

SECTION A

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

1. Iodine and Astatine (At) are Group VII elements in the Periodic Table.

(a) (i) Draw the electronic diagram of the compound formed between potassium and iodine, showing electrons in the *outermost shells* only.

(ii) Suggest how you would show the presence of potassium ion in potassium iodide.

(3 marks)

(b) Astatine-210 (^{210}At) is a radioactive isotope of astatine. State one class of properties ^{210}At and ^{211}At in common and one they differ.

(2 marks)

(c) Iodine is responsible for the synthesis of thyroid hormone in human. In some area near nuclear energy plants, people's thyroid gland contains a trace amount of ^{210}At . Explain.

(2 marks)

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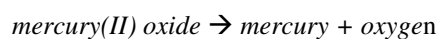
2. Consider three mono-functional organic compounds **X**, **Y** and **Z**.
- (a) Upon addition of sodium hydrogencarbonate, a colourless gas which can turn limewater milky evolved from **X** while no gas from **Y** and **Z**. To what homologous series does **X** belong ?
- (1 mark)
- (b) Both functional groups of **Y** and **Z** can be converted to that of **X** by adding a specific oxidizing agent. Suggest the reagent.
- (1 mark)
- (c) Suppose **Y** can be obtained directly from oxidizing **Z**. Suggest a general formula for the homologous series that **Z** belongs.
- (1 mark)
- (d) Assume both **X** and **Z** are the precursors of an apple flavor methyl butanoate. Deduce the possible structure(s) of **Y**.
- (2 marks)

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3. Mercury oxide (HgO) undergoes thermal decomposition represented as follows:



(a) Transcribe the word equation into chemical equation.

(1 mark)

(b) State an expected observation of the above decomposition.

(1 mark)

(c) Is the decomposition a redox reaction? Explain.

(1 mark)

(d) Suppose 6.20 g of mercury oxide undergo complete decomposition. With reference to the information on page 20, calculate the mass of mercury that would be formed.

(2 marks)

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4. Calcite is a mineral which contains mainly calcium carbonate. An experiment, consisting of the following five stages, was conducted to determine the percentage by mass of calcium carbonate in a sample of calcite.

Stage I: Weigh the sample. Add dilute nitric acid to it until the acid is in excess.

Stage II: Filter the mixture obtained in State 1 to remove any undissolved solid.

Stage III: Add excess sodium sulphate solution to the filtrate to precipitate out calcium sulphate.

Stage IV: Collect the calcium sulphate precipitate and wash it with distilled water.

Stage V: Allow the calcium sulphate to dry and weigh it.

- (a) Suggest how one can know that excess acid has been added in *Stage I*.

(1 mark)

- (b) Draw a labelled diagram of the set-up used in *Stage II*.

(2 marks)

- (c) Write the ionic equation for the reaction in *Stage III*.

(1 mark)


- (d) Explain why it is necessary to wash the precipitate with distilled water in *Stage IV*.

(1 mark)

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5. A student proposed the following methods to accomplish three tasks, (a), (b) and (c). The proposed methods were all considered inappropriate.

- (a) *Task:* To extract chlorine gas in the electrolysis of brine.
Proposed method: Set up an electrolytic cells using platinum as the electrodes

Reason	(i)
Appropriate method	(ii)

(2 marks)

- (b) *Task:* To clean the floor with a household bleach with full capacity.
Proposed method: Mix the household bleach with an acid toilet cleaner

Reason	(i)
Appropriate method	(ii)

(2 marks)

- (c) *Task:* To collect sulphur dioxide in laboratory
Proposed method: Connect the reacting mixture to the delivery tube with a test tube turned up-side down

Reason	(i)
Appropriate method	(ii)

(2 marks)

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6. Hydrogen chloride can be prepared by the action of concentrated sulphuric(VI) acid on potassium chloride as follows:

potassium chloride + concentrated sulphuric acid \rightarrow *potassium hydrogensulphate + hydrogen chloride*

- (a) Transcribe the above word equation into a chemical equation.

(1 mark)

- (b) Draw a labeled diagram of the laboratory set-up.

(3 marks)

- (c) Apart from wearing safety goggles, state one safety precaution for the experiment.

(1 mark)

- (d) Peter attempted to prepare hydrogen bromide employing the same concept. It is observed that the preparation using potassium bromide is not very effective.

- (i) Propose a reason for the infeasibility of the reaction scheme.

- (ii) Elaborate your conjecture with a chemical equation.

(3 marks)

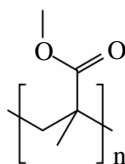
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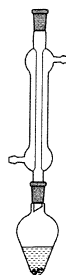
7. (a) Perspex is commonly referred as synthetic glass. It has the following skeletal structure, in which each intersection represents a carbon atom:



- (i) Give the molecular structure of the monomer.
- (ii) Suggest an advantage of replacing glass by perspex in eye-glasses.

(2 marks)

- (b) Perspex can be prepared by methyl methacrylate using the setup shown below.



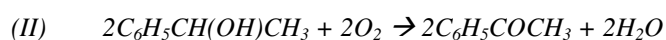
- (i) Label the above set-up properly, clearly indicating the direction of water flow.
- (ii) Suggest, with an explanation, a safety precaution that should be taken in the preparation.
- (iii) Name the type of polymerization involved in the formation of perspex.

(3 marks)

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8. Acetophenone ($C_6H_5COCH_3$), an organic chemical as a precursor to useful resins and fragrances, can be synthesized in following two approaches:



where scheme *II* is under the action of catalyst.

- (a) Give one functional group that the precursor to acetophenone possesses.

(1 mark)

- (b) The term 'atom efficiency' is defined as a percentage fraction of the molecular masses of the desired products over the total molecular masses of all substances in the stoichiometric equation.

- (i) Calculate the atom efficiency for each of the two synthetic pathways.
(Relative atomic masses: H = 1.0, C = 12.0, O = 16.0, S = 32.1, Cr = 52.0)

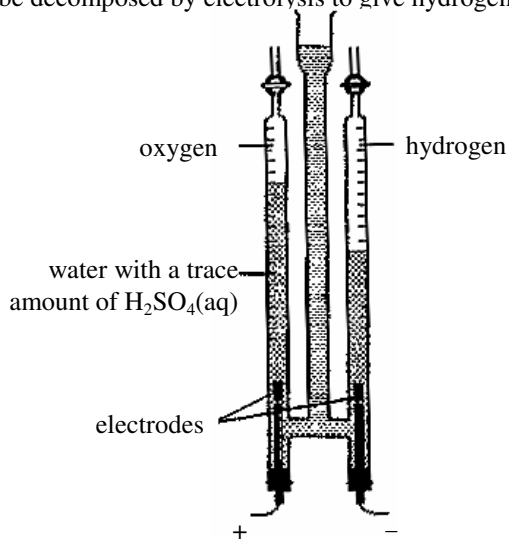
- (ii) Which of the two ways is more preferable ? Explain your answer.

(3 marks)

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11. (a) Water can be decomposed by electrolysis to give hydrogen and oxygen as follows:

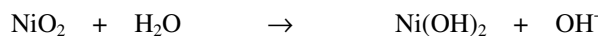


- (i) Explain why a trace amount of sulphuric acid has been added to the water.
- (ii) Suggest a suitable material for the electrodes.
- (iii) Write the half-equation for the formation of oxygen.

(3 marks)

(b) Nickel-cadmium cell is a chemical cell.

- (i) Complete and balance the following half-equations for the reactions that occur at the electrodes of a nickel-cadmium cell.



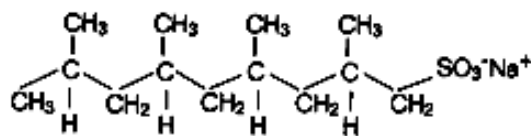
- (ii) Is nickel-cadmium cell rechargeable? Explain.

(4 marks)

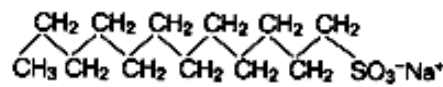
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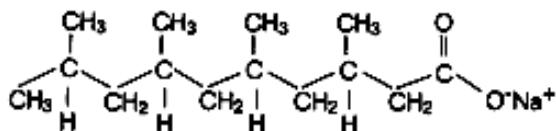
12. The structural formulae of four common detergents are shown below:



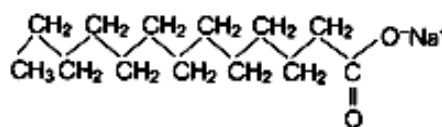
detergent A



detergent B



detergent C



detergent D

- (a) With reference to the above structures, categorize detergents **A**, **B**, **C** and **D** in terms of:
- biodegradability
 - sources of raw materials in its manufacture
- (3 marks)
- (b) Under some circumstances, the use of soapy detergents is not advisable. Suggest and explain one possible condition linked with medium of washing.
- (3 marks)
- (c) A student made the following assertion:
- ‘Although biodegradable plastics can be degraded into non-toxic substances, they still pose potential harm to the environment.’
- Do you agree with him ? Explain.
- (3 marks)

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GROUP 族

PERIODIC TABLE 週期表

I		II												III	IV	V	VI	VII	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)														

atomic number 原子序

relative atomic mass 相對原子質量