SECTION A

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

1. Salts can be obtained when a sample of sea water undergoes two processes **A** and **B**.

(a) What are processes **A** and **B** ?

A: _____________

B: _____________

(1 mark)

(b) Explain, in terms of particle theory, the principle of process **A**.

(1 mark)

(c) Suggest a chemical test for the presence of chloride ion in sea water. State the expected observation and the relevant chemical equation.

(2 marks)

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2. Carbon and nitrogen can form an anion called cyanide with a charge of -1. Cyanide ion can form a stable compound with hydrogen and potassium respectively.

(a) (i) Draw the electronic diagram for hydrogen cyanide, showing the *outermost shell electrons only*.

(ii) Hydrogen cyanide is often referred as a toxic acidic gas. Explain.

(2 marks)

(b) Compare the expected boiling points of potassium cyanide and hydrogen cyanide. Explain your answer.

(2 marks)

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3. Ethanoic acid and hexanoic acid are members of the homologous series of alkaonic acid.

(a) Illustrate TWO characteristics of alkanoic acid using ethanoic acid and hexanoic acid as examples.

(4 marks)

(b) Compare the relative miscibility of ethanoic acid and hexanoic acid with water. Explain your answer.

(2 marks)

(c) Suggest ONE other homologous series of organic compound which may have the same molecular formula as hexanoic acid. Draw ONE possible structure of the compound.

(2 marks)

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4. There are five unlabelled bottles containing the following chemicals:

sodium sulphite, sodium sulphate, sodium carbonate, sodium iodide, sodium hypochlorite

Suppose now you are provided with the following materials and apparatus:

Bromine water, red dye solution, dilute hydrochloric acid and test tubes

(a) Suggest a qualitative test for the presence of iodide ion using the provided material.

(2 marks)

(b) Suggest a qualitative test for the presence of hypochlorite ion using the provided material.

(2 marks)

(c) Outline a schematic flowchart to show how you would identify all the unlabelled chemicals.

(3 marks)

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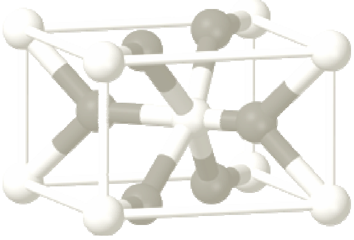
5. Rutile is one common form of titanium(IV) oxide which can be represented by the following model:.



(a) Suggest a chemical formula for titanium(IV) oxide.

(1 mark)

(b) Titanium(IV) oxide catalyses the conversion of nitrogen oxides to nitrate(V) ions under sunlight.

(i) Is the above conversion a redox reaction ? Explain with the help of a relevant theory.

(ii) Suggest an application of titanium(IV) oxide for improving our environment.

(2 marks)

(c) Titanium(IV) oxide can be produced by reacting titanium(IV) chloride with water to give hydrochloric acid or with oxygen to give chlorine as the side-products.

(i) When 100 g of titanium(IV) chloride is reacted, calcuate the mass of desired products.
(Relative atomic masses: O = 16.0, Cl = 35.5, Ti = 47.9)

(iii) From the environmental point of views, which synthetic route is better ? Explain.

(3 marks)

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6. Nowadays, plastic is so widely used but it causes a lot of environmental problems. Suggest how the following parties can help reduce pollution problems associated with disposal of plastics

(a) the public,

Method	(i)
Advantage	(ii)

(b) the government and

Method	(i)
Advantage	(ii)

(c) the manufacturers of plastic products.

Method	(i)
Advantage	(ii)

(6 marks)

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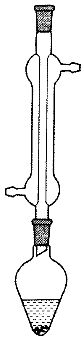
7. John attempted to use the following set-up to prepare an ester with apple flavor:



(a) (i) Label all the apparatus and state clearly the direction of water inlet and outlet.

(ii) Suggest why the end of the 'tube' should not be plugged with a stopper.

(iii) Give an advantage of the above experimental technique.

(3 marks)

(b) His chemistry teacher advised him to add a few drops of concentrated sulphuric acid into the mixture. Is it necessary to add a large amount of acid into the reacting mixture ? Explain.

(1 mark)

(c) It is known that the apple flavor is methyl butanoate. Give the precursors employed in the above experiment.

(1 mark)

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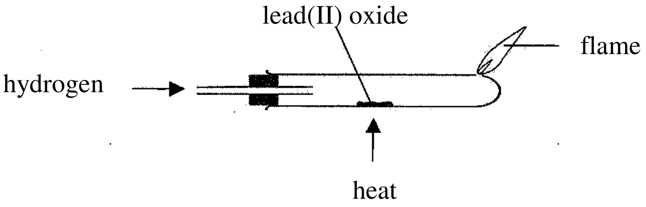
8. Lead(II) oxide can be reduced to metal lead using the setup shown below



(a) State one expected observable change in this experiment.

(1 mark)

(b) How can one know a metal is formed in the reaction ?

(1 mark)

(c) Write a chemical equation for the reaction that takes place in the above.

(1 mark)

(d) Is it necessary to burn the residual hydrogen in this set-up ? Explain.

(1 mark)

(e) A student made the following assertion in a chemistry class:

'If metal lead can be extracted by similar means without hydrogen, it can be deduced from the that lead is a more reactive metal than mercury.'

Do you argee with him ? Explain.

(1 mark)

For question 9, candidates are required to give a paragraph-length answer. For this question, 6 marks will be awarded for chemical knowledge and 3 marks for effective communication.

9. ‘Elements in Group II of the Periodic Table exhibit similar chemical properties. In addition, their reactivity increases down the group.’

Elaborate the first statement above using two reactions of alkali earth metals. Also outline an experiment to illustrate the second statement.

(9 marks)

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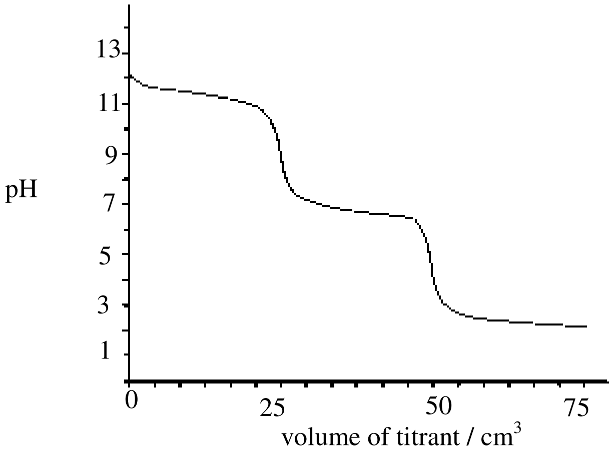
SECTION B

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

10. The graph below shows the variation of pH value upon the titration between sodium carbonate and hydrochloric acid.



(a) Suggest the chemical formula of the titrant.

(1 mark)

(b) Draw a labelled diagram to show the experimental set-up for the titration.

(3 marks)

(c) Suppose the molarity of sodium carbonate and hydrochloric and is 0.10 M and 0.05 M respectively. Estimate the volume of the standard solution.

(3 marks)

(d) If the pH meter and the data-logger were not functioning, suggest a suitable indicator for detecting end-point of the titration. State the observation when the end-point is reached.

(2 marks)

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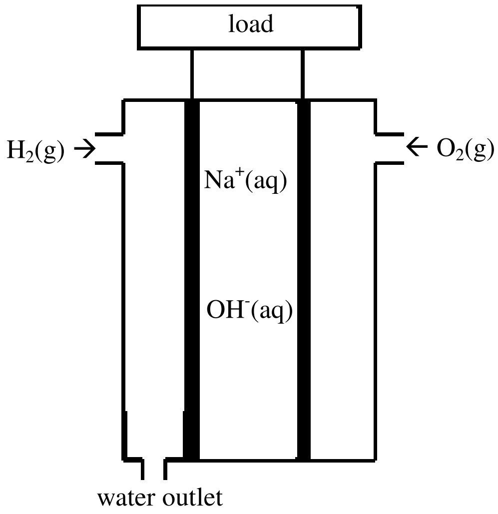
11. Space shuttle uses a fuel cell to generate electricity. The diagram below shows the internal structure of a hydrogen-oxygen fuel cell.



Oxygen reacts with water at positive electrode:

$$O_2(g) + 2\ H_2O(l) + 4\ e^- \rightarrow 4\ OH^-(aq)$$

Hydrogen reacts with hydroxide ions at the negative electrode:

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

The overall reaction in the fuel cell is the formation of water from its constituent elements.

(a) Apart from the storage tank of oxygen and hydrogen gas, suggest one more source of the fuel in the space shuttle.

(1 mark)

(b) Explain whether it undergoes reduction reaction at the positive electrode.

(2 marks)

(c) At room temperature and pressure, a fuel cell consumed 120 dm^3 of hydrogen gas. Calculate the volume of oxygen needed and hence find the mass of water produced.
(Molar volume of gas at room temperature and pressure = 24 dm^3; Relative atomic masses: H =1.0, O = 16.0)

(4 marks)

(d) One of its advantages and disadvantages of using hydrogen-oxygen fuel cells is that it does not emit air pollutant but it has high set-up cost respectively. Apart from these, suggest one more advantage and disadvantage.

(2 marks)

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12. Consumptions of fuels bring about many problems. One of the major ones is causing pollution to our planet earth.

(a) (i) Suggest a common acidic gaseous pollutant which is produced from consumption of fuels in vehicles.

(ii) How does it affect human beings and our infrastructures ?

(4 marks)

(b) Fossils are one category of common fuels.

(i) Incomplete combustion of fossils can lead to serious environmental problems. Suggest one air pollutant associated with it.

(ii) Give the approximate pH range when these pollutants are dissolved in water.

(iii) Explain why the pollutant is harmful. Suggest ONE undesirable effect of them on human.

(5 marks)

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For question 13 candidates are required to give a paragraph-length answer. For this question, 6 marks will be awarded for chemical knowledge and 3 marks for effective communication.

13. Devise an experiment to investigate the effects of surface area of reactant particles on the rate of a chemical reaction. You may use any common laboratory apparatus and reagents as required.

(9 marks)

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GROUP 族

PERIODIC TABLE 週期表

atomic number 原子序

1
H
1.0

relative atomic mass 相對原子質量

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)