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PART A — STRUCTURED ESSAY

*Answer **all four** questions. Each question carries **10 marks**.*

1. (a) Consider the following elements of the periodic table and answer the questions given below.

I	II	III	IV	V	VI	VII	VIII
Li	Be	B	C	N	O	F	Ne

(i) Which element has the largest atomic radius?

.....

(ii) Which element has the highest melting point?

.....

(iii) Which element has the highest second ionization enthalpy?

.....

(iv) Which elements are capable of forming a triple bond between its atoms?

.....

(v) Which elements do **not show** any positive oxidation states?

.....

(vi) Which elements form compounds that act as Lewis acids?

.....

(2·7 *marks*)

(b) Give **one** experimental evidence in each case to demonstrate the discontinuous nature of matter:

(i) air .....

.....

(ii) water .....

.....

(iii) a metal .....

.....

(2·5 *marks*)

(c) **A**, **D** and **E** are three consecutive non-transition elements of the periodic table. The oxide of **A** dissolves in aqueous NaOH solution. **E** forms a chloride which is a liquid at room temperature. This chloride is hydrolysed in water forming two acids.

Identify **A**, **D** and **E** by writing their **chemical symbols** in the space below :

A = ... **D** = ... **E** = ...

(2·4 *marks*)

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(General) (d) **Strike off** the **inappropriate** words given within brackets in the passage given below.

NB : 0·3 marks will be awarded for every correct answer;
0·1 marks will be deducted for every incorrect answer.

The chemical elements in the periodic table are arranged according to the **[mass number/atomic number]**. The majority of these elements are **[metals/non-metals]**. **[All/Most]** of the s-block elements are metals.

The majority of the p-block elements are **[metals/non-metals].**

[Most/All] of the 3d elements are metals. Atoms with the **[same/different]** atomic number and the **[same/different]** mass number are called isotopes.

Nuclei of all atoms have **[protons/neutrons/protons and neutrons]**. **(2·4 *marks*)**

100

2. (a) (Basic) When a sample of potassium hydrogen oxalate, (Hydrated.)

$$\begin{matrix}\text{COOH}\\|\\\text{COOK}\end{matrix} \cdot x\,H_2O$$

was heated strongly CO, CO_2, 1·38 g of K_2CO_3 and 0·90 g of H_2O were obtained as the only products.

(i) Write down the balanced chemical equation for the decomposition of $\begin{matrix}\text{COOH}\\|\\\text{COOK}\end{matrix} \cdot x\,H_2O$

.....

(ii) Calculate the value of *x*.
(K = 39·0, H = 1·0, C = 12·0, O = 16·0)

.....

.....

.....

.....

(3·0 *marks*)

(b) NH_4NO_3 when heated gives N_2O and H_2O as the only products.

(Basic) Write down balanced chemical equations for the relevant oxidation and reduction half reactions.

(i) Oxidation half reaction.

.....

(ii) Reduction half reaction.

.....

(2·0 *marks*)

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(c) Two pure liquids **A** and **B** mix together at temperature **T** to give a homogeneous solution **AB** in which

$$f_{A-A} = f_{B-B} = f_{A-B}$$

where f_{X-Y} for example refers to the force of attraction between two molecules **X** and **Y**.

Two pure liquids **B** and **C** mix together at the same temperature **T** to give a homogeneous solution **BC** in which the force of attraction f_{B-C} is very slightly greater than f_{B-B} and f_{C-C}.

Some of the physical properties of liquids **A**, **B** and **C** together with the liquid quantities mixed to give the above mentioned solutions **AB** and **BC** are given in the table below:

Liquid	Number of moles mixed	Number of molecules mixed	Vapour pressure at temperature **T**	Relative molecular mass	Boiling point
A	x	d	J	M	U
B	y	e	K	L	V
C	z	f	J	N	W

The volume occupied by the vapour in equilibrium with each of the solutions **AB** and **BC** is S at the same temperature **T**. There are no intermolecular interactions between molecules in the vapour phase.

Universal gas constant = R.

Using only symbols given above as may be necessary, **(but using no other)**, answer the following.

(i) Write down a mathematical expression for the Avogadro Constant.

(ii) Write down in respect of the **vapour phase** in equilibrium with the solution **AB**, mathematical expressions for,

(I) the equilibrium vapour pressure of **A**

(II) the total equilibrium vapour pressure

(III) the total number of molecules

(IV) the ratio of the number of molecules of **A** and **B**

(V) the number of molecules of **B**

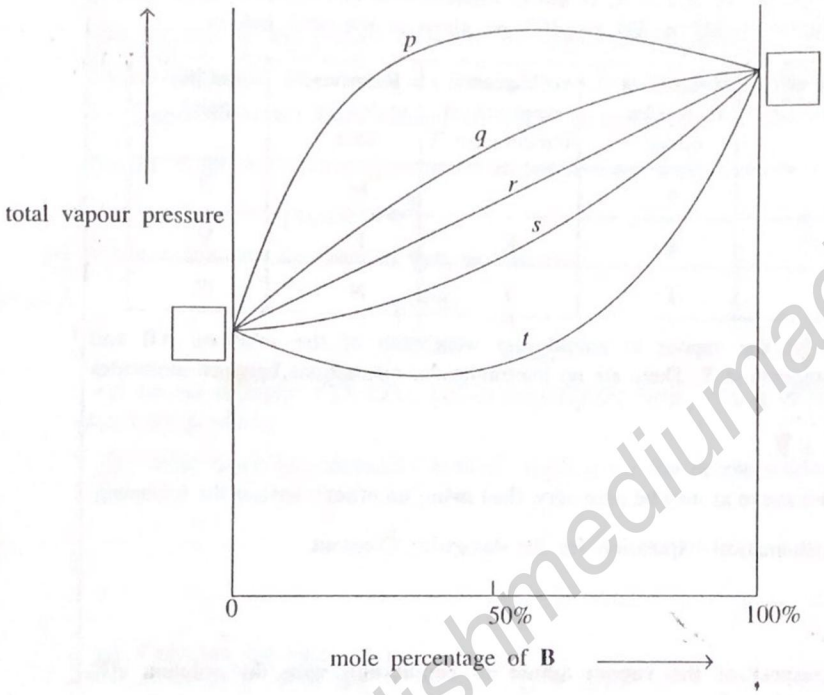
(VI) the mean square speed $\overline{c_B^2}$ of **B** molecules

(3·4 *marks*)

[See page five

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(iii) Possible variations of the total vapour pressure of binary liquid solutions containing **B** with the mole percentage of **B** in solution at temperature **T** are indicated as *p*, *q*, *r*, *s* and *t* in the phase diagram below.



(I) Identify the most appropriate variation *p*, *q*, *r*, *s* and *t* in the above diagram relevant to each of the following solutions by writing same in the appropriate space below.

Solution **AB** : .....

Solution **BC** : .....

(II) Mark in the two boxes of the above diagram, the appropriate symbols for the vapour pressures corresponding to 0% **B** and 100% **B** in both solutions **AB** and **BC**.

(1·6 *marks*)

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(a) Consider the following :

$CH_3CH{=}CHCH_3$, C_3H_7Br, CH_3COCH_3, aqueous HCl, aqueous HBr, CH_3CO_2H, CH_3OH, H_2SO_4, C_2H_5MgBr, benzene, conc HNO_3/conc H_2SO_4

Selecting relevant reactants and reagents from amongst those given above,

(i) write down the mechanism for a nucleophilic addition reaction.

(ii) write down the mechanism for an electrophilic substitution reaction.

(4·0 *marks*)

(b) Consider the scheme of reactions given below:

$$C_4H_8 \text{ (A)} \underset{\text{ethanolic KOH}}{\overset{\text{HBr}}{\rightleftharpoons}} C_4H_9Br \text{ (B)} \xrightarrow{\text{aqueous NaOH}} C_4H_{10}O \text{ (C)}$$

$$\text{(A)} \xrightarrow{H_2/\text{Pt}} C_4H_{10} \text{ (D)}$$

Compound **A** exhibits geometric isomerism while compound **B** exhibits optical isomerism.

(i) Write down the structure of **B**.

Identify each of the carbon atoms in **B** which underwent a change in hybridisation in its formation from **A**. **Mark** these carbon atoms by drawing a circle around each of them in the structure of **B** written by you above.

(ii) **Strike out** the **incorrect** terms/symbols within the brackets in the sentences given below. Note that these sentences refer to the carbon atoms circled by you in (i) above.

(I) The hybridisation changes from $\left[sp/sp^2/sp^3\right]$ in **A** to $\left[sp/sp^2/sp^3\right]$ in **B**.

(II) The geometry around the carbon atoms changes from **[linear/planar triangular/tetrahedral/octahedral]** in **A** to **[linear/planar triangular/tetrahedral/octahedral]** in **B**.

(iii) **Name** the reaction mechanism that operates in the conversion of

(I) **A** ⟶ **B** : .....

(II) **B** ⟶ **C** : .....

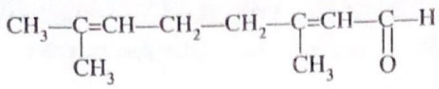
(3·0 *marks*)

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(c) Citral is a colourless natural product.



Citral

(i) From what plant can citral be industrially extracted in Sri Lanka?

.....

(ii) Give the name of the technique used in the extraction of citral.

.....

(iii) Give **one** chemical test (with observation) in each case to show the presence of the following in citral :

(I) **carbon carbon double bond**

test : .....

observation: .....

(II) **aldehyde group**

test : .....

observation: .....

(iv) Draw the stereoisomers of citral.

(v) Citral may be reduced to an alcohol **E** with relative molecular mass = 156. **E** exhibits optical isomerism. Write down the structure of **E**.

(3·0 *marks*)

100

4. (a) A compound **X** $(C_5H_{10}O_5)$ on reaction with PCl_5 gives a compound **Y** having a relative molecular mass of 205·5. Reaction of one mole of **X** with Na_2CO_3 gives one mole of CO_2.

Calculate the number of alcoholic hydroxyl groups present in the compound **X**.

(C = 12·0; H = 1·0; O = 16·0; Cl = 35·5)

.....

.....

.....

.....

.....

.....

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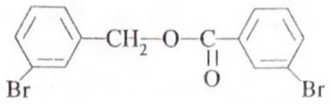
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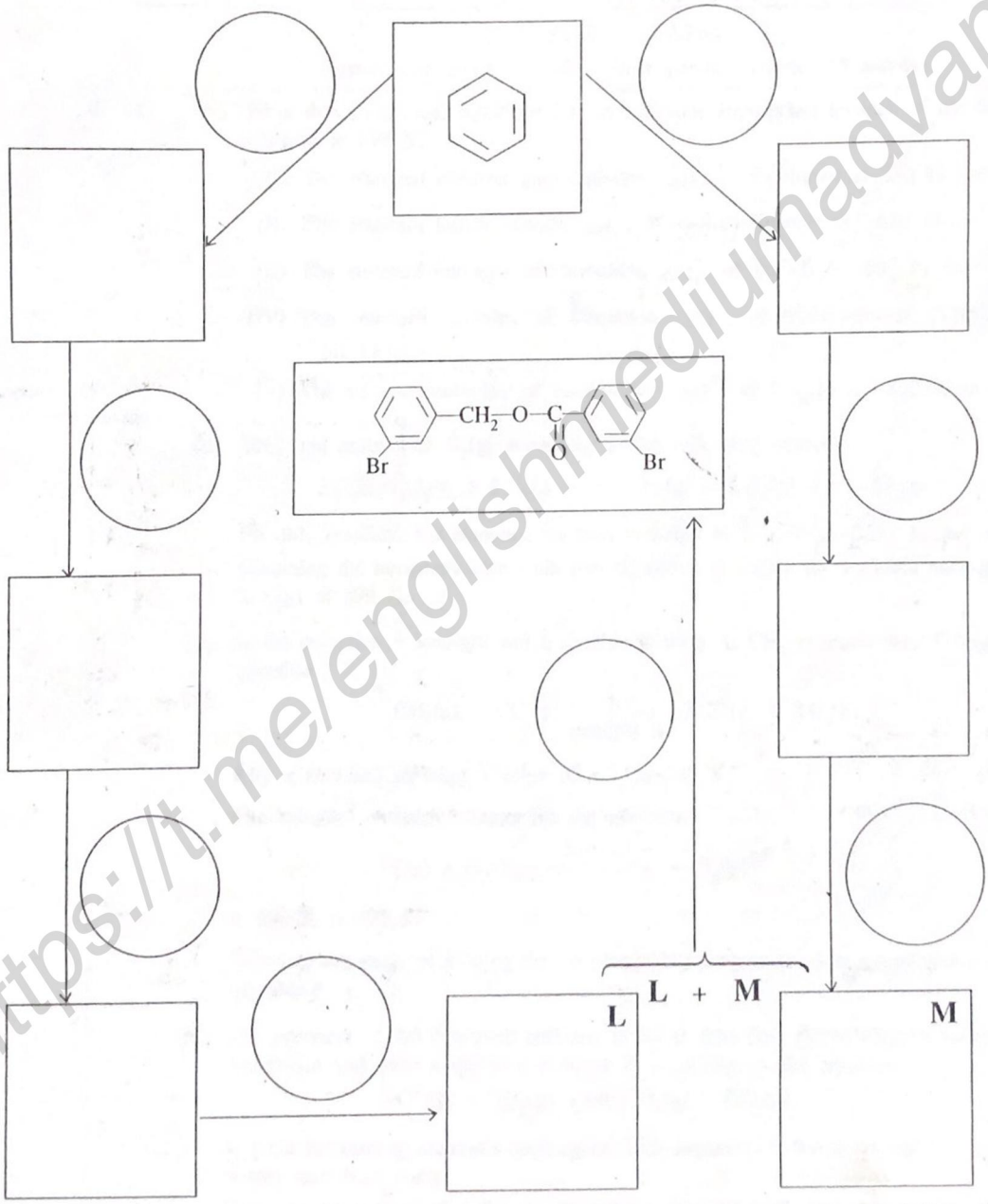
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(3·5 marks)

(b) Using benzene as the starting material, show how you would synthesize the following compound



by completing the scheme given below. For this purpose, write in the boxes structures of appropriate compounds and in the circles appropriate reagents.



(6·5 marks)

100

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முழுப் பதிப்புரிமையுடையது.]
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இலங்கைப் பரீட்சைத் திணைக்களம்
Department of Examinations, Sri Lanka

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கல்விப் பொதுத் தராதரப்பத்திர(உயர் தர)ப் பரீட்சை, 2003 ஏப்பிரல்
General Certificate of Education (Advanced Level) Examination, April 2003

රසායන විද්‍යාව II
இரசாயனவியல் II
Chemistry II

PART B — ESSAY

*Answer **two** questions only. Each question carries **15** marks.*

5. (a) (i) Write down chemical equations for the reactions appropriate to each of the following statements relevant to 298 K.

(I) The standard electron gain enthalpy, ΔH°_{EA}, of chlorine is 350 kJ mol^{-1}.

(II) The standard lattice energy, ΔH°_{L}, of sodium fluoride is –620 kJ mol^{-1}.

(III) The standard enthalpy of formation, ΔH°_{f}, of $H_2O(l)$ is –300 kJ mol^{-1}.

(IV) The standard enthalpy of formation, ΔH°_{f}, of trinitrotoluene (TNT), $C_7H_5N_3O_6(s)$, is –250 kJ mol^{-1}.

(V) The standard enthalpy of combustion, ΔH°_{c}, of $CH_4(g)$ is –800 kJ mol^{-1}.

(3·0 *marks*)

(ii) TNT can react with $O_2(g)$ according to the following equation.

$$2\,C_7H_5N_3O_6(s) + 8\,O_2(g) \longrightarrow 3\,N_2(g) + 5\,H_2(g) + 14\,CO_2(g)$$

For this reaction, the standard reaction enthalpy at 298 K is –2550 kJ per mole of TNT.

Obtaining the necessary data from part (i) above, calculate the standard enthalpy of formation of $CO_2(g)$ at 298 K. **(1·2 *marks*)**

(iii) In the presence of sunlight and a suitable catalyst A, $CH_4(g)$ reacts with $CO_2(g)$ according to the equation

$$CH_4(g) + CO_2(g) \xrightarrow[\text{catalyst A}]{h\nu} 2\,CO(g) + 2\,H_2(g)$$

with a standard enthalpy change of x kJ at 298 K.

The standard enthalpy change for the reaction,

$$C(s) + H_2O(g) \longrightarrow CO(g) + H_2(g)$$

at 298 K is 125 kJ.

Calculate the value of x using the necessary thermochemical data given/calculated in parts (i) and (ii) above. **(2·5 *marks*)**

(iv) The products of the catalysed reaction given in part (iii) above may be reacted under different conditions and over a different catalyst **B** according to the equation

$$2CO(g) + 2H_2(g) \longrightarrow CH_4(g) + CO_2(g)$$

to yield the starting materials once again. This sequence of reactions may be used to convert solar energy into heat energy.

Give **two** advantages of such a cyclic process over the coal combustion process for the production of heat to generate electric power in Sri Lanka.

(2·0 *marks*)

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(v) TNT, which is used as an explosive detonates according to the equation

$$2\,C_7H_5N_3O_6(s) \longrightarrow 3\,N_2(g) + 7\,C(s) + 7\,CO(g) + 5\,H_2O(l)$$

with a standard enthalpy change of -850 kJ per mole of TNT. Use some of the data given in part (i) above to calculate the standard enthalpy of formation of CO(g) at 298 K.

(1·3 *marks*)

(b) $N_2O_5(g)$ decomposes according to the equation,

$$2\,N_2O_5(g) \longrightarrow 4\,NO_2(g) + O_2(g).$$

The reverse reaction can be neglected at 400 K.

The order of the above reaction, with respect to $N_2O_5(g)$, was determined by placing a mixture of $N_2O_5(g)$ and an inert gas in an evacuated bulb of volume 8·314 dm^3, maintained at 400 K and measuring the pressure of the gas mixture as a function of time (**t**).

(i) Using the data given in the following table, calculate,

(I) the amount of $N_2O_5(g)$ reacted after 5 s in each of the experiments **A** and **B** given below.

(II) the order of the reaction with respect to $N_2O_5(g)$, assuming that the time taken for the reactant to reach 400 K is negligible.

State any other assumptions you make.

Experiment	Contents of the bulb at t = 0		Total pressure (in Pa) inside the bulb at t = 5 s
	$N_2O_5(g)$/mol	inert gas/mol	
A	0·125	0·125	$1·012 \times 10^5$
B	0·250	0·125	$1·524 \times 10^5$

(ii) Explain, in molecular terms, the effect of increase in pressure of $N_2O_5(g)$, at a constant temperature, on the rate of the above reaction.

(5·0 *marks*)

6. (a) Write down balanced equations for **all** theoretically possible half reactions that could occur when a dilute aqueous solution of $CuCl_2$ is electrolysed using inert electrodes.

In each case mention whether the half reactions occur at the cathode or the anode.

(3·0 *marks*)

(b) (i) When $SO_2(g)$ dissolves in water, the following equilibrium is established.

$$SO_2(g) \rightleftharpoons SO_2(aq)$$

Write down an expression for the equilibrium constant, K_c, for this process.

Also write down balanced chemical equations and expressions for the relevant equilibrium constants, K_c, to represent all the other equilibria that exist in the above solution.

(ii) Compare qualitatively the pH of a $SO_2(aq)$ solution with that of pure water.

Predict, giving reasons, what would happen to the pH of an aqueous solution of SO_2 when it is aerated by bubbling air through it.

(iii) Giving reasons in brief, name **one** chemical substance in each case that you would add to a solution of SO_2 in water to

(I) increase the concentration of $SO_2(aq)$.

(II) decrease the concentration of $SO_2(aq)$. **(4·0 *marks*)**

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(c) A gaseous compound **A** dissociates at temperatures above 10 °C giving gaseous products **B** and **D** and reaches the equilibrium represented by the equation

$$\mathbf{A}(g) \rightleftharpoons \mathbf{B}(g) + \mathbf{D}(g)$$

(i) Write down expressions for K_p and K_c for the above equilibrium.
Derive the relationship between K_p and K_c mentioning any assumptions you make.
Identify the terms in that relationship.

(ii) An elastic balloon is filled by introducing 6·5 mol of He(g) and 2·0 mol of **A**(g) at a temperature below 5 °C. The system is next allowed to reach the equilibrium given above at 27 °C. Under these conditions it is found that the total pressure inside the balloon is 1×10^5 Pa, and the balloon contains 0·5 mol of A(g).
Calculate K_p and K_c at 27 °C for the above equilibrium. (Express the value of K_c in mol dm^{-3}).

(iii) The balloon referred to in (ii) above is then released to rise in the atmosphere. At a certain altitude when the temperature inside the balloon is 17 °C, it was found that the total pressure in it is $4{\cdot}9 \times 10^4$ Pa and the partial pressure of He(g) is $3{\cdot}5 \times 10^4$ Pa.
Calculate K_P for the above equilibrium at 17 °C.

(iv) Considering the equilibrium mole fractions of **A**(g), **B**(g) and **D**(g) at 27 °C and 17 °C in (ii) and (iii) respectively, **deduce** whether the forward reaction is exothermic or endothermic.

(v) Consider the equilibrium existing at 27 °C in (ii) above. Assume that the system takes 10 minutes to reach equilibrium at this temperature. More **D**(g) is next introduced into the equilibrium system. State, giving reasons, the changes that would happen to the volume of the balloon within the first 15 minutes from the time of introduction of **D**(g). **(8·0 *marks*)**

7. (a) At a certain temperature the concentration of each salt NaCl and K_2CrO_4 in a given aqueous solution is 0·01 mol dm^{-3}. An aqueous solution of 0·1 mol dm^{-3} $AgNO_3$ is slowly added into this solution. The solubility products of AgCl and Ag_2CrO_4 at this temperature are 1×10^{-10} mol^2 dm^{-6} and 1×10^{-12} mol^3 dm^{-9} respectively.

(i) Deduce which of the salts AgCl **or** Ag_2CrO_4 will be precipitated first from the solution.

(ii) At the instant the second silver salt just begins to precipitate, calculate the concentration of the anion of the silver salt that precipitated first which still remains in the solution.

(iii) State the most important assumption you used during the above calculations. **(5·0 *marks*)**

(b) A weak monobasic organic acid HA is soluble in both solvents, water and $CHCl_3$. 500·0 cm^3 of a solution of HA in $CHCl_3$, in which the concentration of HA is 0·057 mol dm^{-3}, is shaken well with 500·0 cm^3 of water and allowed to attain equilibrium at 27 °C. An aqueous layer and $CHCl_3$ layer then separate out; the pH of the aqueous layer is found to be 3·21 under these conditions.
The dissociation constant of HA in water at 27 °C is 1×10^{-5} mol dm^{-3}.

(i) Calculate the partition coefficient at 27 °C for the partitioning of HA between water and $CHCl_3$.

(ii) In a second experiment, a further 500·0 cm^3 portion of the same HA solution in $CHCl_3$ in which the concentration of HA is 0·057 mol dm^{-3}, is shaken well with 500·0 cm^3 of a 0·027 mol dm^{-3} aqueous NaOH solution and allowed to reach equilibrium at 27 °C.
Calculate the pH of the aqueous layer under these conditions.

(iii) State the assumptions you make, if any, in the above calculations.

(iv) An organic amine and a carboxylic acid which are both solids, are soluble in water and $CHCl_3$. An aqueous solution containing this amine and the acid is provided. Suggest a method of separation, using $CHCl_3$ for extraction and any other reagents required, to obtain samples of the pure amine and the pure acid. **(8·0 *marks*)**

(c) Marine life depends on oxygen dissolved in sea water. This oxygen comes from air and the following equilibrium exists between oxygen in air and in sea water.

$$O_2(g) \rightleftharpoons O_2(aq)$$

It has been found that a major portion of the oxygen in sea water comes from the cold currents from the Antarctica (southern pole region) spreading through the oceans.
Using your knowledge of equilibria, explain the above observation. **(2·0 *marks*)**

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PART C - **Essay**

*Answer **two** questions only. Each question carries **15** marks.*

8. (a) **X** is an element with atomic number less than 40. Some properties relevant to **X** are given below.

Maximum oxidation state	+5
Electrical conductivity	Comparable to that of Al
Highest oxide	Weakly acidic
Density	6·1 g cm^{-3}

(i) To which block of elements does **X** belong?

(ii) Write down the chemical symbol of **X**.

(iii) Write down the complete electronic configuration of **X**.

(iv) Write down the **chemical** formula of the highest oxide of **X**.

(v) Write down **one** industrial use of the highest oxide of **X**.

(vi) What are the other oxidation states, if any, shown by **X**?

(4·2 *marks*)

(b) How would you identify the compounds in each of the following groups (i) - (iv), using **only** the method specified for each group.

(i) $(NH_4)_2CO_3(s)$, Ag_2CO_3 (s), Na_2CO_3 (s) — by heating

(ii) $Pb(NO_3)_2$ solution, dilute HCl, dilute H_2SO_4 — by mixing the solutions pair-wise followed by heating.

(iii) CH_3COONH_4 solution, $(NH_4)_2SO_4$ solution, $Ca(OH)_2$ solution — by using the blue litmus paper provided to you.

(iv) 0·1 mol dm^{-3} $Na_2S_2O_3$ solution, 0·5 mol dm^{-3} $Na_2S_2O_3$ solution, 0·5 mol dm^{-3} HCl solution — by mixing the solutions pair-wise.

(6·0 *marks*)

(c) (i) H_2O_2 decomposes into H_2O and O_2 on heating. Write down a balanced chemical equation for this reaction and indicate the changes in the oxidation state of oxygen(O).

(ii) H_2O_2 reacts in acidic medium converting Sn^{2+} ions to Sn^{4+} ions. O_2 is not evolved in this reaction. Write down the relevant oxidation reduction half reactions.

(iii) H_2O_2 reacts in acidic medium converting Ag_2O to Ag metal. O_2 is evolved in this reaction. Write down the relevant oxidation reduction half reactions.

(iv) 100·0 cm^3 of a 0·1 mol dm^{-3} H_2O_2 solution is reacted with 50·0 cm^3 of 0·1 mol dm^{-3} Sn^{2+} ion solution in acid medium. The resultant solution is then reacted with excess Ag_2O.

Calculate the number of moles of O_2 produced.

(4·8 *marks*)

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(a) Sea water contains Na^+, Mg^{2+}, Ca^{2+}, Cl^-, Br^- and SO_4^{2-} ions. The mother liquor remaining after salt has crystallised out from sea water (bittern), contains significant concentrations of Cl^- and Br^- ions.

(i) Using sea water as the **only** source of raw/starting materials and **no other**, and using your knowledge of the chemistry of halogens, propose an **industrial** process for the manufacture of $NaBrO_3$ (steps only required).
(In your answer, wherever possible, reference should be made to established industrial processes and the conditions used.)

(ii) Consider any **three** chemicals produced in the process proposed by you in (i).
Write down **one** industrial use for each such chemical **excluding** its use in the proposed process.

(iii) Mention **two** economic and **two** environmental considerations that should be taken into account in setting up such an industry in Sri Lanka.

(5·0 *marks*)

(b) A mixture contains of the sulphides of two metallic elements **A** and **B** only.
The following tests were performed with the mixture and the observations made are given below.

Test	Observation
(i) Dissolved the mixture in dilute HCl and boiled the solution with a few drops of conc HNO_3 until the evolution of gas ceased.	A clear solution was obtained on cooling.
(ii) Added NH_4Cl and excess of NH_4OH to solution from (i).	A precipitate was formed.
(iii) The precipitate from (ii) was washed with water, dissolved in dilute HCl and shaken with KI and $CHCl_3$.	$CHCl_3$ layer turned violet.
(iv) Added $(NH_4)_2CO_3$ to filtrate from (ii).	A white precipitate was formed.
(v) The precipitate from (iv) was dissolved in dilute acetic acid and treated with K_2CrO_4 solution.	A yellow precipitate was formed.

Identify the elements **A** and **B**, giving as completely as possible, the inferences you can make from each of these tests.

(5·0 *marks*)

(c) Hardness of water is usually expressed in terms of mg dm^{-3} $CaCO_3$, using the following relationship:

$$\text{Hardness (in mg dm}^{-3}\text{ CaCO}_3) = \left\{\begin{array}{c}\text{Concentration of}\\ Ca^{2+}\text{ and/or }Mg^{2+}\\ \text{ions / mol dm}^{-3}\end{array}\right\} \times \left\{\begin{array}{c}\text{Relative molecular mass}\\ \text{of CaCO}_3\end{array}\right\} \times 10^3$$

A water sample contains the compounds $Mg(HCO_3)_2$, $Ca(HCO_3)_2$, $CaSO_4$, $MgCl_2$ and NaCl dissolved in it.

(i) Identify the compound(s) responsible for temporary hardness.

(ii) Identify the compounds(s) responsible for permanent hardness.

(iii) State **two** problems in everyday life that arise due to hardness of water.

(iv) The above water sample was analysed in the following manner to determine its hardness.

(A) 100·0 cm^3 of water sample required 16·0 cm^3 of 0·02 mol dm^{-3} HCl for complete neutralization using methyl orange as the indicator.

(B) 200·0 cm^3 of the water sample was boiled with 18·0 cm^3 of 0·05 mol dm^{-3} Na_2CO_3 solution, filtered and the filtrate diluted to 250·0 cm^3 with distilled water in a volumetric flask. 50·0 cm^3 of this solution required 14·0 cm^3 of 0·02 mol dm^{-3} HCl for complete neutralization using methyl orange as the indicator.

Calculate the temporary hardness and the permanent hardness of the water sample and express them as mg dm^{-3} $CaCO_3$.

(Ca = 40·0; C = 12·0; O = 16·0)

(5·0 *marks*)

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10. (a) (i) Give the chemical formulae and the names of **two** minerals used to extract iron, using the blast furnace.

(ii) What are the other materials required to extract iron by this process?

(iii) Indicate the role of the materials mentioned by you in (ii).

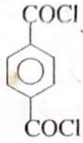
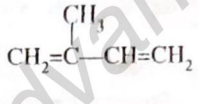
(iv) What are the reducing agents involved in this process?

(v) Indicating the relevant temperatures, write down the balanced chemical equations for the reactions occurring in a blast furnace.

(vi) Write down **three** ill-effects on the environment due to the use of a blast furnace.

(4·8 marks)

(b) Some chemical compounds relevant to the polymer industry are listed below.

HCHO, $HOCH_2CH_2OH$, $CF_2 = CF_2$, , C_6H_5OH, 

Considering only the polymers manufactured from one or more of these compounds, answer the following questions.

(i) Give the names of **four** commonly used polymers.

(ii) Give **one** use of each of the four polymers you have mentioned in (i).

(iii) Draw the structure of a repeat unit of the polymer which is most resistant to heat.

(iv) Draw the structure of a repeat unit of a polymer having the highest elasticity.

(v) Give **one** example of a thermosetting polymer.

(5·0 marks)

(c) A solution **B** contains CrO_4^{2-} and SO_4^{2-} ions. The following procedure was employed to determine the concentrations of these ions.

25·0 cm^3 of solution **B** was reacted with excess $Pb(NO_3)_2$ solution to completely precipitate CrO_4^{2-} and SO_4^{2-} ions as $PbCrO_4$ and $PbSO_4$. The mass of the precipitate so obtained after drying was 0·929 g. This precipitate was then treated with excess dilute HCl and excess aqueous KI solution. The liberated I_2 required 30·0 cm^3 of 0·1 mol dm^{-3} $Na_2S_2O_3$ solution for complete reaction.

Calculate the concentrations of CrO_4^{2-} and SO_4^{2-} ions in solution **B**.

(Pb = 207·0; Cr = 52·0; S = 32·0; O = 16·0)

(5·2 marks)

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