Royal College Colombo 07

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General Certificate of Education (Adv. Level) Examination, 2010

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Grade 13 – Final Term Test July 2010

13 වන ශ්‍රේණිය අවසාන වාර පරීක්ෂණය 2010 ජූලි

Time – 2 Hours

Chemistry I

Answer all the questions.

1) Which one of the following element has the maximum second ionization energy?
1. Mg 2. Al 3. Na 4. S 5. K

2) Which one of the following statement is the most accurate about bonds?
1. Only bond that forms between two atoms may not be a π bond.
2. π bond is more stable than σ bond.
3. Lateral overlapping of hybrid orbitals form π bonds.
4. Lateral overlapping of s and p orbitals, form π bonds.
5. σ bond which is formed by linear overlapping is always non-polar.

3) Percentage mass of conc. H_2SO_4 solution is 96% (w/w). Density of the solution is 1.83 gcm^{-3}. 22 cm^3 of the above solution is diluted up to 1.0 dm^3 with distilled water. What is the concentration of the diluted H_2SO_4 solution? (H = 1 S = 32 O = 16)
1. 1.0 mol dm^{-3} 2. 0.4 mol dm^{-3} 3. 0.2 mol dm^{-3} 4. 0.1 mol dm^{-3} 5. 0.12 mol dm^{-3}

4) Which one of the following element has the maximum electropositivity?
1. Mg 2. Na 3. Al 4. Si 5. F

5) Which one of the following statement is true about the Hydrogen emission spectrum.
1. Gap between the lines of a line spectrum increases to the increasing direction of energy.
2. Emission of radiation occurs during the electrons transfer from lower energy levels to upper energy levels.
3. Lines of the Hydrogen spectrum diverge rapidly when increasing the frequency.
4. There are lot of similarities between the emission spectrums of H atom and He^+ ion.
5. Electron transfer from n = 3 to n = 1 is relative to the Hα line.

6) Which one of the following shows the change of radii of the ionic species N^{3-}, O^{2-} and F^- correctly.
1. 136 pm , 140 pm , 171 pm
2. 136 pm , 171 pm , 140 pm
3. 171 pm , 140 pm , 136 pm
4. 171 pm , 140 pm , 140 pm
5. 140 pm , 171 pm , 136 pm

7) Relative molecular mass of a hydrocarbon is 70. Which one would be the number of non cyclic isomers of that hydrocarbon? (C = 12, H = 1)
1. 3 2. 4 3. 5 4. 6 5. 7

8) 25 cm^3 of FeC_2O_4 (aq) is titrated with 0.05 mol dm^{-3} standard $KMnO_4$ solution which is acidified with diluted sulphuric acid. Volume of $KMnO_4$ reacted at the end point is 30 cm^3. What is the con of Fe^{2+} in FeC_2O_4 solution.

1. 0.15 mol dm^{-3} 2. 0.75 mol dm^{-3} 3. 0.10 mol dm^{-3} 4. 0.02 mol dm^{-3} 5. 0.5 mol dm^{-3}

9) Inorganic salt D evolved coloured gas X and formed colourless solution Y with diluted HCl. Gas X turns into colourless solution with acidified $KMnO_4$. Z didn't give a colour to the Bunsen flame and added excess of K_2CO_3 solution to the solution Y was formed white precipitate. D would be.

1. NaBr 2. KNO_2 3. $Ca(NO_2)_2$ 4. $Sr(NO_2)_2$ 5. $Mg(NO_2)_2$

10) Which one of the following molecule has the unequal bond lengths around the central atom.

1. PF_5 2. CF_4 3. PF_3 4. BF_3 5. SF_6

11) Consider the following equilibrium.

$$O_2(g) + 2NO(g) \rightleftharpoons N_2O_4(g)$$

$O_2(g)$ and NO(g) is allowed to reach to the equilibrium in 1:2 molar ratios under high temperature in a closed vessel 75% of NO(g) is remained in the equilibrium system. what is the molar ratio of NO(g): $N_2O_4(g)$ in the equilibrium system.

1. 2:1 2. 3:1 3. 1:2 4. 6:1 5. 4:1

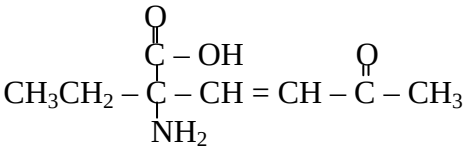
12) Solution was prepared by mixing 500 cm^3 of 0.01 mol dm^{-3} NaCl(aq), 250 cm^3 of 0.02 mol dm^{-3} $BaCl_2$(aq) and 250 cm^3 of 0.02 mol dm^{-3} $NaNO_3$ (aq) at 25^0C. After that the solution was saturated with AgCl(s). What would be the Ag^+ (aq) concentration? [AgCl] $K_{sp} = 1.0 \times 10^{-10}$ mol^2 dm^{-6}

1. 1.0×10^{-6} mol dm^{-3}
2. 1.0×10^{-4} mol dm^{-3}
3. 1.0×10^{-8} mol dm^{-3}
4. 1.0×10^{-10} mol dm^{-3}
5. 1.0×10^{-5} mol dm^{-3}

13) Which one of the following statement is the most accurate about alkynes.

1. Alkynes form white precipitate with ammonical $AgNO_3$ (aq)
2. Alkynes form red precipitate with ammonical Cu_2Cl_2 (aq)
3. Alkynes evolve $H_2(g)$ with solid Na(s)
4. Alkynes can decolourise Br_2(aq)
5. All the above statements are correct.

14) Which one of the correct IUPAC nomenclature of the following compound.



1. 2 – amino – 2 – ethyl – 5 – formylhex – 3 – enoic acid
2. 2 – amino – 2 – ethyl – 5 – oxohex – 3 – enoic acid
3. 5 – amino – 5 – formylhept – 3 – en – 2 – one
4. 2 – amino – 2 – ethyl – 5 – oxohexenoic acid
5. 2 – amino – 2 – ethyl – 5 – oxopentenoic acid

15) One method of industrial production of Hydrogen gas is as follows.

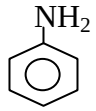
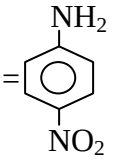
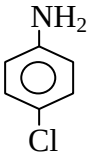
$C(s) + H_2O(g) \rightleftharpoons CO(g) + H_2(g)$ $\quad \Delta H^{\phi} = +131$ KJ

To have more amount of $H_2(g)$

1. Catalyst should be added to the system.
2. C(s) should be added to the system.
3. Temperature should be reduced in the system.
4. CO(g) should be added to the system.
5. None of the above can increase the amount of $H_2(g)$

16) Which one is the false pair of resonance structures.

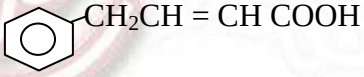
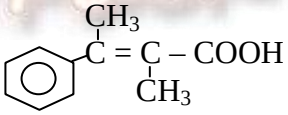
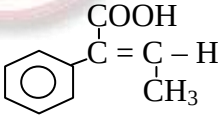
1. $H_2C = N^+ = N^- \leftrightarrow H_2C - N^+ \equiv N$
2. $H_2C = O \leftrightarrow H_2C^+ - O^-$
3. $H_2N - O - H \leftrightarrow H_2N = O - H$
4. $R_2 - C - \underset{\underset{R}{|}}{C} = O \leftrightarrow R_2C = \underset{\underset{R}{|}}{C} - O^+$
5. $R - \overset{\overset{O}{\|}}{C} - O - H \leftrightarrow R - \underset{\underset{O}{|}}{C} = O^+H$

17) A = CH_3NH_2 B = $CH_3CH_2NH_2$ C =  D =  E = 

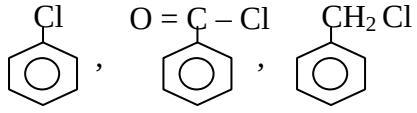
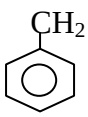
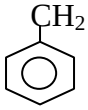
The accurate ascending order of basicity of the above species would be,

1. D < E < C < A < B
2. D < E < C < B < A
3. E < D < C < A < B
4. D < C < E < B < A
5. C < E < D < A < B

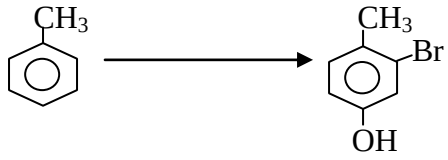
18) Organic compound X produces a pleasant smell with ethanol and few drops of H_2SO_4 when heating. X turns Br_2(aq) colourless X shows the geometrical isomerism but not after heating it with sodalime. X would be,

1. 
2. 
3. 
4. 
5. $CH_3CH = CHCH_2COOH$

19) Which one of the following group of compounds that all can undergo hydrolysis at room temperature.

1. 
2. $CH_3COOC_2H_5$, $CH_3CH_2 - \overset{\overset{O}{\|}}{C} - Cl$, CH_3CH_2MgBr
3. $CH_3CH_2CH_2NH_2$,  , $CH_3CH_2 - \overset{\overset{O}{\|}}{C} - Cl$
4.  , CH_3CH_2MgBr , $CH_3CH_2 - \overset{\overset{O}{\|}}{C} - Cl$
5.  , $CH_3CH_2CH_2NH_2$, $CH_3COOC_2H_5$

20) Consider the following conversion.



What is the most suitable order of reactants to the above conversion.

1. Sn, conc. HCl | Br_2, Fe | CnO, NaOH | $NaNO_2$, HCl ($5 - 10^0C$)
2. $H^+/KMnO_4$ | Br_2, $FeBr_3$ | $NaNO_2$, HCl ($5 - 10^0C$) | H_2O/Δ
3. conc. HNO_3, conc. H_2SO_4 | Br_2, $FeBr_3$ | Sn, conc. HCl | $NaNO_2$, HCl ($5 - 10^0C$) | H_2O/Δ
4. conc. H_2SO_4 , conc. HNO_3 | Br_2, $FeBr_3$ | $NaNO_2$, HCl(aq) | H_2O/Δ
5. H_2SO_4 , HNO_3 | $NaNO_2$, HCl | Br_2, Fe | Sn, conc. HCl | H_2O

21) $CH_2 = CH - \underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}} - OH$ Which one of the following statement is false about the alcohol.

1. It reacts with PBr_3
2. Br_2(l) turns colourless.
3. Can be oxidized to a ketone by acidified $KMnO_4$
4. Gives chloro compound with anhydrous $ZnCl_2$ and conc. HCl
5. Can eliminate water molecule by heating with Al_2O_3

22) What is the compound that you get when Propanone (CH_3COCH_3) and ethanal (CH_3CHO) is treated with dilute NaOH

1. $CH_3\overset{OH}{\overset{|}{C}}HCH_2\overset{OH}{\overset{|}{C}}HCH_3$
2. $CH_3\overset{OH}{\overset{|}{C}}(CH_3)CH_2CH_2OH$
3. $CH_3\overset{O}{\overset{||}{C}}CH_2CH_2CH_3$
4. $CH_3\overset{OH}{\overset{|}{C}}H(CH_3)CH_2OH$
5. $CH_3\overset{OH}{\overset{|}{C}}HCH_2 - \overset{O}{\overset{||}{C}} - CH_3$

23) Consider the following reaction.

$2A + B \rightarrow A_2B$

Order of the reaction with respect to A is zero and with respect to B is 2. At initial rate concentration of A is 2.5×10^{-2} mol dm^{-3} and concentration of B is 1.0×10^{-2} mol dm^{-3} . What could be the concentration of A when the rate is $\frac{1}{4}$ of the initial rate.

1. 5.0×10^{-3} mol dm^{-3}
2. 1.5×10^{-2} mol dm^{-3}
3. 1.0×10^{-3} mol dm^{-3}
4. 2.45×10^{-3} mol dm^{-3}
5. 1.25×10^{-2} mol dm^{-3}

24) 23.7 g of NH_4HCO_3 (s) is heated up to 77^0C in a closed vessel. Pressure inside the vessel after complete dissociation of NH_4HCO_3 (s) is 4.157×10^5 Nm^{-2}. What is the volume of the vessel. (Assume all the gaseous products behave ideally.) (H = 1.0 N = 14 C= 12 O = 16)

1. 8.1 dm^3 2. 2.7 dm^3 3. 5.4 dm^3 4. 4.2 dm^3 5. 16.2 dm^3

25) By the mixing of two liquids A and B form an ideal solution. Vapour pressure of a solution contains 3 mol of A and 1 mol of B is $2.5x10^3$ Nm^{-2} at 27^0C. Saturated vapour pressure of A at that temperature is $2.0x10^3$ Nm^{-2}. What is the molar ratio between A and B in vapour phase at 27^0C.

1. 1:2 2. 2:1 3. 1:3 4. 3:2 5. 1:1

26) pH value of aqueous weak mono basic HAc acid which has the concentration 1.0×10^{-3} mol dm^{-3} is 5.0. What is the pH value of 1.0×10^{-1} mol dm^{-3} HAc(aq) at the same temperature.

1. 5 2. 4 3. 3 4. 2 5. 1

27) What is the IUPAC nomenclature of $K_3[Fe(CN)_5CO]$

1. Potassium(I) pentacyanaocarborniumiron(II)
2. Potassium pentacyanocarbonyliron(II)
3. Potassium pentacyanocarbonylferrate(II)
4. Potassium pentacyanocarbonylfrrates(III)
5. Tripotasium pentacyanocarbonylferrate(II)

28) Metal M belongs to d-block is silver in colour and no reaction with water or air at room temperature. It dissolves in dil.HCl and forms green complex. That solution is basified with NaOH, light green precipitate is formed, dissolved in excess NH_3(aq) and gave blue-violet colour. Addition of few drops of KCN to the M(II) ion aqueous complex forms light green precipitate M would be,

1. Cu 2. V 3. Co 4. Cr 5. Ni

29) 1.0g of an organic compound dissolved in 100 cm^3 of water. It is extracted with 50 cm^3 of ether. Again it is exacted with 25 cm^3 of ether and is separated aqueous layer. Find the mass of organic compound retains in the aqueous solution after the second extraction.

1. 0.067 g 2. 0.8 g 3. 0.13 g 4. 0.2 g 5. 0.16 g

30) K_3PO_4 and K_2SO_4 was dissolved in water at 25^0C and prepared an aqueous solution. 100 cm^3 from the above solution and was added 0.005 mol dm^{-3} $Ba(OH)_2$(aq) in excees that couldn't form precipitate furthermore. Required volume of $Ba(OH)_2$(aq) was 200 cm^3. Precipitate gained was filtered, dried and weighed. Weight of the precipitate was 0.1435 g. concentration of SO_4^{2-}(aq) in the filtrate is $1.1x10^{-7}$ mol dm^{-3} . Solubility product of $BaSO_4$(s) at 25^0C = $1.1x10^{-10}$ mol^2 dm^{-6}. Solubility product of $Ba_3(PO_4)_2$ at 25^0C is $3.4x10^{-23}$ $mol^5 dm^{-15}$. What is the amount of Ba^{2+} precipitated.

1. 7.0×10^{-4} 2. 1.0×10^{-3} 3. 3.0×10^{-3} 4. 2.0×10^{-4} 5. 4.0×10^{-4}

For each of the questions 31 to 40 four responses (a), (b), (c) and (d) are given. One or more of these is/are correct. Select the correct response/responses. In accordance with the instructions on your answer sheet, mark

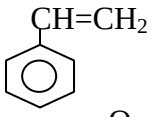
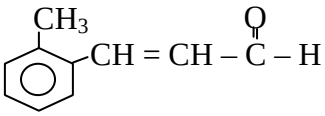
1	2	3	4	5
Only (a) and (b) Correct	Only (b) and (c) Correct	Only (c) and (d) Correct	Only (d) and (a) Correct	Any other number of combination of responses correct.

31) Which one of the statement/s is/are true about allotropic forms of Sulphur.

(a) Monoclinic sulphur is more stable than the rhombic sulphur.
(b) Rhombic sulphur as well as monoclinic sulphur is soluble in CS_2
(c) Bubbling of H_2S in to the aqueous HNO_3 solution produces colloidal sulphur.
(d) Rhombic sulphur can be converted in to monoclinic sulphur but monoclinic sulphur can't convert in to rhombic sulphur.

32) Which one of the following statement/s is/are true.
(a) Rate constant of the endothermic reaction increases with temperature.
(b) In a reversible reaction rate constants of forward and backward reactions will increase with temperature.
(c) Rate constant of the exothermic reaction decreases with increasing temperature.
(d) In the reversible reaction the rate constant of forward reaction increases and the backward reaction decreases with increasing temperature.

33) It has found that the analysis of products of $CO_2(g)$ and $H_2O(l)$ are in 44:9 mass ratio in an organic compound with is combusted with excess of $O_2(g)$. Which of the following compound/s it/they would be.

(a) 
(b) $H - C \equiv C - H$
(c) $CH3 - \overset{O}{\overset{\|}{C}} - H$
(d) 

34) Which one of the following statement/s is/are true?
(a) Ascending order of the strengths of Lewis acidity is $BCl_3 < AlCl_3 < GaCl_3$
(b) Ascending order of the thermal stability is $BeCO_3 < MgCO_3 < CaCO_3 < BaCO_3$
(c) Bond angle increases as $H_2Se < H_2S < H_2O$
(d) Covalent nature increases as $TiCl_2 < TiCl_3 < TiCl$

35) Which one of the following statement/s is/are true?
(a) The existence of nucleus was discovered for the first time by Rutherford through α ray diffraction experiment.
(b) Bohrs theory can be used only to explain about the atom or ion which contains one electron.
(c) Infra red waves in the electro magnetic spectrum have the longest wave lengths.
(d) Maximum number of electrons in p orbital is 6.

36) Which one of the following compound/s would produce $\rangle C = N$ - product with Acetone (CH_3COCH_3).
(a) $C_6H_5NH_2$
(b) $(CH_3)_3N$
(c) $C_6H_5NHC_6H_5$
(d) $C_6H_5NHNH_2$

37) Which one of the following statement/s is/are correct?
(a) $P = \frac{2}{3}N(KE)$
(b) $P = \frac{nRT}{V}$
(c) $P = \frac{1}{3}mN\overline{C^2}$
(d) $\overline{C^2} = \sqrt{\frac{3RT}{m}}$

38) Which one of the following set of compounds that cannot be existed together in an aqueous solution.
(a) Na_2CO_3 and $NaHCO_3$
(b) Na_2CO_3 and $NaOH$
(c) $NaHCO_3$ and HCl
(d) $NaHCO_3$ and $NaOH$

39) Which one of the following statement/s is/are true.
(a) Sn(II) is a strong oxidizing agent.
(b) $PbCl_2$ forms complex ion $(NH_4)_2[PbCl_6]$ with ammonia.
(c) PbI_4 can't be prepared.
(d) $SnCl_2$ is a linear molecule.

40) Which one of the following statement/s is/are true,
(a) Main component of the cinnamon oil is cinnamaldehyde.
(b) Latex of rubber contains polyisoprene.
(c) Citral can be extracted by the Lemon grass.
(d) Buds of clove contain eugenole

In questions 41 to 50, 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 appropriately on your answer sheet.

	1st statement	2nd 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

	1st statement	2nd statement
41)	Benzoyl alcohol is more acidic than para nitro benzoyl alcohol.	Nitro group draws electrons away from the benzene ring.
42)	Standard Lattice energy of $MgCl_2$ is greater than the Standard lattice enthalpy of NaCl.	Ionic radius of Na^+ is lesser than the ionic radius of Mg^{2+}.
43)	Dark red arises in the mixture of $Fe^{3+}(aq)$ and $NH_4CNS(aq)$, reduces with the addition of NaOH.	Fe^{3+} ions get precipitated as $Fe(OH)_3$ (s) with NaOH(aq).
44)	Concentration of $H^+(aq)$ in 1.0 mol dm^{-3} HCl solution at 25^0C is 1.0 mol dm^{-3}.	HCl can act as a strong acid in aqueous medium.
45)	Product given by the reaction between ethanal and HCN is non sterioisometric.	Reaction between $CH_3 - \overset{\overset{O}{\|}}{C} - H$ and HCN is a nucleophilic addition.
46)	pH value is approximately 7 when it is getting closer to the end point of 0.1 mol dm^{-3} F_3CCOOH and 0.1 mol dm^{-3} NaOH titration at 25^0C.	Phenolphthalein as well as methyl orange can be used for normal titration of F_3COOH and NaOH.

47)	Velocity of cathode rays equal to the velocity of light ray.	Cathode rays can't be deflected by a magnetic field.
48)	Temporary hardness appears according to the bicarbonate ions of Ca^{2+} and Mg^{2+}.	Addition of calculated amount of NaOH is a successful method to remove temporary hardness in water.
49)	Calculations done by using Van der Waals equation for real gases having high temperatures and low pressures is incorrect.	Real gases reach to ideal behaviour at low pressures and high temperatures.
50)	Application of tin metal on iron to prevent rusting is an anodic protection.	Tin is more reactive than iron.

51) Standard enthalpy changes of some reactions are given below.

i. $2CO(g) + O_2(g) \rightarrow 2CO_2(g)$ $\Delta H^{\theta} = -566$ KJ

ii. $CO_2(g) + 2H_2O(l) \rightarrow CH_3OH(l) + \frac{3}{2} O_2(g)$ $\Delta H^{\theta} = +715$ KJ

iii. $H_2(g) + \frac{1}{2} O_2(g) \rightarrow H_2O(l)$ $\Delta H^{\theta} = -286$ KJ

What would be the standard enthalpy of the following reaction.

$CO(g) + 2H_2(g) \rightarrow CH_3OH(l)$ $\Delta H^{\theta} = ?$

1. +137 KJ 2. -140 KJ 3. +435 KJ 4. +1567 KJ 5. -1537 KJ

52) Consider the following equilibrium.
$NH_4HS(s) \rightleftharpoons NH_3(g) + H_2S(g)$

0.51 g of $NH_4HS(s)$ is allowed to reach the equilibrium in 5.0 dm^3 closed vessel at 327^0C. Kp at 327^0C is 4.0×10^4 N^2m^{-4}. What is the amount of molar dissociation of $NH_4HS(s)$.

1. 0.01 2. 0.025 3. 0.12 4. 0.02 5. 0.001

53) 0.772 g of chloride M which is a transition metal, completely dissolved in water and added excess of $AgNO_3(aq)$. Precipitate formed is filtered, washed dried and weighed. Mass of the precipitate was 2.151 g. Molecular formula of the metal chloride would be,
(Ag = 108 Cl = 35.5 M = 48)

1. MCl_2 2. M_2Cl_3 3. MCl_4 4. MCl 5. MCl_3

54) Two standard electrode potentials are as follows.
Ag^+ (aq 1.0 mol dm^{-3}) | Ag(s) $E^{Q} = +0.80$ V

Pt (s), Cl_2 (g 1.0 atm) | Cl^- (aq 1.0 mol dm^{-3}) $E^{Q} = +1.36$ V

Which one of the following statement is correct about the electro chemical cell which is made by using the above two electrodes under the standard conditions.

1. Chlorine electrode is the cathode
2. E.m.f.of the cell is +2.16V
3. Oxidation occurs at Ag electrode.
4. E.m.f value of the cell is independent of temperature.
5. Oxidation occurs at cathode.

55) Which one of the following tri halide is the least basic.

1. NCl_3 2. NF_3 3. NI_3 4. NBr_3 5. NAs_3

56) Which one of the following statement is true.

1. Combustion of NH_3 produces NO_2 and H_2O as products.
2. If NH_3 is passed on heated CuO produces NO_2 .
3. Industrial production of NH_3 uses high temperatures and low pressures.
4. Production of NH_3 is an exothermic reaction
5. All the above are correct.

57) Which one of the following statement/s is/are incorrect about catalysts.

1. $TiCl_4$ is used as a catalyst in the polymerization of ethane and propene.
2. Mn^{2+} is a self catalyst in MnO_4^- and $C_2O_4^{2-}$ reaction.
3. MnO_2 is a catalyst in $KClO_3(s)$ thermal decomposition
4. Cr_2O_3/ZnO use as a catalyst in the production of CH_3OH by using CO and H_2.
5. V_2O_5 use as a catalyst in Haber process which is use to produce NH_3 .

58) Which one of the following is incorrect about phosphorous.

1. Phosphorous is stored in water.
2. It exists in allotropic forms.
3. Undergoes disproportionation with the presence of dil. Acids.
4. Forms cyclic oxiacids.
5. More reactive than Nitrogen.

59) A bottle containing $SnCl_2(s)$ in the lab is mixed with $BaCl_2(s)$ by mistake. This is the method used by a A/L student to determine the mass percentage of $SnCl_2(s)$ in the salt mixture. Mixed the salt well and weighted 5.88g from it. Dissolved it in 100 cm^3 of distilled water. 25 cm^3 from that solution was measured by using a pipette and put into the titration flask. 0.2 mol dm^{-3} H_2O_2 50 cm^3 was added and kept it for some minutes. After that it was added excess of Ag_2O and evolved O_2 collected under s.t.p. was 112 cm^3. Which one of the following value for mass percentage $SnCl_2(s)$ would be, (O_2 (g) behaves as an ideal gas. molar volume of ideal gas at s.t.p. is 22400 cm^3)
Sn = 119 Cl – 35.5 Ba – 137

1. 12.36% 2. 50.54% 3. 64.62% 4. 85.42% 5. 75.84%

60) This experiment is done to determine the dissolved oxygen in a swimming pool. Water of the swimming pool was taken into 500 cm^3 reagent bottle and $MnSO_4$ and alkaline KI(aq) were added. After ten minutes sulphuric acid was added and liberated I_2 was titrated with $Na_2S_2O_3$ (aq). 50 cm^3 of I_2 solution required 20 cm^3 of 0.02 mol dm^{-3} $Na_2S_2O_3$ (aq) to react completely. Concentration of O_2 in the water of the swimming pool would be,

1. 8.0 ppm 2. 16.0 ppm 3. 32.0 ppm 4. 64.0 ppm 5. 120.0 ppm

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General Certificate of Education (Adv. Level) Examination, 2010

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Grade 13 – Final Term Test July 2010

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Chemistry II

Part A – Structured Essay

Time – 3 Hours

Answer two questions only.

1.(a) "Relative atomic mass of carbon is 12.0115". Explain what does it mean.

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(b) Consider Na, Mg, Al, Si, P, S, Cl, Ar which belong only to the third period.

i) Element that has the maximum third ionization energy.

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ii) Element that shows the highest melting point

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iii) Element that has the highest electrical conductivity.

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iv) Element/s that shows/show allotropy.

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v) One element react with other element/s and the compound that produces, contain two elements with the oxidation numbers as follows. Give one example for each compound in a box given below.

Oxidation no	-2	-1	+1	+2	+4
Compound					

vi) Compound contains two elements reacts with water and produces tri basic weak acid as one product. Give the relavent balanced chemical equation.

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(c) Beryllium forms stable BeF_3^- and BeF_4^{2-} ions. Write the geometrical shape and state the hybridization of the central atom with the aid of the shape of the molecule

	BeF_3^-	BeF_4^{2-}

Geometrical shape ....

hybridization of the central atom ....

(d) Arrangement of N_2O molecule is found as N–N–O by using the molecular spectroscopy. Draw three possible stable resonance structures to N_2O if all the atoms obey to the "octet rule". Draw them in the boxes given below. Show the lone pairs by using pair of dots (••).

	↔		↔	

(2)(a) Reaction of hydrated $Cu_2S \,.\, xH_2O$ with acidified $MO_4^-(aq)$ gives $Cu^{2+}(aq)$, $M^{2+}(aq)$, SO_2 (g) as products. Required volume of 0.20 mol dm^{-3} of MO_4^- to react completely with 1.335g of the hydrated salt sample was 40.00 cm^3 (Cu = 63.5 S = 32)

i) Write oxidizing agent half reaction.

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ii) Write the reducing agent half reaction.

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iii) Write oxidation reduction reaction.

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iv) What is the mass of Cu_2S in hydrated salt.

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v) What is the value of " x"

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(b) NH_3 gas is industrially produced by nitrogen gas and hydrogen gas. Equation for the above reaction as follows.

$$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$$

i) Write an expression to show the relationship between the reaction rate (R) and concentration of components.

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ii) Initial partial pressures of $N_2(g)$ and $H_2(g)$ are P_{N_2} and P_{H_2} respectively. Derive an expression to show the relationship between reaction rate (R) and partial pressures by using the above (i) expression.

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iii) Give two assumptions that you made when deriving the above (ii) relationship.

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iv) "Reaction rate increases when the partial pressures of the reactants increase" Explain the statement according to the chemical kinetics.

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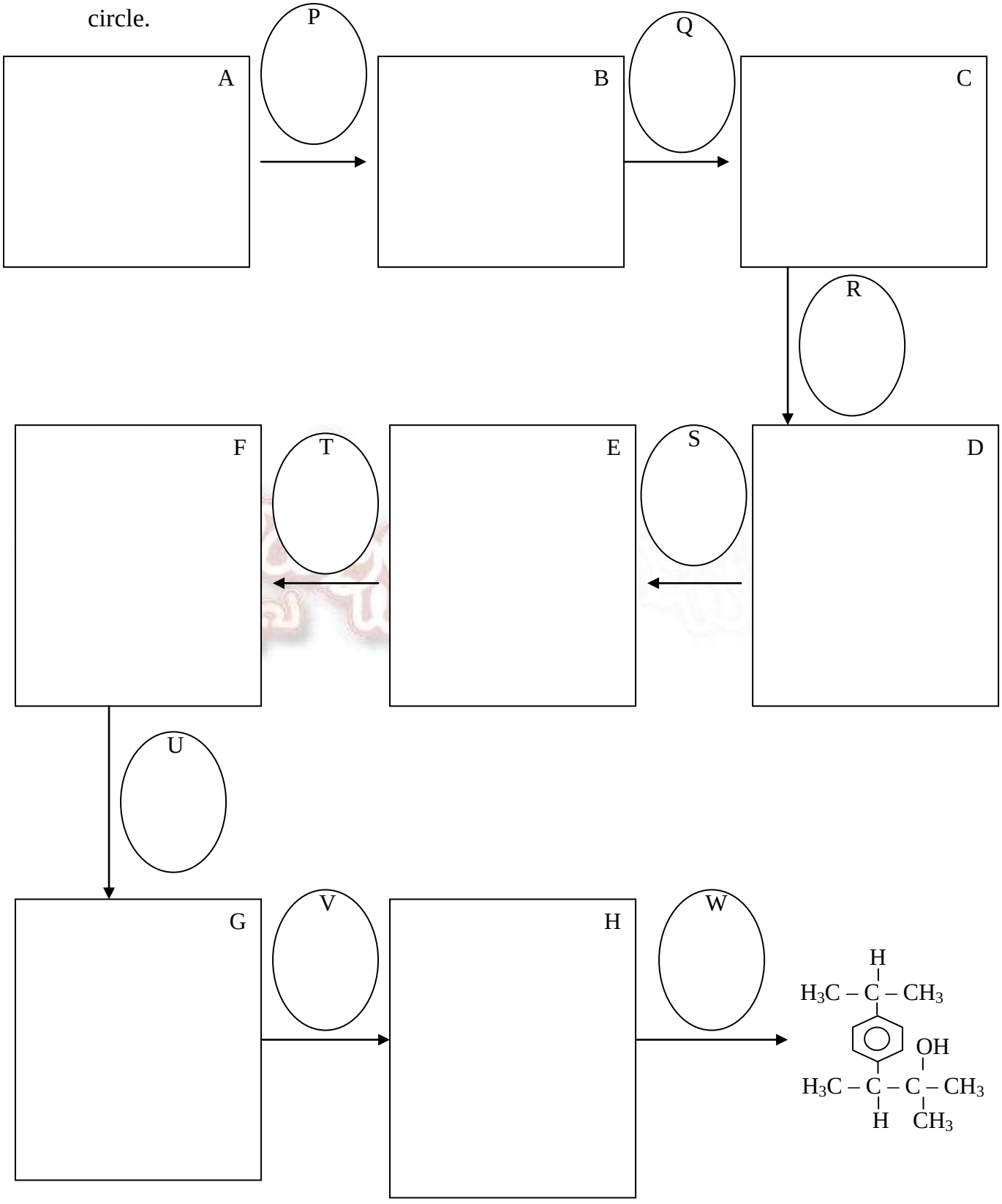
v) Complete the following statements related with the above reaction.

I. Rate of consumption of $N_2(g)$ is …….. times of the rate of consumption of $H_2(g)$.

II. Rate of consumption of $N_2(g)$ is ……times of the rate of production of $NH_3(g)$.

(3)(a) Synthesis the compound given below by using the relevant compounds among Mg, PCl_5, H_2O, anhydrous $AlCl_3$, $LiAlH_4$, $KMnO_4$, conc. H_2SO_4, CH_3-CH=CH_2, CH_3COCH_3, CH_3COCl, C_6H_6, $C_2H_5OC_2H_5$. Write the compounds in boxes and reagents in circles. If hydrolysis is necessary after any reaction, write it as (1)/(2) in the same circle.



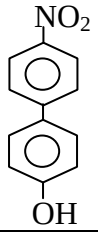
(b) Answer the following questions by using the given reactants and reagents.

(A) $CH_3CH_2CHO \xrightarrow{KOH(aq)}$

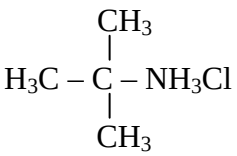
(B) $CH_3COCH_3 \xrightarrow{NH_2OH}$

(C) $CH_3COCl \xrightarrow{C_6H_5OH}$

(D) $CH_3CH{=}CH_2 \xrightarrow{ICl}$

(E)  $\xrightarrow{\text{conc. } HNO_3}$

	Final organic product	Species that attack the initial organic compound	Name of the mechanism of the reaction
A			
B			
C			
D			
E			

(c) How do you separate the mixture of  and $CH_3CH_2CH_2CH_2NH_3Cl$,

using the necessary compounds given below.

H_2SO_4, $NaNO_2$, HCl, PCl_5, $AgNO_3$, NaOH, $KMnO_4$

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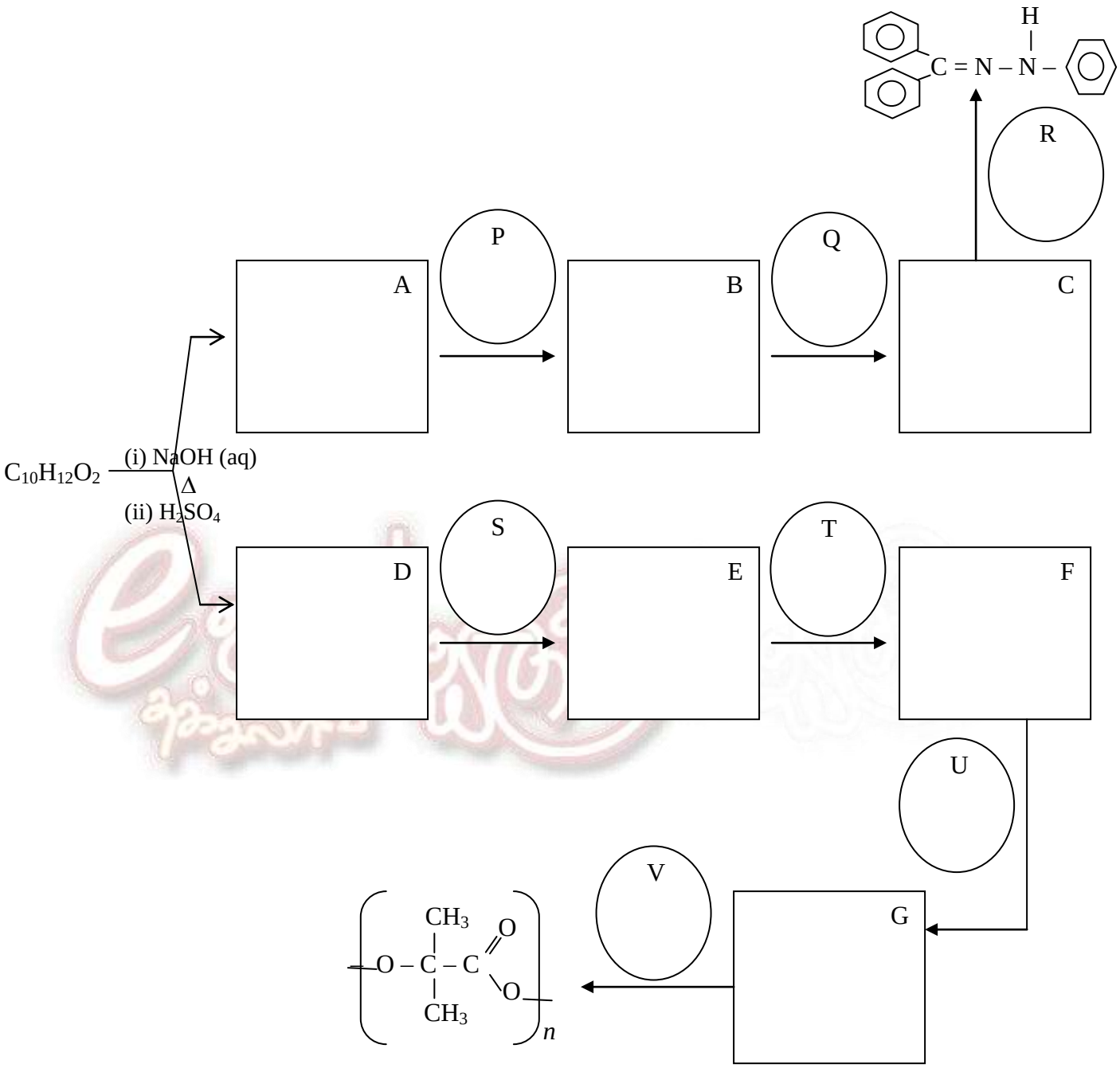
(4)(a) Complete the following reaction paths by putting correct compound in boxes and correct reagents in circle.



(b) Complete combustion of 0.20 mol of an organic compound A, evolves 0.80 mol of CO_2 and 0.60 mol of water. 60.00 cm^3 of 0.25 mol dm^{-3} NaOH solution was required to neutralize 25.00 cm^3 of 0.30 mol dm^{-3} of solution A.

i) Find the molecular formula of A by using the data given above.

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ii) Give possible structures for "A".

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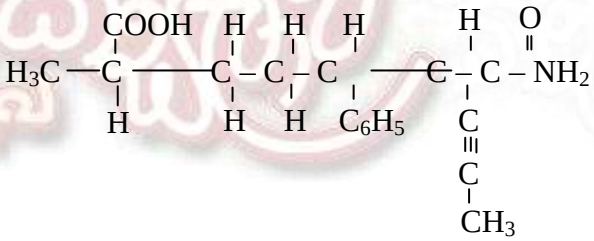
iii) Give IUPAC nomenclature for the following compound.



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(c) Compound "A" having $C_8H_{15}ON$ molecular formula shows optical isomerism. Further it shows geometrical isomerism. When it is heated with H_2/Ni produces $C_8H_{19}N$, compound "B", which shows neither optical isomerism nor geometrical isomerism. When A is heated with NaOH(aq), produces NH_3 and C . Addition of dil H_2SO_4 to C produces "D". Draw the structures for A, B, C and D in the following boxes.

A	B
C	D

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General Certificate of Education (Adv. Level) Examination, 2010
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Grade 13 – Final Term Test July 2010
13 වන ශ්‍රේණිය අවසාන වාර පරීක්ෂණය 2010 ජූලි

Chemistry II
Part B – Essay

Answer two questions only.

(5)(a)i) Define the following standard enthalpies and give thermo chemical equation for each.

I. Standard enthalpy of formation $\Delta H_f^0\ H_2SO_4(l)$; - 194 kJ mol^{-1}

II. Standard enthalpy of hydration $\Delta H_{hyd}\ Na^+(aq)$; - 390 kJ mol^{-1}

III. Standard lattice enthalpy $\Delta H_L\ MgCl_2$; - 2502 kJ mol^{-1}

ii) $CaC_2(s)$ is produced by heating C(s) and CaO(s) in electric arc furnace Standard enthalpies of CaO(s) , $CaC_2(s)$, $CO_2(g)$ are - 668 kJ mol^{-1}, - 798 kJ mol^{-1}, - 393 kJ mol^{-1}.
By using the given data above, calculate the enthalpy of the following reactions using enthalpy diagram.

$$2CaO + 5C(s) \rightarrow 2CaC_2(s) + CO_2(g)$$

iii) $$CaC_2(s) + 2H_2O(l) \rightarrow Ca(OH)_2(aq) + C_2H_2(g)$$

Standard enthalpies of formation of $\Delta H_f\ H_2O(l)$, $\Delta H_f\ Ca(OH)_2(aq)$, and $\Delta H_f\ C_2H_2$ are – 286 kJ mol^{-1}, -991.1 kJ mol^{-1}, and +227 kJ mol^{-1}. Calculate the enthalpy change with relevant to the reaction between 1mol of CaC_2 and water by using the above data.

iv) $$C_2H_2(g) + \frac{5}{2}O_2(g) \rightarrow 2CO_2(g) + 2H_2O(l)$$

Calculate the enthalpy of combustion related to the above reaction by using the thermo chemical data given in above parts.

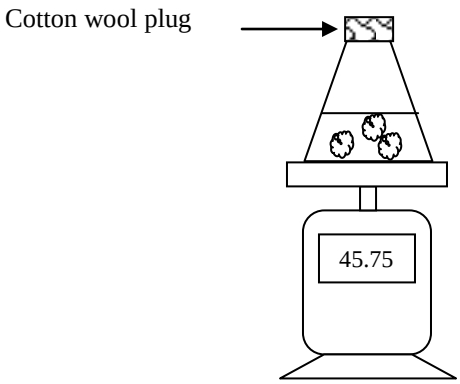
(b) Consider the following equilibrium.

$$COCl_2(g) \rightleftharpoons CO(g) + C1_2(g)$$

0.1 mol of $COCl_2(g)$ introduced in to a closed vessel which has volume V, was allowed to reach equilibrium at 400^0C. Total pressure was $2x10^5$ Pa in the equilibrium mixture. Percentage dissociation of $COCl_2(g)$ was 25% from the initial amount.

i) Calculate the mole fractions of each component in equilibrium mixture.
ii) Calculate the partial pressures of $COCl_2$, CO and $C1_2$ in equilibrium mixture.
iii) Calculate Kp and Kc of the equilibrium system at 400^0C
iv) Calculate the partial pressures and the total pressure of the mixture if 0.1mol of He is introduced in to the vessel.
v) Calculate the degree of dissociation of $COCl_2$ (g) if the volume is reduced to V/2.

(c) Student was planned the following experiment to determine the rate of a reaction between $CaCO_3(s)$ and HCl.
$CaCO_3(s)$ (marble chips) was taken to the flask and dil HCl was added to it and closed with the cotton wool plug. He was put it on the electronic balance and was taken the reading after every 10 seconds.



	Time seconds	mass **g**
1	0	200.00
2	10	191.00
3	20	183.50
4	30	178.50
5	40	174.25
6	50	170.50
7	60	167.25
8	70	164.00
9	80	164.00
10	90	164.00
11	100	164.00

i) Plot a graph mass Vs time.
ii) According to the graph at what time the reaction is ceased after mixing.
iii) What is the criteria that can be used to measure the rate of a reaction.
iv) Mark the change of reaction rate with time in the graph. Which quantity shows the rate of the reaction.

d) Different volumes of 1 mol dm^{-3} solution and water were mixed according to the following table and added same shaped equal amounts of piece of $CaCO_3(s)$. Mass reduction after 20 s was recorded. Determine the order of the reaction with respect to HCl.

1 mol HCl ml	**water ml**	mass reduction after **20**
10	90	0.20 g
20	80	0.87 g
30	70	1.78 g
40	60	3.56 g
50	50	4.96 g
60	40	7.18 g

(6)(a) (i) Define the term "buffer solution" ? Expalin how a buffer solution resist changes in pH, if small amounts of acid or base solutions were added, using an example ?

(ii) Calculate the of pH of 0.22 mol dm^{-3} C_2H_5COOH solution, pKa 4.87 at 25^0C

(iii) A solution made by adding 100 cm^3 of 0.22 mol dm^{-3} C_2H_5COOH solution to 100 cm^3 of 0.10 mol dm^{-3} solution NaOH. Calculate the pH of the resultant solution?

(iv) 25.00 cm^3 of a weak acid HX of concentration 0.10 mol dm^{-3} was titrated with 0.10 mol dm^{-3} sodium hydroxide solution, and the pH measured at intervals. The results are set out below.

volume of sodium hydroxide cm^3	5	10	12	20	23	24	25	26	30
pH	4.5	4.8	4.9	5.5	6.5	7.0	9.0	12.0	12.5

I. Draw a titration curve and use it to calculate the Pk_a for the acid HX

II. Suggest a suitable indicator for the titration ?

(b) The solubility product of $Ag_2C_2O_4$ at 25^0C is 1.29×10^{-11} mol^3 dm^{-9} . A solution of $K_2C_2O_4$ containing 0.1520 mol in 500 cm^3 water, is shaken with excess of Ag_2CO_3 till the following equilibrium will be reached.

$$Ag_2CO_3(s) + K_2C_2O_4(aq) \rightleftharpoons Ag_2C_2O_4(s) + K_2CO_3(aq)$$

At equilibrium the solution contains 0.0358 mol of K_2CO_3 . Assuming the degree of dissociation of $K_2C_2O_4$ and K_2CO_3 to be equal, calculate the solubility product of $Ag_2CO_3(s)$

(c) A weak mono acid base "B" is in the equilibrium between an organic solvent. "L" and water at 298 K. 5 cm^3 of 0.2 mol dm^{-3} HCl solution is required to titrate the 10 cm^3 of aqueous layer and 2.5 cm^3 of 0.1 mol dm^{-3} HCl solution is required to titrate the 25 $cm^3$of organic solvent " L"

i) Calculate the partition coefficient of B between water and L

ii) Calculate the dissociation constant K_b of "B"
K_w at 298 K is $K_w = 1 \times 10^{-14}$ mol^2 dm^{-6}

(7)(a) Sample of molten $CuBr_2$ is electrolyzed with the presence of C electrodes. When 1A is passed through the electrolyte in 30 s, mass of the electrode increased by 0.508 g.
(Cu = 63.5, Br = 80.0 charge of an electron 1.6×10^{-19}C)

i) How do you recognize the cathode and anode of the electrolytic cell.

ii) Write the balanced half ionic equations for the reactions occur near anode and cathode.

iii) What quantity of electricity is required to produce one mole of Cu at the respective electrode.

iv) Calculate a value for Avogadro's constant by using the experimental results and data.

v) Explain one reason if the calculated value in (iv) is different from the standard value.

vi) Can we do the same calculation for Avogadro's constant as the above if the electrolysis of $CuBr_2$(aq) is done through long period of time.

(b) Standard chemical cell is prepared by the standard electrode containing $A^{4+}(aq) / A^{2+}(aq)$ ions and $B^{3+}(aq) / B^{2+}(aq)$. Standard electrode potentials of that electrodes are 0.15V and 0.77V respectively.

i) State anode and cathode of the above electro chemical cell clearly.

ii) What is the most suitable instrument to measure the electro motive force of the above cell

iii) Give the reactions occur near anode and cathode and the cell reaction?

iv) Give the standard cell diagram.

v) Calculate the electromotive force of the cell.

vi) If small amount of H_3PO_4 is added to the ionic solution B which is considered as iron, is there any effect or not on electromotive force.

(c) Consider the mixture of n- hexane and n-heptane behave as ideal.

i) Plot a graph temperature Vs. liquid composition at constant pressure and mark following things on it. Saturated Vapour pressures of n-hexane and n-heptane are P_{hexane} and $P_{heptane}$ respectively.
Composition of n-heptane when the mole fraction is 0.8, is m_1. Standard boiling point at composition of m_1 is T_1. Composition of vapour of the solution which boils at T_1 in equilibrium is n_1. Composition of n_1 distillate is m_2. Standard boiling temperature of liquid m_2 is T_2. Composition of the vapour of the liquid boils at T_2 is n_2.

ii) Explain composition of m_1 can be separated out by using fractional distillation with the use of boiling point - composition curve.

iii) What is the instrument that can use to the above process (II)

iv) State the law related to the above process.

v) Can we use the above principle to extract citronell oil. Explain.

C Part Essay

(8)(a) Consider four elements Fe, Cr, Mg and Al .

i) Which blocks of the periodic table each element belongs to.

ii) State four physical or chemical properties of transitional elements among the above elements.

iii) Give one example related with the above properties

iv) Name three soils that contain iron

v) Name two other things mix with the soil use in iron exaction.

vi) Write down five relevant balanced chemical equations for the reactions occur in the blast furnance.

vii) Write down the half reactions for rusting of iron and state anodic and cathodic reactions clearly.

viii) Give two methods that can use Cr to prevent rusting of iron.

ix) Write down the relevant balanced chemical equations for the preparation of aqueous $Cr_2O_7^{2-}$ solution starting with Cr.

x) Briefly explain how the process of iron containg certain component in a body changes due to NO_3^- ion containing drinking water.

xi) How do you show that Fe^{3+} and Fe^{2+} ions contain in the aqueous solution containing Fe and Cr, at laboratory.

(b) Costic Soda (NaOH) the can be produced by using sea water Cl_2 evolves as one byproduct. High percentage of NaOH is used for soap production. NaOH liquid required for the soap production being sent to market as it is.

i) State the most important steps of NaOH production (States and balanced equations are required).

ii) Give two other byproducts of NaOH production .

iii) Name three industrial or domestic products of Cl_2. Give uses of each. (Uses must differ from each other).

iv) What are the affects of chlorine containing products in (III) to the environment. Explain.

v) Give two advantages of introducing NaOH which is used to the soap production, in liquid form to the market.

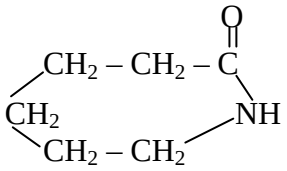
vi) Name other three substances that use in the production of soap with NaOH.

(9)(a) Sample of 1.00 g of vulcanized rubber containing the oxide of a certain element, burnt completely and the evolved gas was reacted with excess of Br_2 and steam. Solution gained was acidified with dil. HNO_3 and was added excess of $BaCl_2$ solution. Precipitate formed was filtered, dried and weighed. Mass of the precipitate was 0.739 g precipitate formed by combustion was dissolved in dil HCl. Excess of NH_3 was added and H_2S was bubbled. Then clear white precipitate was formed and it was filtered, dried and weighted. Mass was 0.055 g.

i) Write down all the relevant balanced equations for the above process.
ii) Write the structural formulae of monomer and polymer of rubber.
iii) State the structural difference occurred in rubber after vulcanization.
iv) Deduce the oxide that has added to the vulcanization.
v) Name one filling agent is added to the rubber.
vi) Calculate the mass percentage of S in the sample.
vii) Calculate the mass percentage of the oxide in the sample.

R.m.m. of the oxide of the element = 81 Ba = 137 S = 32 O = 16 C = 12
R.m.m. of the sulphide of the element = 97 Cl = 35.5 Br = 80 H = 1 N = 14

(b) Structure of caprolactam is given below.



Useful polymer can be produced by the polymerization of the product, gained by the hydrolysis of the above compound in the basic medium.

i) Write the structural formula of caprolactam produced by hydrolysis.
ii) Using the above structure as the monomer, draw its polymer and name it.
iii) Why is that polymer doesen't wet with water.

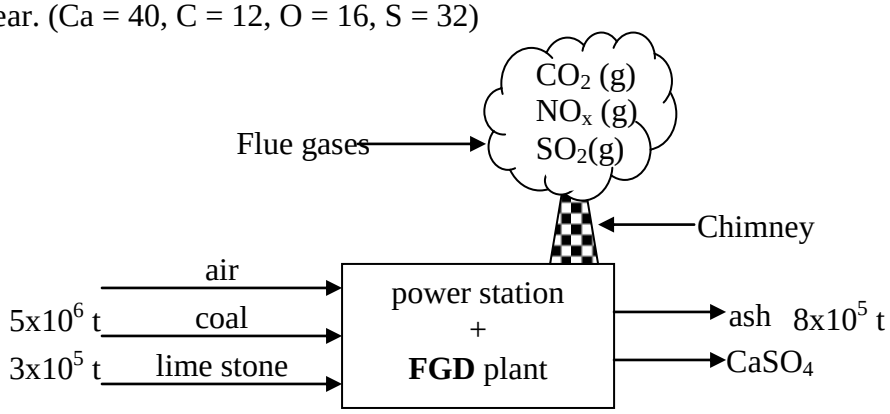
(c) Sulphunic acid can be produced by the byproducts removed from purification process of crude oil. Considerable percentage of the purified crude oil is used as a fuel. Use anti knocking agents to increase the fuel efficiency.

i) What do you mean by "cracking of petroleum"
ii) Name the main elemental pollutant releases to the atmosphere by the combustion of petrol.
iii) Name four gaseous pollutants is added to the environment by the fuel combustion.
iv) Explain the affect of the two pollutants to the environment.

(d) Consider the chlorides of NCl_3, PCl_3 and $BiCl_3$

i) Give balanced chemical equations for the hydrolysis of the above chlorides.
ii) Deduce the electro negativity changes according to N>C1>Bi by using the products gained by hydrolysis.
iii) Based on two basic characters of oxides derived from the maximum oxidation state of N,P and Bi, show how the electro positivity of an element increases with the increasing atomic number of a group.

(10)(a) A coal - fired power station is fitted with a flue gas desulphurization (FGD) plant, which removes some of the sulphur dioxide from waste gases.
In the FGD plant, the waste gases are treated with powdered limestone ($CaCO_3$) producing $CaSO_3$ this is oxidized by air to form solid $CaSO_4$ (s) . The diagram below shows the amounts of substances used. and produced by such a coal - fired power station with an FGD plant in one year. (Ca = 40, C = 12, O = 16, S = 32)



i) I. What process provides the energy used in the power station?
II. Which gas, not visited in the diagram, is the chief component of the flue gases ?
III. Explain why oxide of nitrogen (NO_x) are present in the flue gases.

ii) Write a balanced equation in each case to show
I. lime stone reacts with SO_2
II. $CaSO_3$ is oxidized by air

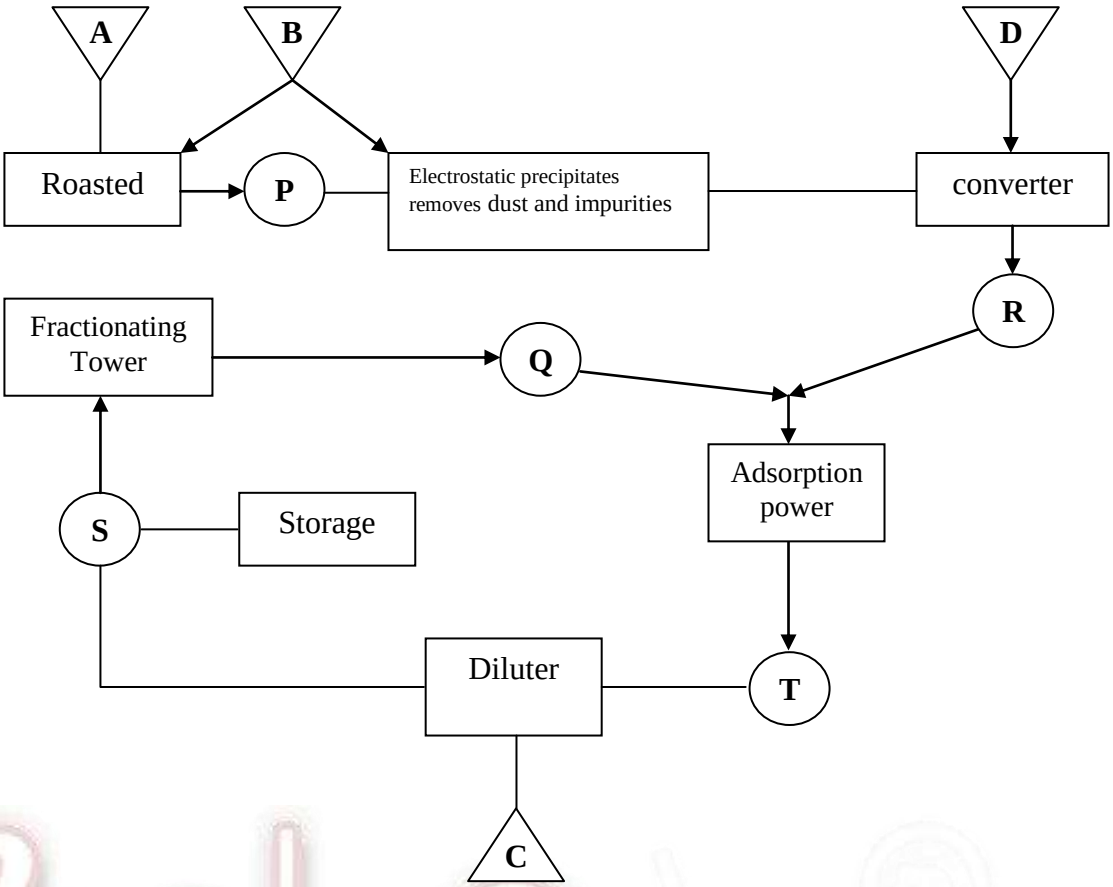
iii) I. Using the equation in (ii) (I) to determine the maximum mass of SO_2 which could be removed by $3x10^5$ of lime stone in the FGD plant. (1 t = 1000 kg)
II. Use the equation in (iii) to determine the maximum mass of $CaSO_4$ which would be produced from the $3x10^5$ of tons of lime stone.

iv) The FGD plant removes 90% of the SO_2 from the waste gases using for your answer to (iii)(I). Calculate the mass of SO_2 which is released into the atmosphere each year by this power station when $5x10^6$ t of coal are burnt.

v) What are the other things that you get except $CaSO_4$ when effluent gases treated with $CaCO_3$.

vi) Suggest two possible disadvantages of the use of an FGD plant.
(Ca = 40, S = 32, C = 12)

(b)



Answer the following questions using above flow chart given above for contact process in the manufacture of H_2SO_4.

i) Write the starting material used in the triangle A, B, C.
ii) Write the catalyst used in converter in triangle D.
iii) Write the chemical formulae of substances in proper circles P,Q, R, S, T.
iv) Write the structural formulae for compound T.
v) Give the conditions used in converter.
vi) Give two industrial uses of H_2SO_4.
vii) Write the chemical balanced equations for all reactions occur in this process.