G.C.E. (A/L) Examination
2005 April
Chemistry I / Two hours

Important :

* *This paper consists of 08 pages (Periodic Table is also provided)*
* *Answer all the questions.*
* *Use of calculators is not allowed.*
* *Write your Index Number in the space provided in the answer sheet and then indicate your Index Number by shading the appropriate numbers in the grid immediatly below it.*
* *In each of the questions 1 to 60, pick one of the alternatives. (1), (2), (3), (4), (5) which is correct or most appropriate and shade its number on the answer sheet in accordance with the instructions given therein.*

Universal gas constant, $R = 8.314\ JK^{-1}\ mol^{-1}$
Avogadro Constant $N_A = 6.022 \times 10^{23}\ mol^{-1}$

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1. The third ionisation enthalpy is highest for,
(1) Al (2) Si (3) S (4) Mg (5) Ar

2. The oxidation number of the carbonyl carbon in acetaldehyde, $[CH_3 - \overset{\overset{O}{\|}}{C} - H]$ is
(1) +2 (2) O (3) +1 (4) -1 (5) -2

3. Which arrangement of compounds given below, gives the correct increasing order of **acid strength**?
(1) $H_2O < CH_3OH < CH_3COOH < C_6H_5OH$
(2) $CH_3OH < H_2O < CH_3COOH < C_6H_5OH$
(3) $H_2O < CH_3OH < C_6H_5OH < CH_3COOH$
(4) $CH_3OH < H_2O < C_6H_5OH < CH_3COOH$
(5) $H_2O < C_6H_5OH < CH_3OH < CH_3COOH$

4. Which of the following **does not occur** when the atomic number of the elements increases in group V of the periodic table?
(1) Increase in metallic character
(2) Oxides becoming more acidic
(3) Hydrides becoming less basic
(4) Hydrides becoming more reducing
(5) Oxyacids becoming less acidic

5. Which arrangement of compounds given below gives the correct increasing order of **base strength**?
(1) $C_6H_5NH_2 < CH_3CONH_2 < CH_3NH_2 < NH_3$
(2) $CH_3CONH_2 < C_6H_5NH_2 < NH_3 < CH_3NH_2$
(3) $NH_3 < CH_3CONH_2 < CH_3NH_2 < C_6H_5NH_2$
(4) $CH_3NH_2 < NH_3 < CH_3CONH_2 < C_6H_5NH_2$
(5) $CH_3CONH_2 < CH_3NH_2 < C_6H_5NH_2 < NH_3$

6. Which one of the following statements regarding ideal solutions of two volatile liquids is incorrect?
(1) The standard boiling point of an ideal solution of a **given composition** is a constant.
(2) When an ideal solution is distilled, its boiling point changes with time.
(3) Ideal solutions can occur only over a limited range of compositions.
(4) All ideal solutions obey Raoult's law.
(5) The boiling point of an ideal solution lies between the boiling points of the two pure components.

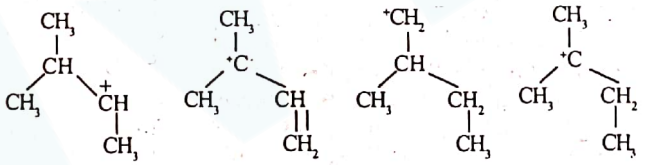
7. With which of the following compounds does H_2O_2 react as a reducing agent?
(1) H_2S (2) KI (3) $FeSO_4$ (4) SO_2 (5) Ag_2O

8. Which one of the following compounds has the largest dipole moment?
(1) *cis* CICH = CHCI (2) CO_2 (3) $CI_2C = CCI_2$
(4) CCI_4 (5) *trans* CICH = CHCI

9. The coloured salt that gives a colourless solution in hot water is
(1) $KMnO_4$ (2) $FeCl_3$ (3) KI
(4) PbI_2 (5) $CuSO_4$

10. One of two identical glass bulbs is filled with **X** moles of an ideal gas and the other with **X** moles of a real gas. Which of the following statements about the two gases is **least likely** to be correct?
(1) The volumes of the two gases are equal at any temperature where no liquefaction occurs.
(2) the pressure of the ideal gas is never smaller than that of the real gas at the same temperature.
(3) The pressures of the two gases may become equal at some temperatures.
(4) The compressibilities of the two gases may become equal at some temperatures.
(5) The mean square speeds, of the two gases are equal at any temperature.

11. Consider the following carbocations :



(I) (II) (III) (IV)

Which of the following gives the correct increasing order of **stability** of the above carbocations?
(1) III < I < II < IV (2) III < I < IV < II
(3) IV < II < I < III (4) I < II < III < IV
(5) II < IV < I < III

12. Which one of the following statements is **incorrect**?
(1) The elements at the top of the electro-chemical series are the most reducing.
(2) Zn will replace Fe from a solution of $FeSO_4$
(3) Cl_2 will liberate I_2 from a solution of KIO_3
(4) Elements above H in the electrochemical series will liberate $H_2(g)$ from acids.
(5) The oxidation state of an element in a compound can be zero.

13. The correct order of the standard enthalpies of formation, ΔH_f° of the atoms of oxygen, nitrogen, chlorine and neon is
(1) CI < Ne < N < O (2) CI < N < O < Ne
(3) O < Ne < CI < N (4) O < N < Ne < CI
(5) Ne < CI < O < N

14. Which one of the following statements is **not true** regarding CrO_4^{2-} and $Cr_2O_7^{2-}$ ions?
(1) Both contain Cr in its highest oxidation state.
(2) Both oxidise I^- to I_2.
(3) They are in equilibrium with each other in aqueous solution.

(4) Both give precipitates with NH_4OH.
(5) Both are reduced to Cr^{3+} by SO_2.

15. Which step given below makes the largest contribution to the yield of CH_3Cl in the following reaction?

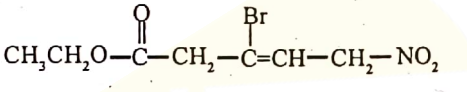
$$CH_4 \xrightarrow[light]{Cl_2} CH_3Cl$$

(1) $CH_3^+ + Cl^- \rightarrow CH_3Cl$ (2) $CH_3^{\bullet} + Cl_2 \rightarrow CH_3Cl + Cl^{\bullet}$
(3) $CH_3^{\bullet} + Cl^{\bullet} \rightarrow CH_3Cl$ (4) $CH_3^+ + Cl_2 \rightarrow CH_3Cl + Cl^+$
(5) $Cl^{\bullet} + CH_4 \rightarrow CH_3Cl + H^{\bullet}$

16. Which one of the following statements is **not true** regarding the elements in the periodic table?
(1) All elements with one valence electron are metals.
(2) There are metals as well as non-metals in group IV.
(3) Most elements in group III are metals
(4) All 3d - transition elements are metals.
(5) Group VII contains elements that exist as gas, liquid or solid at room temperature.

17. **P, Q, R,** and **S** are respectively, pure water, an aqueous solution of sugar, a mixture of ether and water and a mixture of coconut oil and water. The correct order of the boiling points of **P, Q, R** and **S** is
(1) **P < Q < R < S** (2) **R < S < Q < P**
(3) **R < S < P < Q** (4) **Q < P < R < S**
(5) **P < S < Q < R**

18. The IUPAC name of the compound,



is,

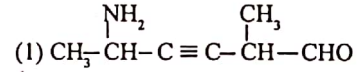
(1) 3-Bromo-1-ethoxy-5-nitropent-3-enone
(2) 3-Bromo-5-ethoxy-1-nitropent-2-enone
(3) 2-Bromo-1-carboethoxy-4-nitrobut-2-ene
(4) Ethyl 3-bromo-5-nitropent-3-enoate
(5) Ethyl 3-bromo-1-nitropent-2-enoate

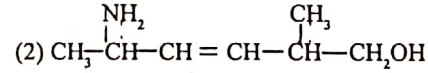
19. .In group III of qualitative analysis, the filtrate from group II is,
(1) treated with NH_4Cl and NH_4OH.
(2) boiled with HNO_3 and then treated with NH_4Cl and NH_4OH.
(3) boiled and then treated with NH_4Cl and NH_4OH.
(4) boiled and then heated with HNO_3 and treated with NH_4Cl and NH_4OH.
(5) boiled with HNO_3, NH_4Cl and NH_4OH.

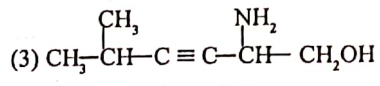
20. The valency and oxidation number of the central atom in $S_2O_3^{2-}$ ion are respectively.
(1) 2 and +4 (2) 4 and +6
(3) 6 and +4 (4) 6 and +2
(5) 4 and +4

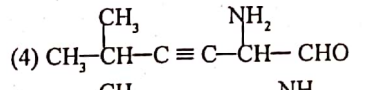
21. The shape of the BrF_5 molecule is
(1) trigonal bipyramidal (2) octahedral
(3) square pyramidal (4) tetrahedral
(5) none of these

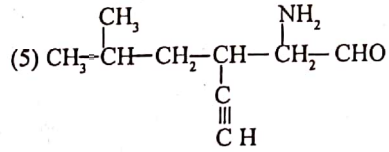
22. Choose the structure which corresponds to the IUPAC name, 2- Amino-5-methylhex-3-ynal











23. NaOH reacts with urea as follows.

$2NaOH + NH_2CONH_2 \rightarrow Na_2CO_3 + 2NH_3\uparrow$

0.6 g of urea (relative molecular mass of urea = 60.0) reacted compleytely with 25.0 cm^3 of 1.0 mol dm^{-3} NaOH. All NH_3 was expelled by boiling. The volume of 0.5 mol dm^{-3} HCl necessary to neutralise the resulting solution is
(1) 10.0 cm^3 (2) 12.5 cm^3 (3) 20.0 cm^3
(4) 25.0 cm^3 (5) 50.00 cm^3

24. For the species NO_2, NO_2^- and NO_2^+ the correct order of the bond angles is,
(1) $NO_2^- > NO_2 > NO_2^+$ (2) $NO_2^+ > NO_2 > NO_2^-$
(3) $NO_2^- > NO_2 = NO_2^+$ (4) $NO_2^- > NO_2^+ > NO_2$
(5) $NO_2^+ > NO_2^- > NO_2$

25. The structural formula of ammonium aquapentafluoroferrate (III) is,
(1) $(NH_4)\ (Fe(H_2O)F_5]$ (2) $(NH_4)\ [Fe(H_2O)_5F]$
(3) $(NH_4)_2\ [Fe(H_2O)\ F_5]$ (4) $(NH_4)_2\ [Fe(H_2O)_5F]$
(5) $[Fe\ (NH_3)\ (H_2O)F_5]$

26. A closed vessel contains water in contact with CO_2 gas at 3 atm pressure. A number of equilibria exist in this system. If CO_2 and H_2O behave ideally in the gas phase, the number of equilibria in the system is
(1) 3 (2) 4 (3) 5 (4) 6 (5) 7

27. Which of the following will show the largest change in pH when 1.0 cm^3 of 1.0 mol dm^{-3} NaOH solution is added to each of them?
(1) 20.0 cm^3 of 1.0 mol dm^{-3} CH_3COOH
(2) 20.0 cm^3 of 1.0 mol dm^{-3} NaOH
(3) A mixture of 10.0 cm^3 of 1.0 mol dm^{-3} CH_3COOH and 10.0 cm^3 of 1.0 mol dm^{-3} CH_3COONa
(4) 20.0 cm^3 of 1.0 mol dm^{-3} H_2SO_4
(5) 20.0 cm^3 of distilled water.

28. Which one of the following cations.
(i) gives a precipitate with NaOH, which is insoluble in excess NaOH?
(ii) gives a precipitate with NH_4OH, which is soluble in excess NH_4OH?
(1) Al^{3+} (2) Cr^{3+} (3) Zn^{2+} (4) Fe^{2+} (5) Cu^{2+}

29. A test tube contains 1- hexyne and another 2-hexyne. Which of the following would you add to each of the two test tubes to distinguish between 1- hexyne and 2 - hexyne?
(1) dilute H_2SO_4 and $HgSO_4$
(2) Br_2 / CCl_4
(3) alkaline $KMnO_4$
(4) ammoniacal $AgNO_3$
(5) aqueous Na_2CO_3

30. Of those given below, the possible combination of bonds that can be formed between any two atoms is
(1) two σ bonds and one π bond
(2) three σ bonds
(3) one σ bond and one π bond
(4) three π bonds
(5) two σ bonds

31. Which of the following columns 1-5, contains the correct observations for both tests A and B, performed on aqueous solutions of the respective salts?

	(1) $AgNO_3$	(2) $Ba(NO_3)_2$	(3) $CdSO_4$	(4) $MgSO_4$	(5) $FeCl_3$
(A) Addition on dil HCl	white ppt	no ppt	no ppt	white ppt	no ppt
(B) Passing H_2S through the solution from test A	white ppt	white ppt	black ppt	no ppt	no ppt

32. Consider the solutions given below.
(a) 0.1 mol dm^{-3} aqueous NH_4Cl
(b) 0.1 mol dm^{-3} aqueous NH_4OH
(c) Mixture of 50.0 cm^3 of 0.2 mol dm^{-3} aqueous NH_4Cl and 50.0 cm^3 of 0.2 mol dm^{-3} aqueous NH_4OH
(d) Mixture of 25.0 cm^3 of 0.2 mol dm^{-3} aqueous NH_4OH and 25.0 cm^3 of 0.2 mol dm^{-3} aqueous acetic acid.

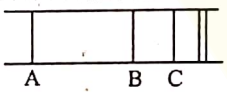
The pH values of the solutions follow the order,
(1) d < c < b < a (2) a < b < c < d
(3) a < d < c < b (4) b < c < d < a (5) b < c < a < d

33. 1.0 dm^3 of 0.2 mol dm^{-3} H_2SO_4 and 1.0 dm^3 of 0.2 mol dm^{-3} HCl were mixed to obtain 2.0 dm^3 of solution. The H^+ ion concentration of the resulting solution, if H_2SO_4 is fully dissociated under these conditions, is
(1) 0.1 mol dm^{-3} (2) 0.15 mol dm^{-3} (3) 0.2 mol dm^{-3}
(4) 0.3 mol dm^{-3} (5) 0.4 mol dm^{-3}

34. Which one of the following is an oxidation - reduction reaction?
(1) $2CrO_4^{2-} + 2H^+ \rightarrow Cr_2O_7^{2-} + H_2O$
(2) $CaCO_3 \rightarrow CaO + CO_2$
(3) $N_2O_4 \rightarrow 2NO_2$
(4) $Ca(COO)_2 \rightarrow CaCO_3 + CO$
(5) $CO_2 + H_2O \rightarrow H_2CO_3$

35. Which one of the following tests can be used to distinguish between acetamide (CH_3CONH_2) and ethylamine ($CH_3CH_2NH_2$)?
(1) addition of Br_2 water
(2) heating with aqueous NaOH
(3) addition of Brady's reagent
(4) heating with dil HCl
(5) treating with acidic $KMnO_4$

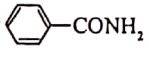
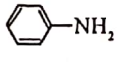
36. The emission lines of the Balmer series of the atomic spectrum of hydrogen are shown below.



The colours of the lines **A,B** and **C** are respectively
(1) red, green, blue (2) blue, green, red
(3) green, red, blue (4) blue, red, green
(5) red, blue, green

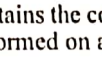
37. Which of the following is **not used** as a bleaching agent?
(1) NaOCl (2) $KMnO_4$ (3) moist SO_2
(4) $Ca(OCl)_2$ (5) H_2O_2

38. An organic compound **X** reacts with nitrous acid to give **Y**. Compound **Y** reacts with acidified $KMnO_4$ give **Z**. Compound **Z** reacts with acidfied, alcoholic, 2,4- dinitrophenylhydrazine to give an orange precipitate.
The compound **X** is

(1)  (2) 

(3) $CH_3-CH_2-\underset{\displaystyle CH_3}{\underset{|}{CH}}-NH_2$ (4) $CH_3-\underset{\displaystyle CHO}{\underset{|}{CH}}-CH_2-NH_2$

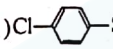
(5) $CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_2-NH_2$

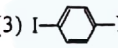
39. Consider the following compounds
(A) C_6H_5OH (B) HCHO (C) Cl - CO  -COCl
(D) $NH_2-(CH_2)_6-NH_2$ (E) $NH_2-CO-NH_2$
Which pair of these compounds given below will produce a thermoplastic polymer?
(1) A and B (2) B and C (3) C and D
(4) D and E (5) E and A

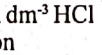
40. An organic compound **X** was fused with sodium. The aqueous extract of the fusion mixture was subjected to the following tests.

Test	Observation
(i) Boiled with excess dil HNO_3 and added aqueous $AgNO_3$	A precipitate insoluble in excess NH_4OH
(ii) Added a solution of sodium nitroprusside	A purple colouration
(iii) Added aqueous $FeSO_4$	A black precipitate

The compound X is,

(1) Cl- -SO_2NH_2 (2) Br-  -NH_2

(3) I-  -$NHCH_3$ (4) I-  -$SO_3^-Na^+$

(5) Cl-  -SH

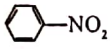
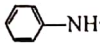
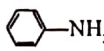
- **Instructions for questions No. 41 to 50 :**

For each of the questions **41** to **50**, four responses *(a), (b), (c)* and *(d)* are given; one or more is/ are correct. Select the correct response/responses. In accordance with the instructions given on your answer sheet, mark.
(1) if only *(a)* and *(b)* are correct.
(2) if only *(b)* and *(c)* are correct.
(3) if only *(c)* and *(d)* are correct.
(4) if only *(d)* and *(a)* are correct.
(5) if **any other** number or combination of responses is correct.

Summary of above Instructions				
(1)	(2)	(3)	(4)	(5)
Only *(a)* and *(b)* are correct.	Only *(b)* and *(c)* are correct.	Only *(c)* and *(d)* are correct.	Only *(d)* and *(a)* are correct.	**Any other** number or combination of responses is correct.

41. Which of the following statement/s is/are true?
(a) Electrons have particle as well as wave properties.
(b) A proton is heavier than a neutron.
(c) All atoms have electrons, protons and neutrons.
(d) All ions have at least one proton.

42. The kinetic molecular theory equation for an ideal gas is, $pV = \frac{1}{3} mN\overline{C^2}$. Which of the followi ng statement/s is/are true for an ideal gas?
(a) $\overline{C^2}$ is independent of temperature.
(b) $\overline{C^2}$ is a constant at constant temperature.
(c) pV is a constant at constant temperature.
(d) pV is independent of the number of moles.

43. Compound **X** was treated with the reducing agent Sn and conc. HCl. The reaction mixture was basified with aqueous NaOH. The organic product resulting from basification was isolated and treated with nitrous acid, followed by 2-naphthol to give a reddish - orange dye.
Which of the following structures for **X** is / are consistent with the above reaction sequence?
(a)  -NO_2 (b) CH_3- -NO_2 (c)  -NH-CH_3
(d)  -NH_2

44. Which of the following can be taken as evidence for the non-ideal nature of real gases?
(a) Different real gases have different boiling points.
(b) Certain real gases are coloured while others are not.
(c) Under identical conditions different real gases have different densities.
(d) Certain real gases react chemically with each other.

45. Which of the following solutions **cannot be used** to distinguish between SO_2 and CO_2
(a) $K_2Cr_2O_7/H^+$ (b) $KMnO_4$
(c) Litmus solution (d) $FeCl_3/H^+$

46. The rate of a chemical reaction increases when the concentrations of the reactants are increased at constant temperature, because :
(a) The number collisions between molecules increases
(b) The fraction of molecules with energy in excess of the activation energy/increases.
(c) The energy of the collisions increases.
(d) The fraction of collisions with the correct geometry increases.

47. The standard electrode potentials of two metal/metal ion electrodes, P/P^+ and Q/Q^{2+} are 0.80 and -0.44 V respectively. Which of the following reaction/s is/are consistent with the above potentials?
(a) $2P(s) + Q^{2+}(aq) \rightarrow 2P^+(aq) + Q(s)$
(b) $Q(s) + 2H^+(aq) \rightarrow H_2(g) + Q^{2+}(aq)$
(c) $H_2(g) + P_2O(s) \rightarrow 2P(s) + H_2O(l)$
(d) $H_2O(l) + P(s) \rightarrow H_2(g) + POH(aq)$

48. Water from a tube well is clear as it is pumped out, but turns cloudy and brown on exposure to air for some time, due to the formation of $Fe(OH)_3$. Which of the following statements are most likely to be true in this situation?
(a) $Fe(OH)_3$ dissolves in water under pressure but is deposited when the pressure is atmospheric.
(b) Iron is present mainly as Fe^{2+} in the ground water feeding the well.
(c) Conditions underground are reducing.
(d) The solubility of $Fe(OH)_3$ is much less than that of $Fe(OH)_2$

49. Which of the following may be considered as a standard hydrogen electrode/ standard hydrogen electrodes at 25°C?
(a) HCl(aq) (1.0 mol dm^{-3}) / $^{Pt}H_2(g)$ (1atm)
(b) CH_3COOH(aq) (1.0mol dm^{-3}) / $^{Pt}H_2(g)$ (1atm)
(c) H_2SO_4(aq) (1.0mol dm^{-3})/$^{Pt}H_2(g)$ (1atm)
(d) HNO_3(aq) (1.0 mol dm^{-3}) /$^{Pt}H_2(g)$ (1atm)

50. S is a solution of Na_2CO_3 and $NaHCO_3$ in water. By which method/ methods given below can the concentrations of Na_2CO_3 and $NaHCO_3$ in S be determined by titrating 25.0 cm^3 of S with standard HCl?
(a) Using phenolphthalein as indicator.
(b) First using methyl orange as indicator and further titrating the same solution using phenolphthalein as indicator.
(c) First using phenolphthalein as indicator and further titrating the same solution using methyl orange as indicator.
(d) Tirate using phenolphthalein as indicator and thereafter titrate a separate 25.0 cm^3 of S using methyl orange as indicator.

Instructions for questions No. 51 to 60

In questions No. **51** to **60**, two statements are given in respect of each question.
From the Table given below, select the response out of the responses (1), (2), (3), (4) and (5) that **best** fits the two statements given for each of the questions and mark appropri ately on your answer sheet.

Response	First Statement	Second Statement
(1)	True	True, and correctly explains the first statement.
(2)	True	True, but does **not** explain the first statement correctly.
(3)	True	False
(4)	False	True
(5)	False	False

	First Statement	Second Statement
51.	Ethylamine does not give a stable diaszonium salt with HNO_2.	HNO_2 reacts with aromatic amines only.
52.	Under a given set of conditions, a catalyst increases the amount of product obtained in unit time.	A catalyst alters the enthalpy change of a reaction.
53.	CH_4 and CO_2 are green - house gases.	Green-house gases are those that consist of carbon - containing, small molecules.
54.	Two different reactions taking place at the same rate, at the same temperature should have the same activation energy.	The rate of a reaction is directly proportional to the activation energy.
55.	The organic product obtained from the reaction of optically active 2-butanol with acidic $KMnO_4$ is not optically active.	The organic product is a recemic mixture.
56.	Cl_2 gas dissolved in water can be expelled by boiling.	Dissolution of chlorine in water is exothermic and reversible.
57.	$CUSO_4.5H_2O$ becomes colourless on heating.	Cu^{2+} ion is reduced to Cu^+ ion on dehydration.
58.	ICl_4^- ion is tetrahedral.	There are four repulsion units around the iodine atom in ICl_4^-
59.	The properties of one N-H bond in the NH_4^+ ion are different from those of the other three N-H bonds.	One N-H bond in the NH_4^+ ion can be identified as a co-ordinate bond.
60.	In the fermentation of glucose ($C_6H_{12}O_6$) by yeast, some carbon atoms of the glucose molecule are oxidised while others are reduced.	The chemical products of fermentation of glucose are CO_2 and CH_3CH_2OH.

G.C.E. (A/L) Examination
2005 April
Chemistry II / Three hours

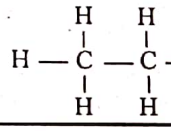
- Periodic Table is provided on page 14.
- Use of calculators is not allowed.

PART A - Structured Essay (Pages 2-8)

- Answer **all** the questions.
- Write your answer in the space provided for each question. Please note that the space provided is sufficient for the answer and that etensive answers are not expected.

N.B. INSTRUCTION BOX

In answering questions 3 and 4, you may represent alkyl groups in a condensed manner.

e.g.  may be shown as CH_3-CH_2 -

PART B and PART C - Essay (pages 9-14)

Answer **four** questions selecting not more than two questions from each part. Use the paper supplied for this purpose.

At the end of the time allotted for this paper, tie the answers to three parts **A, B** and **C** together so that Part **A** is on top and hand them over to the Supervisor.

You are permitted to remove only Parts **B** and **C** of the question paper from the Examination Hall.

Universal gas constant, R	= 8.314 JK^{-1} mol^{-1}
Avogadro constant N_A	= 6.022 x 10^{23} mol^{-1}

PART A - STRUCTURED ESSAY

Answer all four questions on this paper itself. (Each question carries **10 marks.**)

1. (a) Complete each of the statements given below by filling the blanks with a compound from the following list.

BCl_3, PCl_5, Cl_2O_7, N_2O_5, SiO_2, HF, HI, HCl, H_2S, H_2O

(i) The most acidic oxide is .....

(ii) The hydrogen halide showing the highest acidity in aqueous solution is .....

(iii) The compound with the highest melting point is .....

(iv) The compound forming the strongest hydrogen bonds is .....

(v) The compound most likely to act as a Lewis acid is .....

(vi) The element with the numerically highest oxidation number is found in the compound .....

(3.6 marks)

(b) **X** is a non-transition element which does not react with deuterium oxide (D_2O) at room temperature. The hydroxide of **X** is not amphoteric but shows basic properties. The sulphate of **X** is very soluble in water.

(i) Identity **X**.

.....

(ii) Give balanced chemical equations for the reactions that occur when **X** is burnt in air.

.....

.....

.....

(3.4 marks)

(c) **A,B, C** and **D** are four non-transition elements whose atomic numbers are Z, Z+1, X+2 and Z+3 respectively. Of these elements, C has the highest first ionization energy. Identify the group in the periodic table to which **C** belongs, if

(i) the atomic radius of **D** is smaller than that of **C**.

.....

(ii) the atomic radius of D is larger than that of C.

.....

(3.0 marks)

2. (a) **Y** is a hydrated salt containing Na, S, H and O **only**. It contains 18.5% of Na, 25.8% of S and 4.0% of H, by mass. In this compound H is present as H_2O only.
(Na = 23.0, S = 32.0, H = 1.0, O = 16.0)

(i) Determine the empirical formula of **Y**.

.....

.....

.....

.....

.....

(2.5 marks)

(ii) If the relative molecular mass of Y is 248, deduce its molecular formula.

.....

.....

.....

.....

(0.6 marks)

(iii) Draw the structure of the anion of salt **Y**.

.....

.....

.....

.....

(1.0 marks)

(iv) Give a commonly used name for **Y**.

.....

(0.3 marks)

(v) Give **two** uses of **Y**.

.....

.....

.....

(0.6 marks)

(b) The reversible reaction $2A(g) \rightleftharpoons B(g)$ reaches equilibrium at temperatures above 100°C. Figure I, shows the activation energy curve for the above reaction. Figure II, shows the Maxwell - Bolzmann distributions of speeds for the molecules **A** and **B** at temperatures T_1 and T_2 where $T_2 > T_1 :> 100°C$.

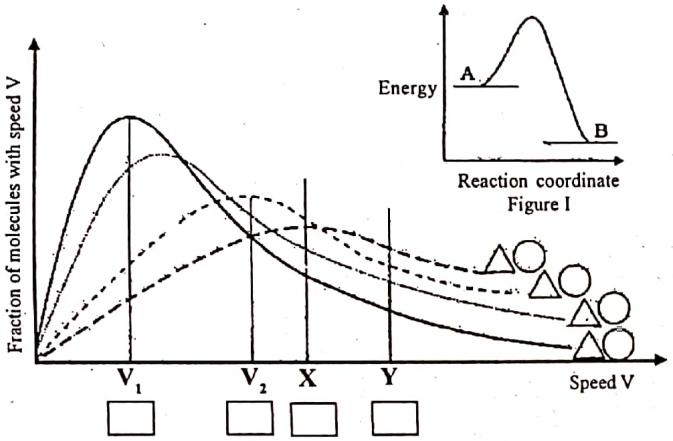


Figure II

(i) In figure I, draw vertical arrows to show the activation energy of the forward reaction, **F**, and the activation energy of the reverse reaction, **R**. Label them **F** and **R**.

(ii) Delete the **inappropriate** words in the following statement :

'The forward reaction is **endothermic/exothermic** and its enthalpy change is **negative/positive.**

(iii) In figure II, **X** and **Y** are the speeds of molecules with energy equal to each activation energy. Identify the activation energies corresponding to **X** and **Y**, by writing **F** and **R** in the appropriate cages placed below **X** and **Y** in the figure.

(iv) In figure II, V_1 and V_2 refer to the mean speeds of the two types of molecules at the same temperature. The mean molecular speed is inversely proportional to molecular mass. Identify as to which type of molecules the mean speeds V_1 and V_2 refer to by writing **A** and **B** in the appropriate cages placed below V_1 and V_2 in the figure.

(v) Hence identify the different distributions in figure II, by writing **A** and **B** in the appropriate triangles and T_1 and T_2 in the **appropriate** adjacent circles, which are placed at the ends of the curves.

(vi) Delete the **inappropriate** words in the following statements :

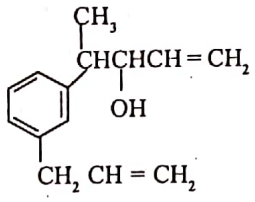
'The equilibrium concentration of **A** at T_1 is **greater/ smaller,** than its value at T_2.'

'The equilibrium concentration of **B** at T_1 is **greater/ smaller,** than its value at T_2.'

'When the temperature is increased from T_1 to T_2, the rate of the forward reaction **increases/ decreases** and the rate of the reverse reaction **increases/ decreases.**'

(5.0 marks)

3. Selecting appropriate reagents and solvents only from the list below, show how you would synthesize the following compound.



List of reagents and solvents.

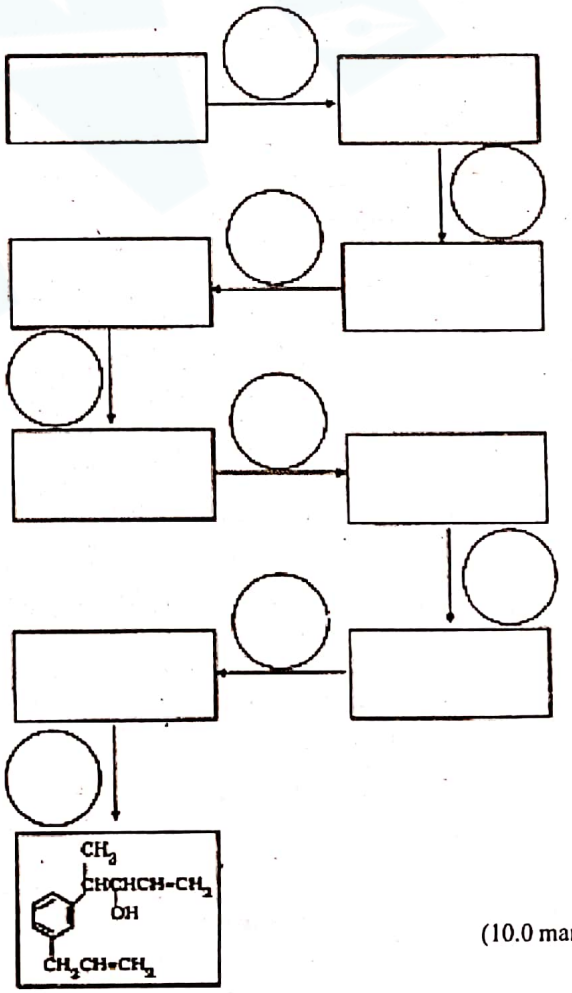
acetophenone ($(C_6H_5COCH_3)$), Propenal (CH_2= CHCHO)
$AlCl_3$, PCl_5, Cl_2, I_2
$NaBH_4$, $KMnO_4$, Ag_2O
Mg, Zn (Hg)
water, conc. HCl, aq. NaOH
acetone, ethanol, dry ether

Note :

I. In the following schemes each arrow indicates a single reaction.

II. Write in the boxes the structures of the appropriate compounds and in the circles the reagents/solvents required.

III. Before filling the scheme on the answerscript, you are advised to work out the correct reaction sequence on a rough paper.



(10.0 marks)

4 (a) **A** and **B** are isomeric hydrocarbons each having **two** sp^3 - hybridized carbon atoms, **two** sp^2 - hybridized carbon aoms and **two** sp-hybridized carbon atoms. **A** shows optical isomerism while **B** shows geometric isomerism. Write **one** possible structure each, for **A** and **B** in the cages below.

A B

(2.0 marks)

(b) **A** compound **X** with the molecular formula, $C_9H_{12}O$ reacts

(i) with hot acidic $KMnO_4$ to give benzoic acid,

(ii) with sodium to give a colourless and odourless gas Y, and

(iii) with concentrated hydrochloric acid and zinc chloride to give a cloudy precipitate immediately

Write the structure of **X** in the cage below

X

Identify the gas **Y** in the cage below.

Y

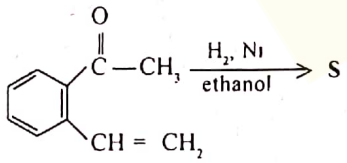
(2.0 marks)

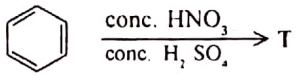
(c) Consider the following reactions (I-V)

(I) $CH_3CH_2I \xrightarrow{\text{aq. KCN}} P$

(II) $CH_3CH{=}CH_2 \xrightarrow[\text{ether}]{\text{HBr}} Q$

(III) $CH_3CHO \xrightarrow[\text{room temp}]{\text{dil.aq. NaOH}} R$

(IV) 

(V) 

(i) **P,Q, R, S** and **T** are the respective major products of the above reactions, (I) - (V).
Write their structures in the appropriate cages

P Q

R S

T

(ii) Identify the mechanism type of each of the above reactions as.

electrophilic addition (A_E).
electrophilic substitution (S_E).
nucleophilic addition (A_N).
nucleophilic substitution (S_N) or
any other mechanism (M_O)

by writing A_E, S_E, A_N, S_N or M_O in the appropriate cage in the second column of the table below.

Also write in the appropriate cages the electrophiles in electrophilic reactions and the nucleophiles in nucleophilic reactions.

Reaction number	Mechanism - type (A_E, S_E, A_N, S_N or M_O)	Electrophile (in electrophilic reactions)	Nucleophile (in nucleophilic reactions)
I			
II			
III			
IV			
V			

(iii) Write the structure of the intermediate in reaction (V)

(6.0 marks)

PART B - ESSAY

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

5. Answer part (a) and **either** part (b) **or** (c) **only.**

(a) At temperatures above 400 K, **A**(g) dissociates to give **B** (g) and **D** (g) resulting in the equilibrium,

$$aA(g) \rightleftharpoons B(g) + D(g)$$

(i) The equilibrium constants K_c and K_p for the above equilibrium have the same numerical value. Starting with the definitions of K_c and K_p for the above reaction, deduce that the balancing coefficient, 'a', in the above equation is equal to 2.

(ii) In a certain equilibrium mixture of the gases **A**,**B** and **D**, at 500 K, the respective partial pressures of the gases are as follows ;

$P_A = 2 \times 10^5$ Pa, $P_B = 8 \times 10^5$ Pa and $P_D = 2 \times 10^5$ Pa

Calculate Kp for the above equilibrium at 500 K.

(iii) A rigid vessel of volume 4.157m³ is filled with only **A**(g) at 27°C and the pressure of the gas under these conditions is **X**. When the vessel and its contents are heated to 500 K, and the system allowed to reach equilibrium at this temperature, it is found that, the total pressue in the vessel is **Y** and the partial pressure of **B** in the vessel is **Z**. Assuming that the volume of the vessel is unchanged on heating, show that,

$$Y = \frac{5}{2} Z \text{ and } \frac{Y}{X} = \frac{5}{3}$$

State any assumption/s you have used.

If Y is 8×10^5 Pa, calculate the values of X and Z.

(iv) To the equilibrium mixture in (iii) above where $Y = 8 \times 10^5$ Pa, n moles of **A** are added. When the system reaches equilibrium again at 500 K, the total pressure in the vessel is found to be 2.5×10^6 Pa. Calculate the value of n and the partial pressures of **A**(g), **B**(g) and **D**(g) under the new equilibrium conditions.

(8.0 marks)

(b) Write down balanced chemical equations for the processes appropriate to each of the following statements from (i) to (vii).

(i) The standard electron gain enthalpy, ΔH^0_{EA}, of bromine is -328.0 kJ mol^{-1}.

(ii) The standard enthalpy of formation, ΔH^0_f, of $MgCl_2(s)$ is -614.0 kJ mol^{-1}.

(iii) The standard enthalpy of combustion, ΔH^0_C, of stearic acid, $C_{17}H_{35}COOH$, is -11380.0 kJ mol^{-1}

(iv) The standard enthalpy of first ionisation, $\Delta H^0_{I_1}$, and the standard enthalpy of second ionisation, $\Delta H^0_{I_2}$, of Mg are respectively, 737.0 kJ mol^{-1} and 1451.0 kJ mol^{-1}.

(v) The standard enthalpy of atomisation, ΔH^0_A, of Mg is 148.0 kJ mol^{-1}

(vi) The standard lattice enthalpy, ΔH^0_L, of $MgBr_2(s)$, is -2440.0 kJ mol^{-1}

(vii) The standard bond dissociation enthalpy, ΔH^0_D, of Br_2 is 193.0 kJ mol^{-1}

Given that the standard state for bromine is $Br_2(l)$ and that its standard enthalpy of vaporisation ΔH^0_{vap}, is 15.0 kJ mol^{-1}, calculate the standard enthalpy changes of the following reactions (viii) and (ix).

(viii) $Mg(s) + Br_2(l) \rightarrow MgBr_2(s)$

(ix) $Cl_2(g) + MgBr_2(s) \rightarrow MgCl_2(s) + Br_2(l)$

(7.0 marks)

(c) A closed vessel contains a solution of three volatile liquids **A**,**B** and **C**, in equilibrium with a vapour phase containing **A**, **B** and **C** molecules only, at a temperature Q. The total vapour pressure is H. There are no interactions between the molecules in the vapour phase, while there is complete uniformity of forces amongst the molecules in the liquid phase. Some selected properties of the above system and its pure components are given in the table below.

	Pure Liquid		Liquid phase		vapour phase	
compound	vapour pressure	relative molecular mass	number of molecules	number of moles	number of molecules	number of moles
A		L	a	a	a/3	
B	H/2	M	2a			b
C		N		3b		

Using **only** the symbols given in this question and **no other,** write down expressions for the following and simplify them as far as possible.

(i) Avogadro Constant N_A.

(ii) q, the number of moles of **B**, in the liquid phase.

(iii) c, the number of molecules of **C** in the liquid phase.

(iv) the mole fractions of **A**, **B** and **C**, in the liquid phase.

(v) the partial presssure of **B**, in the vapour phase.

(vi) the total number of moles **T**, in the vapour phase.

(vii) the mole fractions of **A**, **B** and **C** in the vapour phase.

(viii) the partial pressure of **A** and **C** in the vapour phase.

(ix) the volume **G**, of the vapour phase, if the gas constant is **R**.

(x) the mean square speed of A molecules, $\overline{C_A^2}$ in the vapour phase.

(N.B. Answers with symbols other than those given in the question will not be given marks)

(7.0 marks)

6. Answer **all** parts

(a) A procedure used in a student project to investigate the pollution of ground water in a village by an agrochemical **X** of relative molecular mass 125, is given below.

(I) 500 cm³ of an aqueous solution containing 90.0 ppm of **X**, was shaken well with 100.0 cm³ of ether and the two layers allowed to reach equilibrium at 25°C. The ether layer was then separated and evaporated to dryness. A residue containing 40.0 mg of **X** was obtained.

(II) Experiment (I) was repeated using 1000.0 cm³ of water from a well, in place of the 500.0 cm³ of the aqueous solution of **X**. The residue obtained contained 43.2 mg of **X**.

(III) 2000.0 cm³ of the above well water was shaken with 100.0 g of ground redbrick powder for 30 minutes. The water was then filtered to remove brick particles. Experiment (I) was repeated, this time using 1000.0 cm³ of the above filtrate in place of the 500.0 cm³ of the aqueous solution of **X**. The residue obtained contained 6.0 mg of **X**.

(i) Calculate the content of **X** in the water obtained directly from the well and in the well water after treatment with brick powder, in ppm and in mol dm^{-3}, in each case (1 ppm = 1 mg dm^{-3})

(ii) Giving reasons for your answer, explain the observations in (III) above.

(iii) What additional measurements are needed to make the results more reliable and generally applicable to the ground water quality of the village?

(iv) The World Health Organisation (WHO) recommendation for the maximum content of **X** in drinking water is 9.0 ppm. Suggest a method based on the above procedure, to bring to bring the well water to the above WHO standard.

(8.0 marks)

(b) A student prepared 100.0 g each of three mixtures **P**, **Q** and **R** by mixing the finely ground metals Al, Zn and Mg. The masses of the metals used for each mixture are given in the table below.

Mixture	Mass of metal/ g			Total mass/g
	Al	Zn	Mg	
P	21.6	13. 0	65.4	100.0
Q	27.0	52. 0	21. 0	100.0
R	32. 4	65.0	2.6	100.0

(Al = 27.0, Zn = 65.0, Mg = 24.0)

The student however, failed to label the mixtures and they cannot be identified visually. You are provided with 1.0 g. samples of each of the three mixtures. Show, with necessary calculations, how you would identify the three mixtures using only the following :

0.2 mol dm^{-3} HCl solution
Three identical empty bottles
Three identical balloons, the open ends of which fit tightly over the mouths of the bottles.

Write balanced chemical equations for any reactions you may use.

(7.0 marks)

7. Answer **all** parts.

(a) **A** is a saturated aqueous solution of AgCl and **B** is a 0.1 mol dm^{-3} aqueous solution of NaCl, saturated with AgCl.

At 25°C, the solubility product of AgCl = 1×10^{-10} $mol^2 dm^{-6}$

(Ag = 107.0, Cl = 35.5)

(i) Calculate the concentration of $Ag^+(aq)$ and the solubility of AgCl in mg dm^{-3}, in each of the solutions **A** and **B** at 25°C.

(ii) Draw a labelled sketch of an experimental arrangement for electroplating a small copper ring with silver, using one of the solutions **A** and **B**. Indicate the polarity (+ve or -ve) of the electrodes and clearly label the anode and cathode. Name the metals used for the anode and cathode.

(iii) It is known that the lower the rate of electroplating, the finer and shinier the metal coating obtained. Using your knowledge of chemical kinetics, deduce giving reasons as to which of the solutions **A** and **B** is more suitable for the above experiment (ii).

(iv) The following equilibrium occurs when a silver salt is dissolved in an aqueous solution of KCN :

$$[Ag(CN_2)]^-_{(aq)} \rightleftharpoons Ag^+(aq) + 2\,CN^-(aq)$$

Explain why a solution of a silver salt in aqueous KCN is more suitable than an aqueous solution of the silver salt of the same concentration for the commercial electroplating with Ag.

Comment on the magnitude of the equilibrium constant of the above equilibrium.

(v) Explain why an ammoniacal solution of $AgNO_3$ and not an aqueous solution of $AgNO_3$, is used as the oxidising agent, in the Tollen's silver mirror test for organic reducing agents.

(vi) The copper ring was silver plated at a constant current of 0.15A for 40 minutes. Calculate the increase in mass of the copper ring.

(Faraday Constant, F = 96540 C mol^{-1})

(vii) The electrode potential of a Ag Ag^+ electrode becomes more positive as the concentration of $Ag^+(aq)$ in the electrolyte increases. Sketch an electrochemical cell which can be made using the solutions **A** and **B**, two silver rods and a salt bridge as the only components. Label the sketch to show clearly the anode and cathode and identify the anode and cathode solutions as **A** or **B**.

(10.0 marks)

(b) Deduce by means of suitable calculations, what you would expect to observe when 100.0 cm^3 of a 1×10^{-5} mol dm^{-3} aqueous solution of barium hydroxide is mixed with 100.0 cm^3 of a 2.5×10^{-5} mol dm^{-3} aqueous solution of cadmium sulphate at 25°C.

At 25°C

solubility product of barium sulphate = 1×10^{-10} mol^2 dm^{-6}

solubility product of cadmium hydroxide

= 1.2×10^{-14} mol^3 dm^{-9}

(5.0 marks)

PART B - ESSAY

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

8. Answer **all** parts.

(a) (i) **M** is a 3d- transition element. **M** forms a stable dioxide MO_2, which is white in colour.

(A) Identify **M**

(B) Write the complete electronic configuration of **M**.

(C) Give **one** industrial application in each case for **M** and MO_2.

(ii) The tests performed on a solution prepared by dissolving two 3d-transition metal chlorides in water (solution **S**) and the relevant observations are given below

Test	Observation
(A) Aqueous NaOH was added to solution **S**.	A blue-green precipitate was obtained.
(B) Solution **S** was warmed with aqueous NaOH and H_2O_2 and filtered.	A precipitate and a yellow filtrate were obtained.
(C) Conc. HCl was added to the precipitate obtained in **(B)**	A yellow solution was obtained.
(D) Diluted the yellow solution obtained in **(C)** and passed H_2S.	A black precipitate was obtained.

Identify the cations present in S.

Identify the respective ions responsible for the yellow colour of the filtrate from test (B) and the yellow colour of the solution obtained in test (C). Write balanced chemical equations for the formation of these two ions in the above reactions.

What do you expect to observe when the filtrate from (B) is acidified? Give the relevant balanced chemical equation.

(8.0 marks)

(b) Ammonia is produced industrially using N_2 and H_2. The following questions refer to the 'Haber' process for the manufacture of NH_3

(i) What are the sources of N_2 and H_2 used for this process?

(ii) What are the specific reaction conditions (temperature, pressure and catalyst) used?

(iii) How does the catalyst affect the rate of the forward reaction, the rate of the reverse reaction and the equilibrium constant?

(iv) Name **one** industry in which NH_3 is oxidized. What are the reaction conditions employed in this oxidation?

(v) Give **one** household use of ammonia.

(vi) Write balanced chemical equations and the necessary reaction conditions for the reactions of ammonia with each of the following

CuO, I_2 and Na

(vii) Give, in each case, **one** ammonium compound that is used in

(A) the fertilizer industry
(B) the rubber industry.

What is the role of each of the above compounds in the relevant industry?

(7.0 marks)

Answer **all** parts.

(a) (i) NH_3 is one of the starting materials used for the production of Na_2CO_3 by the 'Solvay' process. What are the other starting materials used for this process? How are these other materials obtained?

(ii) Give **two** by - products of this process.

(iii) Give balanced chemical equations for the reactions taking place during this process of production and during the recycling of by-products.

(iv) Give **two** reasons as to why a low temperature (<15°C) is used in this process.

(v) Give **three** important factors that need to be considered in choosing a site for this industry.

(vi) Give **one** industrial use in each case for Na_2CO_3 and $NaHCO_3$

(7.5 marks)

(b) A test kit for determining the chloride ion concentration of domestic water supplies contains a $AgNO_3$ solution and a K_2CrO_4 solution. $AgNO_3$ solution is added dropwise to a 24.0 cm^3 sample of the water to be tested, to which K_2CrO_4 indicator has been added. When sufficient $AgNO_3$ has been added to convert all Cl^- ions to AgCl, the end point is indicated by the formation of orange coloured Ag_2CrO_4. The concentration of $AgNO_3$ is such that each drop of $AgNO_3$ solution consumed corresponds to 12.5 mg of Cl^- ions in 1.0 dm^3 of water tested, when the sample size of water tested is 24.0 cm^3

(i) What mass of Cl^- (in mg) is contained in a cubic decimetre of water sample which requires 12 drops of $AgNO_3$ solution to reach the end point indicated by the orange colour change?

(ii) What is the molar concentration of Cl^- ions in the water sample tested in (i)?

(iii) If experiment (i) is repeated using 6.0 cm^3 only of the same sample of water used in (i) above, how many drops of $AgNO_3$ will be required to reach the end point? Under these conditions, what Cl^- ion content in mg dm^{-3} of the water sample corresponds to one drop of $AgNO_3$ solution used?

(iv) What is the molar concentration of the $AgNO_3$ solution? (Volume of 20 drops = 1.0 cm^3)

(Cl = 35.5, Ag = 107.0, N = 14.0, O - 16.0)

(4.0 marks)

(c) Consider the polymers poly(styrene), poly (vinyl chloride) and natural rubber

For each of these polymers,

(i) Write the structure of the repeat unit

(ii) Write the structure of the monomer which polymerizes to form the above polymer

Give **one** simple test that can be carried out at your home to distinguish between PVC and bakelite (phenol - formaldehyde).

(3.5 marks)

10. Answer **all** parts

(a) You are provided with unlabelled samples of $(NH_4)_2CO_3$, $ZnCO_3$, $MgCO_3$ and $BaCO_3$, a furnace that can be heated to high temperatures, distilled water, dilute HCl test tubes and crucibles. Show how you would identify these carbonates using only the materials mentioned above

Write balanced chemical equations for the reactions you use

(5.0 marks)

(b) Give **one** sulphur containing and one chlorine containing compound, each of which acts as a bleaching agent. Explain the bleaching action of each compound. Give **one** method in each case for the industrial production of the bleaching agents you mentioned above.

(4.0 marks)

(c) Antacid tablets are used to control excessive acid (HCl) in the gastric solution present in the stomach. One make of antacid tablets contains 0.520 g of $Mg_2Si_3O_8$ and 0.087 g of $Mg(OH)_2$ per tablet, both of which react with HCl

The stomach of a patient contains 0.365 g of HCl per 100.0 cm^3 of gastric solution. The total volume of the gastric solution is 500.0 cm^3

Calculate,

(i) the pH of the gastric solution of the patient

(ii) the pH of the gastric solution after rthe patient has taken two of these antacid tablets. Assume that the tablets have reacted completely with the gastric solution and that no further acid has been secreted during this period

$Mg_2Si_3O_8$ reacts with HCl as follows

$$Mg_2Si_3O_8 + 4\,HCl \longrightarrow 2MgCl_2 + 3\,SiO_2 + 2H_2O$$

(Mg = 24.0, Si = 28.0, O = 16.0, H = 1.0, Cl = 35.5)

(6.0 marks)

The Periodic Table

1	1 H															2 He
2	3 Li	4 Be										5 B	6 C	7 N	8 O	9 F	10 Ne
3	11 Na	12 Mg										13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
4	19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
5	37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
6	55 Cs	56 Ba	La-Lu	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
7	87 Fr	88 Ra	Ac-Lr	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Uun	111 Uuu	112 Uub	113 Uut	....				

57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

G.C.E. (A/L) Examination
Chemistry - 2005

M.C.Q. Answers

(1)	4	(16)	1	(31)	all	(46)	5
(2)	3	(17)	3	(32)	3	(47)	2
(3)	4	(18)	4	(33)	4	(48)	5
(4)	2	(19)	4	(34)	4	(49)	4
(5)	2	(20)	3	(35)	2	(50)	3
(6)	3	(21)	3, 5	(36)	1	(51)	3
(7)	5	(22)	4	(37)	2	(52)	3
(8)	1	(23)	5	(38)	3	(53)	3
(9)	4	(24)	2	(39)	3	(54)	5
(10)	5	(25)	3	(40)	4	(55)	3
(11)	2	(26)	4	(41)	4	(56)	1
(12)	3	(27)	5	(42)	5	(57)	3,5
(13)	5	(28)	5	(43)	5	(58)	5
(14)	4	(29)	4	(44)	4	(59)	5
(15)	2	(30)	3	(45)	5	(60)	1

PART A - STRUCTURED ESSAY

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

01. (a) (i) Cl_2O_7 (ii) HCl/HI
(iii) SiO_2 (iv) HF
(v) BCl_3 (vi) Cl_2O_7 (6 x 6 = 36)

(b) (i) Mg/Magnesium (24)

(ii) $2Mg + O_2 \rightarrow 2MgO$ (5)
$3Mg + N_2 \rightarrow Mg_3N_2$ (5)

(b = 34 marks)

(c) (i) V (15)
(ii) VIII/O (15)

(c = 30 marks)

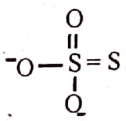
02. (a) (i)

Na	S	H	O
$\frac{18.5}{23}$	$\frac{25.8}{32}$	$\frac{4.0}{1.0}$	$\frac{51.7}{16}$
1	1	5	4

(5 x 4)

$NaSH_5O_4$ (5)

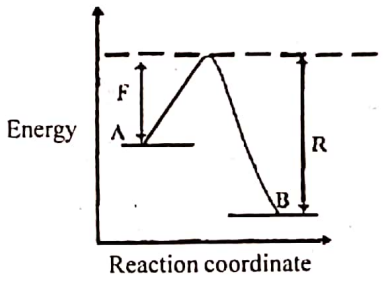
(ii) Empirical mass = 124 (3)
∴ Molecular formula = $Na_2S_2O_8H_{10}$ (3)

(iii)  (10)

(iv) Hypo ; Sodium thiosulphate (03)

(v) In photography (03)
As a fungicide (03)

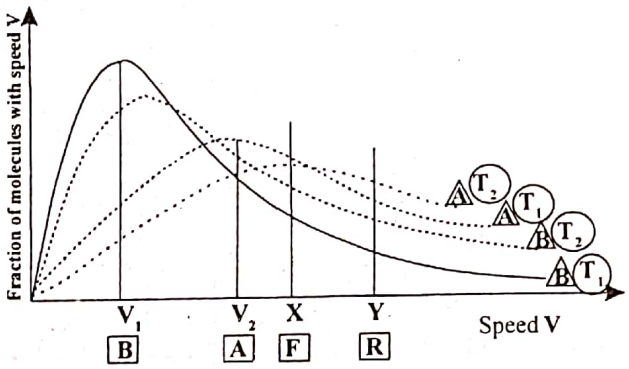
(b) (i)



(2 x 4 = 08)

Figure I

(b)



(02 x 12 = 24)

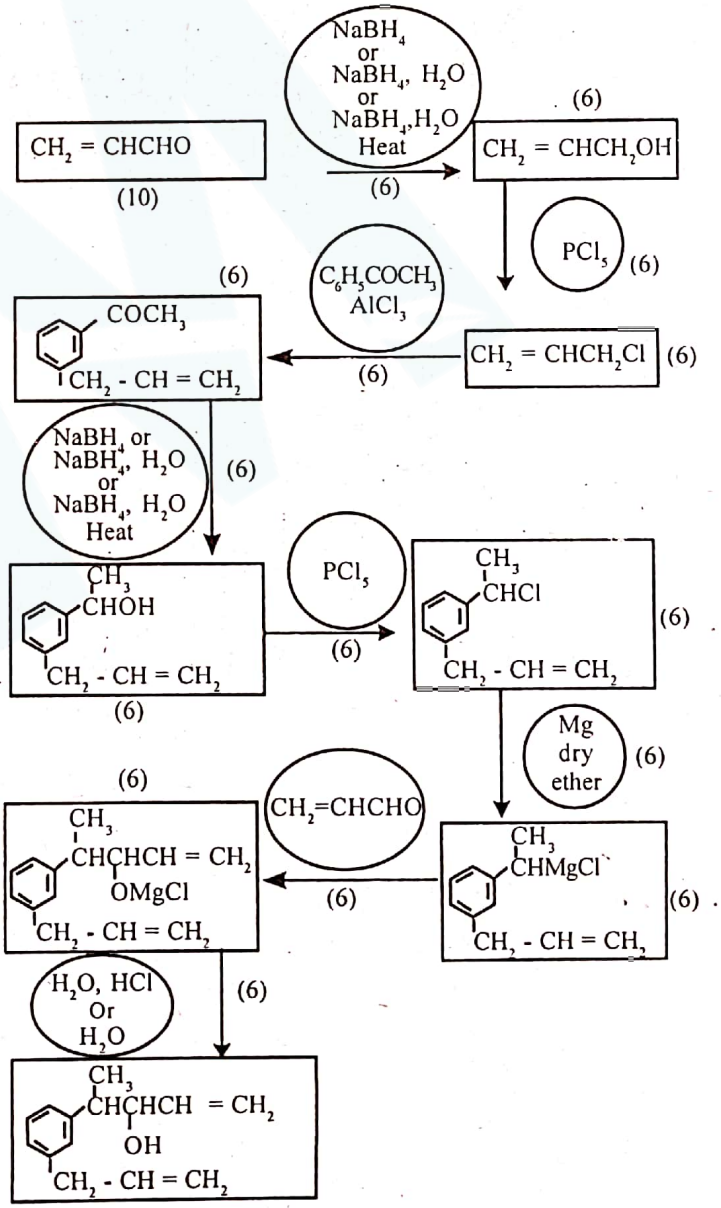
Delete words;

(ii) endothermic, positive (3 + 3)

(vi) greater, (3) smaller, (3) decreases, (3) decreases (3)

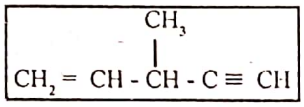
(b = 50 marks)

03.

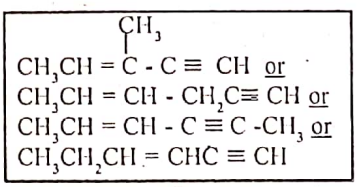


(3) = 100 marks

04. (a)



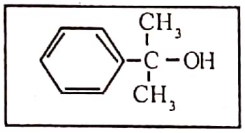
A (10)



B (10)

(a) = 20 marks

(b)



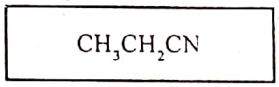
X (16)

Hydrogen (or H_2)

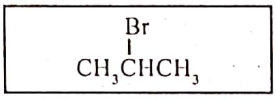
Y (04)

(b) = 20 marks

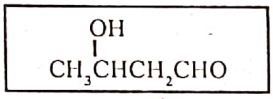
(b) (i)



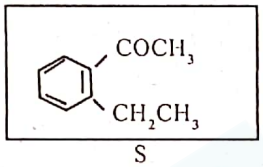
P



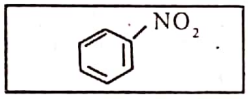
Q



R



S



T

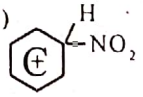
(4 x 5 = 20)

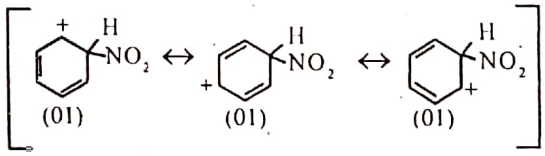
(ii)

Reaction number	Mechanism - type (A_E, S_E, A_N, S_N or M_O)	Electrophile (in electrophilic reactions)	Nucleophile (in nucleophilic reactions)
I	S_N		CN^-
II	A_E	H^+	
III	A_N		$-CH_2CHO$
IV	M_O		
V	S_E	NO_2^+	

(4 x 9 = 36)

(iii)

(03)  (01) HSO_4^- OR



(01) (01) (01) HSO_4^- (01)

05. (a) (i) $K_p = \frac{P_B P_D}{[P_A]^a}$ (02)

$K_c = \frac{C_B C_D}{[C_A]^a}$ (02)

$pV = nRT$ (02)

$P = CRT$ (02)

$K_p = \frac{C_B C_D}{[C_A]^a} (RT)^{(2-a)}$ (02)

$(RT)^{(2-a)} = 1$ (02)

$(2 - a) = 0,\ a = 2$ (02)

Total for (i) = 14 marks

Alternative answer for question 5 (a) (i).

	$aA(g)$	=	$B(g)$	+	$D(g)$
initial	a mol		0 mol		0 mol
Concentration	$a(1-\alpha)$ mol		α mol		α mol
at equilibrium	$a(1-\alpha)/v$		α/v		α/v (3 x 01)
Partial Pressure	$\frac{a(1-\alpha)p}{a+(2-a)\alpha}$		$\frac{\alpha p}{a+(2-a)\alpha}$		$\frac{\alpha p}{a+(2-a)\alpha}$

(3 x 01)

$\therefore K_p = K_c$

$\frac{\left(\frac{\alpha p}{a+(2-a)\alpha}\right)^2}{\left(\frac{a(1-\alpha)p}{a+(2-a)\alpha}\right)^a} = \frac{\left(\frac{\alpha}{v}\right)^2}{\left(\frac{a(1-\alpha)}{v}\right)^a}$ (02)

$\frac{P^{(2-a)}}{[a+(2-a)\alpha]^{(2-a)}} = \frac{1}{v^{(2-a)}}$ (02)

$\left(\frac{pv}{a+(2-a)\alpha}\right)^{(2-a)} = 1$ (02)

$2 - a = 0,\quad a = 2$ (02)

(ii) $K_p = \frac{8 \times 10^5 Pa \times 2 \times 10^5 Pa}{(2 \times 10^5 Pa)^2}$ (1 + 1 for units)

$= 4$ (02)

Total for (ii) = 04 marks

(iii) $P_B = P_D = Z$ (02)

$P_A = Y - 2Z$ (02)

$4 = \frac{Z^2}{(Y - 2Z)^2}$ (02)

$2 = \frac{Z}{(Y - 2Z)}$ (02)

$2Y = 5Z$ (02)

$Y = \frac{5Z}{2}$ (02)

Assume ideal gas behaviour (02)

For the reaction $\Delta n = 0$ (01)

Total moles at 27°C = Total moles at 500 K (01

$\frac{P_1}{T_1} = \frac{P_2}{T_2}$ (02)

$\frac{X}{300} = \frac{Y}{500}$ (02)

$\frac{Y}{X} = \frac{5}{3}$ (02)

If $Y = 8 \times 10^5$ Pa (02)

$Z = \frac{2}{5} \times 8 \times 10^5$ Pa (02)

$= 3.2 \times 10^5$ Pa (02)

$X = \frac{3}{5} \times 8 \times 10^5$ Pa (02)

$= 4.8 \times 10^5$ Pa (02)

Total for (iii) = 30 marks

(iv) No of moles at equilibrium in (iii) = n_1

$n_1 = \frac{8 \times 10^5 \text{ Pa} \times 4.157 \text{ m}^3}{8.314 \text{ Jk}^{-1} \text{ mol}^{-1} \times 500 \text{ K}}$ (2 + 2)

$= 800$ mol (02)

No of moles after addition of A is n_2

$\frac{n_1}{n_2} = \frac{P_1}{P_2}$ (02)

$\frac{800}{n_2} = \frac{8 \times 10^5}{2.5 \times 10^6}$ (02)

$n_2 = 2500$ mol (02)

No of moles of A added = 2500 - 800 = 1700 mol (02)

Let the no of moles of B at equilibrium in (iv) be n_B

$4 = \frac{\left[\frac{n_B}{2500 \text{ mol}}\right]^2 \left[2.5 \times 10^6 P_a\right]^2}{\left[\frac{2500 \text{ mol} - 2n_B}{2500 \text{ mol}}\right]^2 \left[2.5 \times 10^6 P_a\right]^2}$ (1 + 1 for units)

$2 = \frac{n_B}{2500 - 2n_B}$ (02)

$5n_B = 5000$ mol (02)

$n_B = n_D = 1000$ mol (02)

$n_A = 500$ mol (02)

$P_A = \frac{500 \times 2.5 \times 10^6 \text{Pa}}{2500}$ (02)

$= 5 \times 10^5$Pa (02)

$P_B = P_D = \frac{2.5 \times 10^6 - 5 \times 10^5 \text{Pa}}{2}$ (02)

$= 10^6$Pa (02)

Total for (iv) = 32 marks

Total for (a) = 80 marks

(b) (i) $Br_{(g)} + e \rightarrow Br^-_{(g)}$

(ii) $Mg_{(s)} + Cl_{2(g)} \rightarrow MgCl_{2(s)}$

(iii) $C_{17}H_{35}COOH_{(s)} + 26O_{2(g)} \rightarrow 18CO_{2(g)} + 18H_2O(l)$

(iv) $Mg_{(g)} \rightarrow Mg^+_{(g)} + e$

$Mg^+_{(g)} \rightarrow Mg^{2+}_{(g)} + e$

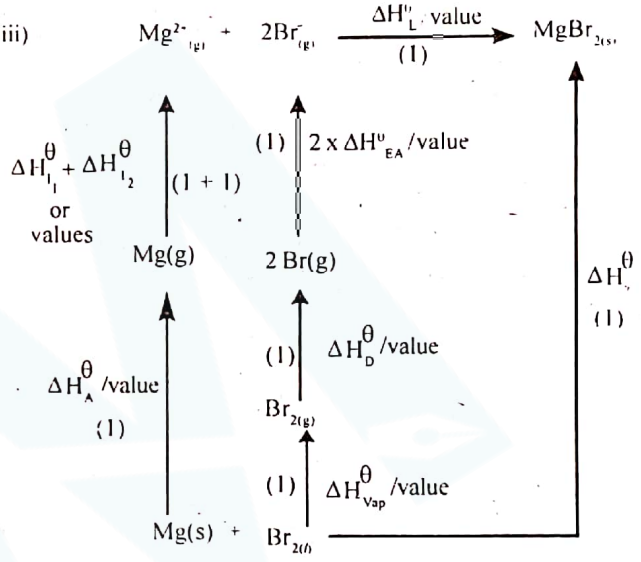
(v) $Mg_{(s)} \rightarrow Mg_{(g)}$

(vi) $Mg^{2+}_{(g)} + 2Br^-_{(g)} \rightarrow MgBr_{2(s)}$

(vii) $Br_{2(g)} \rightarrow 2Br_{(g)}$

(8 x 4 = 32 marks)

(viii)



(8 x 1 = 8 marks)

$\Delta H^\theta_r = \Delta H^\theta_{A(Mg)} + (\Delta H^\theta_{I_1} + \Delta H^\theta_{I_2})_{Mg} + \Delta H^\theta_{vap(Br_2)} + 2\Delta H^\theta_{D(Br_2)} + 2\Delta H^\theta_{EA(Br)} + \Delta H^\theta_{L(MgBr_2)}$ (07)

$= 148.0 + (737.0 + 1451.0) + 15.0 + 193.0 + (2 \times -328.0) + (-2440.0)$ KJ mol^{-1} (07)

$= -552.0$ KJ mol^{-1} (02 + 02)

Total for (viii) = 26 marks

(ix) $\Delta H^\theta_r = \Delta H^\theta_{f(MgCl_2)} + \Delta H^\theta_{f(Br_2)} - \Delta H^\theta_{f(MgBr_2)} - \Delta H^\theta_{f(Cl_2)}$ (04)

$= -641.0 + 0 - (-552.0) - 0$ (04)

$= -89.0$ KJ mol^{-1} (2 + 2)

Total for (ix) = 12 marks

Total for (b) = 70 marks

(c) (i) $N_A = a/b$ (3)

(ii) $q = 2b$ (3)

(iii) $C = 3a$ (3)

(iv) Total moles = $6b$ (3)

$X_A = 1/6$ (3)

$X_B = 1/3$ (3)

$X_C = 1/2$ (3)

(v) $P_B = \frac{H}{2} \times \frac{1}{3}$ (03)

$= H/6$ (03)

(vi) $\frac{H}{6} = \frac{bH}{T}$ (3)

$T = 6b$ (3)

(vii) $Y_B = b/6b$ (3)

$= 1/6$ (3)

$n_A(\text{vapour}) = \frac{a}{3} \times \frac{1}{N_A}$ (3)

$= \frac{a}{3} \times \frac{b}{a} = \frac{b}{3}$ (3)

$Y_A = \frac{b}{3} \times \frac{1}{6b} = \frac{1}{18}$ (3)

$Y_C = 1 - \frac{1}{6} - \frac{1}{18}$ (3)

$= \frac{7}{9}$ (3)

(viii) $P_A = H/18, \quad P_C = 7H/9$ (3 + 3)

(ix) $G = \frac{6bRQ}{H}$ (5)

(x) $\bar{C}^2 = \frac{3RQ}{L}$ (5)

Total for (c) = 70 marks

06. (a) (i) From I,

X content in ether layer = 40.0 mg x 1000 cm^3 /100 cm^3 (2)

= 400 ppm (2)

Original X content of 500.0 cm^3 of water = 45.0 mg (2)

X content of aqueous layer = 5.0 mg x 1000 cm^3/500 cm^3 (2)

= 10.0 ppm (2)

K = 400/10 (2)

= 40 (2)

From II

X content of ether layer = 43.2mg x 1000 cm^3/100cm^3 (2)

= 432.0 ppm (2)

X content of water layer = 432/40 (2)

= 10.8 ppm (2)

Original X content of well water = (43.2 + 10.8) ppm (2)

= 54 ppm (2)

From III

X content of ether layer = 6.0mg x 1000 cm^3 / 100 cm^3 (2)

= 60.0 ppm (2)

X content of aqueous layer = (60/40) ppm (2)

= 1.5 ppm (2)

Original X content in brick treated water = (1.5 + 6.0) ppm (2)

= 7.5 ppm (2)

Alternate answer for question 6 (a) (i)

From I. $K = \frac{40.0 \text{ mg}}{0.100 \text{ dm}^3}$

$$\frac{\left[\frac{90.0 \text{ mg}}{\text{dm}^3} \times 0.500 \text{ dm}^3\right] - 40.0 \text{ mg}}{0.500 \text{ dm}^3}$$ (06)

$= \frac{400}{10}$ (06)

$= 40.0$ (02)

From II.

$$K = 40 = \frac{43.20 \text{ mg}}{\frac{\left[X \frac{\text{mg}}{\text{dm}^3} \times 1.00 \text{ dm}^3\right] - 43.2 \text{ mg}}{1.00 \text{ dm}^3}}$$ (6)

$40.0 = \frac{432}{X - 43.2}$ (2)

$40.0 X - (40.0 \times 43.2) = 43.2 \times 10$ (2)

$X = \frac{43.2 \times 50}{40.0} = \frac{432}{8}$ (2)

$= 54.0$ ppm (2)

From III,

$$K = 40.0 = \frac{6.0 \text{ mg}}{\frac{\left[X \frac{\text{mg}}{\text{dm}^3} \times 1.00 \text{ dm}^3\right] - 6.0 \text{ mg}}{1.00 \text{ dm}^3}}$$ (6)

$40.0 (X - 6.0) = 6.0 \times 10$ (2)

$X = \frac{6.0 \times 50}{40}$ (2)

$= \frac{30}{4}$ (2)

$= 7.5$ ppm (2)

(i) X content of well water = 54.0 mg dm^{-3} (2)

= 54.0 x 10^{-3} / 125 mol dm^{-3} (2)

= 4.32 x 10^{-4} mol dm^{-3}

X content of reacted water = 7.5 ppm (2)

= 7.5 x 10^{-3} / 125 mol dm^{-3} (2)

6.0 x 10^{-5} mol dm^{-3} (2)

(ii) Treatment with brick powder reduces X content due to adsorption / uptake / retention (5)

(iii) Repeat readings at each site

Take readings at different sites

Take readings under different conditions of rainfall /weather

Take readings on different dates .

any three (3 x 5) = 15

(iv) Filter through brick particles (5)

Filter to remove brick particles (5)

(Total for (a) = 80 marks)

(b) $2Al + 6HCl \rightarrow 2AlCl_3 + 3H_2$ (2)

$Mg + 2HCl \rightarrow MgCl_2 + H_2$ (2)

$Zn + 2HCl \rightarrow ZnCl_2 + H_2$ (2)

1.0 g of mixture	Moles of metal			Moles of H_2
	Al	Zn	Mg	
P	0.008	0.002	0.02725	0.04125
Q	0.010	0.008	0.00875	0.03175
R	0.012	0.010	0.00108	0.02908

12 x 3 = 36

The three mixtures give different volumes of H_2 on complete reaction with HCl (04)

Place 1.0 g of each mixture seperately in bottles. (04)

Add excess HCl to each and fit a balloon over the mouth of each bottle (04)

After complete reaction (04)

Balloon with largest volume corresponds to P. (04)

Balloon with smallest volume corresponds to R (04)

The other is Q (04)

(Total for (b) = 70 marks)

(07) (a) (i) Solution A

$K_{sp} = [Ag^+_{(aq)}][Cl^-_{(aq)}]$ (02)

No marks if (aq) is not given

$= [Ag^+_{(aq)}]^2$ (02)

$[Ag^+_{(aq)}]^2 = 1 \times 10^{-10}\ mol^2dm^{-6}$ (02)

$[Ag^+_{(aq)}] = 1 \times 10^{-5}\ mol\ dm^{-3}$ (02)

∴ Solubility of AgCl $= 1 \times 10^{-5}\ mol\ dm^{-3}$ (02)

$142.5 \times 10^{-5}\ g\ dm^{-3}$ (02)

$= 1.425\ mg\ dm^{-3}$ (02)

Solution B

$1 \times 10^{-10}\ mol^2dm^{-6} = [Ag^+_{(aq)}][0.1\ mol\ dm^{-3}]$ (02)

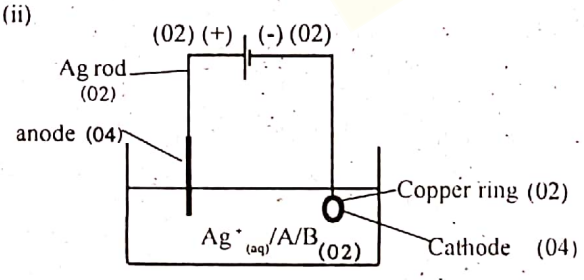
$[Ag^+_{(aq)}] = 1 \times 10^{-9}\ mol\ dm^{-3}$ (02)

Solubility of AgCl $= 1 \times 10^{-9}\ mol\ dm^{-3}$ (02)

$= 142.5 \times 10^{-9}\ g\ dm^{-3}$ (02)

$(=1.425 \times 10^{-4}\ mg\ dm^{-3})$ (02)

(ii)



(iii) Rate of reaction α concentration (02)

Rate of deposition α concentration (02)

$[Ag^+]$ in B < $[Ag^+]$ in A (02)

rate of deposition is lower for B (02)

Select B (02)

(iv) Complex very stable (02)

$[Ag^+]$ much lower in KCN than in aq solution (02)

Better metal coating (02)

∴ Select KCN solution (02)

K is very small (02)

(v) In Tollens test $Ag^+_{(aq)} + e \rightarrow Ag_{(s)}$ (02)

To obtain a shiny mirror, rate of deposition to be low. (02)

Ag- ammonia complex is very stable. (02)

∴ very low free $[Ag^+]$ (02)

∴ Better mirror than with aqueous solution. (02)

(vi) Q = 0.15 x 60 x 40C Coulombs (02)

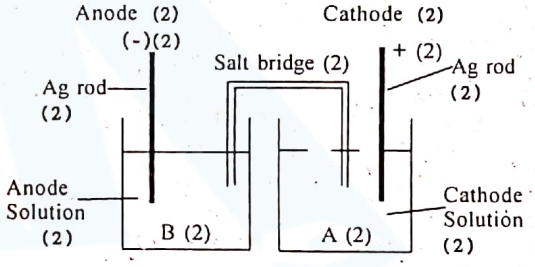
∴ The no. of moles deposited $= \frac{0.15 \times 60 \times 40C}{96540\ Cmol^{-1}}$ (1 + 1)

Mass of Ag deposited $= \frac{0.15 \times 60 \times 40 \times 107}{96540}$ (02)

$\simeq$ 0.3994 g

∴ increase in mass = 0.3994 g (02)

(vii)



Total for (a) = 100 marks

07. (b) Final Solution.

$[OH^-(aq)] = 1 \times 10^{-5}\ mol\ dm^{-3}$ (1 + 2 + 1) (aq), answer, unit)

$[Ba^{2+}(aq)] = 5 \times 10^{-6}\ mol\ dm^{-3}$ (1 + 2 + 1)

$[Cd^{2+}(aq)] = 1.25 \times 10^{-5}\ mol\ dm^{-3}$ (1 + 2 + 1)

$[SO_4^{2-}(aq)] = 1.25 \times 10^{-5}\ mol\ dm^{-3}$ (1 + 2 + 1)

$[Ba^{2+}(aq)][SO_4^{2-}(aq)] = 5 \times 10^{-6} \times 1.25 \times 10^{-5}\ mol^{-2}\ dm^{-6}$ (1 + 2 + 1)

$= 6.25 \times 10^{-11}\ mol^2dm^{-6}$ (2 + 2)

$< K_{sp}(BaSO_4)$ (4)

∴ Does not precipitate (4)

$[Cd^{2+}_{(aq)}][OH^-_{(aq)}]^2 = 1.25 \times 10^{-5} \times 1 \times 10^{-10}\ mol^3\ dm^{-9}$ (1 + 2 + 1)

$= 1.25 \times 10^{-15}\ mol^3dm^{-9}$ (02 + 02)

$< K_{sp}[Cd(OH)_2]$ (04)

∴ Does not precipitate (4)

∴ No ppt formed (02)

Total for (b) = 50 marks

08. (a) (i) (A) Ti / Titanium (10)

(B) $1s^2 2S^2 2P^6 3S^2 3P^6 4S^2 3d^2$ or $1s^2 2S^2 2P^6 3S^2 3P^6 3d^2 4S^2$ (10)

(C) M - Rocket / aircraft/ spacecraft parts/ alloy (05)

MO_2 - As a (white) pigment in paints/ As a photocatalyst (05)

(ii) Cr^{3+} and Cu^{2+} (or Chromic & Cupric) (10 + 10)

Test (B) - yellow colour due to CrO_4^{2-} (05)

Test (C) - yellow colour due to $[CuCl_4]^{2-}$ (05)

$Cr^{3+} + 8OH^- \rightarrow CrO_4^{2-} + 4H_2O + 3e$

OR $3H_2O_2 + 10\ OH^- + 2Cr^{3+} \rightarrow 2CrO_4^{2-} + 8H_2O$ (05)

$Cu^{2+} + 4Cl^- \rightarrow [CuCl_4]^{2-}$ (05)

Filterate from (B) turns **Orange** on acidification (05)

$2CrO_4^{2-} + 2H^+ \rightarrow Cr_2O_7^{2-} + H_2O$ (05)

08. (b) (i) Source of N_2 - Air (04)

Source of H_2 - Petrolium/ Synthesis gas (reaction of CH_4 or C_7H_{16} with steam) (04)

(ii) Temperature - about 400 - 500 ^{0}C (04)

Pressure - > 200 atm (04)

Catalyst - Fe/iron Oxide (04)

(iii) Effect of Catalyst on

- rate of forward reaction : increases (04)
- rate of reverse reaction : increases (04)
- equilibrium constant (04)

(iv) Ostwald process/ manufacture of nitric acid (04)

Conditions : Temperature : about 850^{0}C (04)

Pressure : near atmospheric (04)

Catalyst : Pt, Pt/Rh (04)

(v) Disinfectant / cleaning agent (02)

(vi) $2NH_3 + 3CuO \rightarrow 3Cu + N_2 + 3H_2O$ (03)

Passing ammonia over **hot** CuO (or heat) (01)

$NH_3 + 3I_2 \rightarrow NI_3 + 3HI$ (03)

Excess iodine / low PH (01)

$2NH_3 + 2Na \rightarrow 2NaNH_2 + H_2$ (03)

Liquid ammonia / gaseous ammonia (01)

(vii) Uses of ammonia

Fertilizer industry $(NH_4)_2SO_4$, NH_4NO_3, $(NH_4)_3PO_4$ (02)

As a source of nitrogen (02)

In rubber industry : NH_4OH/ aq ammonia (02)

To stabilize latex / to prevent coagulation (02)

09. (a) (i) CO_2 - by burning limestone ($CaCO_3$) (5 + 5)

Brine from Sea water (5 + 5)

(ii) By products : CaO, NH_4Cl, $CaCl_2$ (any two) (5 + 5)

(iii) Reactions · Production Process

$CaCO_3 \rightarrow CaO + CO_2$

$NH_3 + H_2O \rightarrow NH_4OH$

$2NaHCO_3 \rightarrow Na_2CO_3 + H_2O + CO_2$

OR

$NH_3 + H_2O + CO_2 \rightarrow NH_4HCO_3$

$NH_4HCO_3 + NaCl \rightarrow NaHCO_3 + NH_4Cl$

$NaCl + NH_4OH + CO_2 \rightarrow NaHCO_3 + NH_4Cl$

Recycling of by products :

$2NH_4Cl + CaO \rightarrow CaCl_2 + 2NH_3 + H_2O$ (5 x 2 = 10)

(iv) Low temperature increases the solubility of gases (CO_2 & NH_3)

Decreases the solubility of $NaHCO_3$ (5 +5)

(v) Availability of limestone deposits / ammonia. Closer to sea (to get brine). Climatic conditions, pollution of the environment (by ammonia, CO_2), heat generation, disposal of by - products etc.

Any 3 factors (3 x 05 = 15)

(vi) Uses : Na_2CO_3 : for washing clothes / cleaning articles/ water saftening/ glass industry (05)

$NaHCO_3$: as baking powder, in fire extinguishers, medical uses (05)

Total for g (a) = (75)

9 (b) (i) 1 drop of $AgNO_3$ corresponds to 12.5mg of Cl^- in 1 litre of water

∴ 12 drops of $AgNO_3$ correspond to 12 x 12.5 mg of Cl^- /litre = 150 mg (05)

(ii) Concentration of Cl^- ions. $= \frac{150}{1000 \times 35.5}$ moldm^{-3}

$= 0.0042$ moldm^{-3} (05)

(iii) No. of drops of $AgNO_3$ required if 6.0cm^3 of the water sample is used $= \frac{12 \times 6}{24} = 3$ (05)

1 drop of $AgNO_3$ now corresponds to $= \frac{12.5\text{mg} \times 24}{6}$

$= 50$ mg Cl^- / litre (5 + 5)

(OR 150 mgl^{-1}/3 drops = 50 mg/1itre)

(iv) 1 drop of $AgNO_3$ corresponds to 12.5 mg of Cl^- / litre of water sample

The amount of Cl^- ions equivalent to Ag^+ ions in 1 drop of $AgNO_3 = \frac{12.5\text{ mg} \times 24}{1000} = 0.30$ mg (05)

$= \frac{0.3 \times 10^{-3}}{35.5}$ mol (05)

∴ Amount of Ag^+ ions in 1 drop of $AgNO_3 = \frac{0.3 \times 10^{-3}}{35.5}$ mol

(20 drops = 1 cm^3)

∴ The concentration of $AgNO_3$ solution

$= \frac{0.3 \times 10^{-3} \times 20 \times 1000}{35.5}$ moldm^{-3}

$= 0.169$ moldm^{-3}

Total for 9 (b) = (40)

(c) (i) $-CH(C_6H_5) - CH_2 -$; $-CH(Cl) - CH_2 -$;
$-CH_2 - C(CH_3) = CH - CH_2 -$ (Cis)
Cis structure must be shown / indicated (3 x 5 = 15)

(ii) $C_6H_5CH = CH_2$, $ClCH = CH_2$; $CH_2=C(CH_3)-CH=CH_2$
(3 x 5 = 15)

(iii) Test : On heating PVC softens (03)
On heating bakelite does not soften / decomposes (02)
(Total for 9 (c) = 35)

10. (a) The compound that dissolves in water / leaves no residue on heating is $(NH_4)_2 CO_3$ (05)

$(NH_4)_2 CO_3 \rightarrow 2NH_3 + CO_2 + H_2O$

OR $(NH_4)_2 CO_{3(s)} \rightarrow 2NH^+_4(aq) + CO_3^{2-}(aq)$ (05)

Heat the compounds strongly. The residue that dissolves in water is produced by $BaCO_3$ (05)

$BaCO_3 \rightarrow BaO + CO_2$ (05)

$BaO + H_2O \rightarrow Ba(OH)_2$ [OR $Ba^{2+}(aq) + 2OH^-(aq)$] (05)

$ZnCO_3 \rightarrow ZnO + CO_2$ (05)

$MgCO_3 \rightarrow MgO + CO_2$ (05)

Add a small amount of the other two residues separately to portions of solution formed by dissolving the soluble residue in water.

The residue that dissolves in the above solution is formed from $ZnCO_3$ (05) } or

$ZnO + Ba(OH)_2 \rightarrow BaZnO_2 + H_2O$ (05) }

{(OR the residue that becomes yellow when hot is ZnO;) (10)}

The other residue (which does not dissolve) is formed from $MgCO_3$ (05)

(OR the other residue (or the residue that does not become yellow when hot) is MgO: (05)

(Total for 10 (a) = 50)

(b) (i) SO_2, Na_2SO_3, H_2SO_3 any one compound (05)

HOCl. NaOCl. bleaching powder or $[Ca(OCl)_2]$ (05)

Bleaching action : Bleaching occurs by **reduction** of the materials by suplphur containing compounds. (05)

$SO_2 + H_2O \rightarrow SO_3 + 2H^+ + 2e$

OR $(SO_3^{2-} + H_2O \rightarrow SO_4^{2-} + 2H^+ + 2e)$ (05)

Bleaching occurs by **oxidation** of the materials by chlorine containing compounds. (05)

NaOCl or $Ca(OCl)_2$ on acidification produces HOCl.

$2HOCl \rightarrow H_2O + Cl_2 + 'O'$ (03)

$'O' + 2e \rightarrow O^{2-}$ (or explanation) (02)

Preparation

SO_2	:	Burning sulphur, roasting sulphides
Na_2SO_3		Dissolve SO_2 in NaOH
H_2SO_3		Dissolve SO_2 in water

Any One (05)

NaOCl	Dissolve Cl_2 in NaOH (low/room temp)
$Ca(OCl)_2$	Dissolve Cl_2 in $Ca(OH)_2$ (low/room temp)
HOCl	Dissolve Cl_2 in water (low/room temp)

Any One (03 +2)

(03 for method / equation. 02 for low/room temp)
(Total for 10 (6) = 40)

(c) (i) PH of the gastric solution .

Amount of HCl in gastric solution = 0.365g/100 cm^3

Amount of HCl 1 dm^3 gastric solution $= \frac{0.365\text{ g} \times 1000\text{ cm}^3}{100\text{ cm}^3 \times 36.5\text{g mol}}$ (10)

$= 0.1$ mol

$\therefore [H^+] = 0.1$ mol dm^{-3}

$PH = -\log[H^+] = 1.0$ (05)

(ii) Each tablet contains 0.520 g of $Mg_2Si_3O_8$ and 0.087 g of $Mg(OH)_2$

1 mol $Mg_2Si_3O_8$ reacts with 4 mol of HCl (reaction given)

1 mol $Mg(OH)_2$ reacts with 2 mol of HCl (5)

$Mg_2Si_3O_8$ = 260, $Mg(OH)_2$ = 58

Amount of HCl reacting with 0.520 g of $Mg_2Si_3O_8$ $= \frac{4 \times 0.520\text{ mol}}{260}$ (05)

$= 0.008$ mol (05)

Amount of HCl reacting with 0.087 g of $Mg(OH)_2$ $= \frac{2 \times 0.087\text{ mol}}{58}$ (05)

$= 0.003$mol (05)

Amount of HCl reacting with 1 tablet $= 0.008 + 0.003$
$= 0.011$ mol

Amount of HCl reacting with 2 tablets $= 0.011 \times 2$
$= 0.022$ mol (05)

Volume of gastric solution = 500 cm^3

Amount of HCl in 500 cm^3 of gastric soln = 0.05 mol (See i)

$\therefore$ Amount of HCl remaining (in 500 cm^3) $= 0.05 - 0.022$ mol
$= 0.028$ mol (05)

$\therefore$ Amount of HCl remaining in 1 dm^3 $= \frac{0.028\text{ mol} \times 1000\text{ cm}^3}{500\text{ cm}^3}$
$= 0.056$ mol (05)

$\therefore [H^+] = 0.056$ mol dm^3

The pH of the gastric solution after taking 2 tablets $= -\log(0.056)$
$= 1.25$ (05)

(Total for 10 (C) = 60)