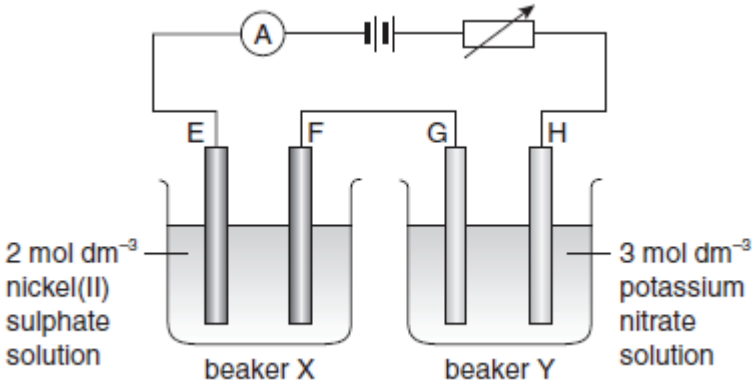
A $O_2(g) + H_2O(l) \longrightarrow O_3(g) + 2H^+(aq) + 2e^-$

B $O_2(g) + 4H^+(aq) + 4e^- \longrightarrow 2H_2O(l)$

C $H_2(g) + O_2(g) + 2H^+(aq) + 2e^- \longrightarrow 2H_2O(l)$

D $H_2(g) + 2OH^-(aq) \longrightarrow 2H_2O(l) + 2e^-$

Directions: Questions 10 and 11 refer to the following set-up.



Electrodes E and F are nickel electrodes while electrodes G and H are carbon electrodes.

10. Which of the electrodes are cathodes?

A E and H

B E and G

C F and H

D F and G

11. Which of the following combinations about the solutions is correct after the electrolysis has been carried out for some time?

	Solution in beaker X	Solution in beaker Y
A	become more concentrated	become more concentrated
B	remain unchanged	become nitric acid
C	become less concentrated	become less concentrated
D	remain unchanged	become more concentrated

12. Which of the following elements can form covalent molecules with the central atom having an non-octet structure?
    A Nitrogen
    B Oxygen
    C Sulphur
    D Fluorine

13. Which of the following chemical species is planar in shape?
    A BF_3
    B NF_3
    C PCl_3
    D SF_6

14. Which of the following statements about particulates is INCORRECT?
    A They are produced from cars, factories and incinerators.
    B They are produced by incomplete combustion of fuels.
    C They irritate respiratory systems.
    D They can be removed by scrubbers.

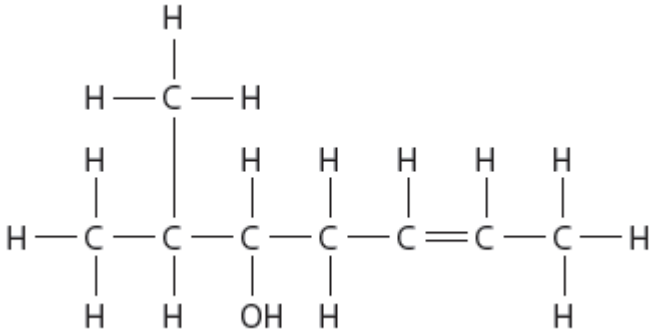
15. Which of the following statements about oxides of nitrogen are correct?
    (1) High temperatures inside car engines cause their formation.
    (2) Installing low nitrogen oxide burners in power stations can reduce their emission.
    (3) They are converted to nitrogen in scrubbers installed in car exhaust systems.

    A (1) and (2) only
    B (1) and (3) only
    C (2) and (3) only
    D (1), (2) and (3)

16. Which of the following methods can reduce the formation of acid rain?
    (1) Installing flue gas desulphurization systems in factories
    (2) Installing low nitrogen oxide burners in power plants
    (3) Installing particulate removal devices in motor vehicles

    A (1) and (2) only
    B (1) and (3) only
    C (2) and (3) only
    D (1), (2) and (3)

17. Consider the following structural formula of a molecule:



What is the condensed structural formula of the molecule?

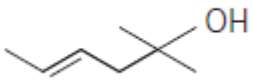
A $CH_3CH(CH_3)CH(OH)CH_2CHCHCH_3$

B $CH_3(CH_2)_4OHCH{=}CHCH_3$

C $CH_3(CH_2)_3OHCHC_2H_2CH_3$

D $CH_3CH(CH_3)CH(OH)CH_2CH{=}CHCH_3$

18. A carbon compound has the following structure:



What is the molecular formula of the compound?

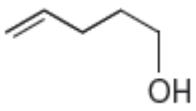
A $C_6H_{12}O$

B $C_6H_{14}O$

C $C_7H_{14}O$

D $C_7H_{16}O$

19. A carbon compound has the structure shown below.



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

(1) Its structural formula is $C_5H_{10}O$.

(2) It is soluble in water.

(3) Its IUPAC name is pent-4-en-1-ol.

A (1) only

B (2) only

C (1) and (3) only

D (2) and (3) only

20. Which of the following compounds represents the third member of a homologous series?

A Butane

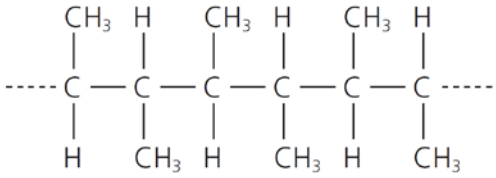
B But-1-ene

C Butan-1-ol

D Butanoic acid

II. Structured Questions (50 marks)

1. A part of the structure of a polymer is shown below. The polymer is made from monomer X.



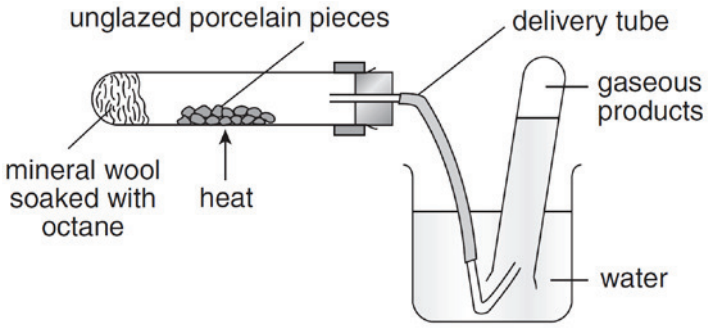
(a) (i) Draw the structure of monomer X. (1 mark)

(ii) Give the systematic name of monomer X. (1 mark)

(b) The polymer is formed by polymerization. Explain the meaning of the term 'polymerization'. (1 mark)

(c) Suggest why the polymer does NOT have a constant relative molecular mass. (1 mark)

(d) A student carried out an experiment using a sample of octane (C_8H_{18}) with the set-up shown below.



(i) Name the type of reaction involved in the experiment. (1 mark)

(ii) In one of the reactions, octane is converted to X and alkane Y.

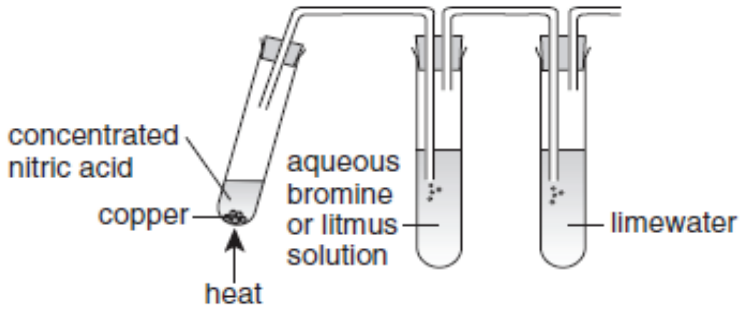
octane $\longrightarrow$ X + alkane Y

Draw a structure of Y and give its systematic name. (2 marks)

(iii) (1) The student added a few drops of bromine dissolved in CH_3CCl_3 into the boiling tube containing the gaseous products. The orange colour of the bromine solution disappeared immediately. Why? (2 marks)

(2) The student then dropped more bromine solution into the boiling tube until the orange colour of the bromine solution persisted. After about 10 minutes, the orange colour disappeared. Why? (2 marks)

2. A student used the following experimental set-up to study the reaction of concentrated nitric acid and copper.



(a) (i) State any observable change for the copper. (1 mark)

(ii) Write an equation for the reaction involved. (1 mark)

(b) Is there any observable change for the aqueous bromine in the test tube? Explain your answer. (2 marks)

(c) State and explain the expected observation if the gas given off is bubbled into litmus solution instead of aqueous bromine. (2 marks)

(d) What property of concentrated nitric acid is responsible for the reaction between concentrated nitric acid and copper? (1 mark)

3. This experiment was carried out to determine the percentage by mass of sulphate in a lawn fertilizer.

Step 1 2.60 g of a sample of the fertilizer was ground up and dissolved in 200 cm^3 of dilute hydrochloric acid.

Step 2 Excess barium chloride solution was added to the solution obtained in *Step 1* to form a precipitate.

Step 3 The precipitate was separated from the mixture and washed with water.

Step 4 The precipitate was dried and weighed. Its mass was 3.04 g.

(a) (i) Name the precipitate formed in the experiment. (1 mark)

(ii) Write an ionic equation for the formation of the precipitate. (1 mark)

(b) Explain why excess barium chloride solution was added in *Step 2*. (1 mark)

(c) Suggest how the precipitate can be separated from the mixture in *Step 3*. (1 mark)

(d) Why was the precipitate washed with water in *Step 3*? (1 mark)

(e) Suggest a method that could be used to dry the precipitate in *Step 4*. (1 mark)

(f) (i) Calculate the percentage by mass of sulphate in the original fertilizer sample. (3 marks)
(Relative atomic masses: O = 16.0, S = 32.1, Ba = 137.3)

(ii) Suggest ONE more step to the procedure so as to improve the reliability of the results of this investigation. Explain your suggestion. (2 marks)

4. A student carried out the following experiment to determine the concentration of ethanoic acid in a brand of household vinegar.

   25.0 cm^3 of vinegar were diluted to 250.0 cm^3 with distilled water. 25.0 cm^3 of the diluted vinegar solution were withdrawn and titrated against 0.110 mol dm^{-3} sodium hydroxide solution with phenolphthalein as the indicator.

(a) Suggest ONE reason for diluting the vinegar. (1 mark)

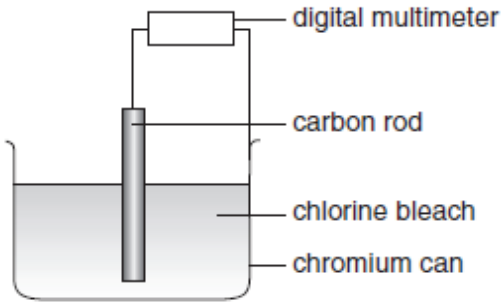
(b) Describe briefly how 25.0 cm^3 of vinegar can be diluted to 250.0 cm^3 with distilled water. (4 marks)

(c) State the colour change of the indicator at the end point of the titration. (1 mark)

(d) The mean titre was 17.90 cm^3. Calculate the concentration, in g dm^{-3}, of ethanoic acid in the vinegar. (Relative atomic masses: H = 1.0, C = 12.0, O = 16.0) (4 marks)

(e) Will the volume of sodium hydroxide solution used to be the same if methyl orange is used instead of phenolphthalein as indicator? Explain your answer. (2 marks)

5. A student used a chromium can, a carbon rod and chlorine bleach to make a chemical cell. The diagram below shows the set-up of the cell connected to a digital multimeter.



When the cell is producing a current, the chromium can undergoes oxidation to give hexahydroxochromate(III) ions, $[Cr(OH)_6]^{3-}$, while at the carbon rod the hypochlorite ions (OCl^-) in chlorine bleach undergo reduction in the presence of water to give chloride ions and hydroxide ions.

(a) What is the oxidation number of chlorine in OCl^- ion? (1 mark)

(b) Given that the chlorine bleach is alkaline, write ionic half-equations for

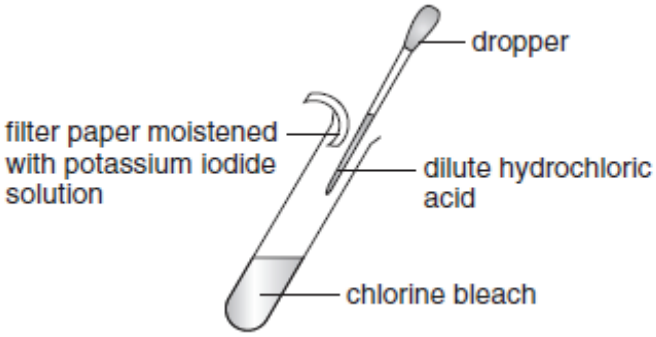
   (i) the oxidation of the chromium metal, and (1 mark)

   (ii) the reduction of the hypochlorite ions. (1 mark)

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

(d) The student noticed that the current produced by the cell increases with the concentration of hypochlorite ions in the bleach. Suggest an explanation for the phenomenon. (1 mark)

(e) The student carried out an experiment using the chlorine bleach as shown below.



(i) Chlorine bleach and dilute hydrochloric acid react according to the following word equation:

sodium hypochlorite + dilute hydrochloric acid

⟶ chlorine + sodium chloride + water

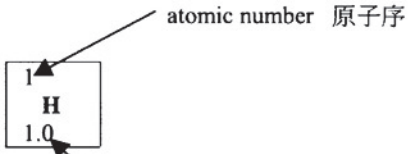
Transcribe the word equation into a chemical equation. (1 mark)

(ii) State the observable change that would occur on the filter paper. Explain whether or not the change would involve a redox reaction. (3 marks)

End of paper

PERIODIC TABLE 週期表

GROUP 族



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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