Unit 3

(1) **1980 A/L (Optional)**

a) An organic compound contains 41.0% of carbon, 4.6% hydrogen and 54.4% of oxygen.

i) What is the empirical formula of the compound?

.....

.....

.....

.....

.....

.....

.....

ii) The relative molecular mass of the compound is approximately 180. What is the molecular formula of the compound?

.....

.....

.....

.....

(2) **1982 A/L**

a) When 8.00 g of a hydrated sulphate of $M_2SO_4 . xH_2O$ was heated which consists of x number of molecules in crystallized water, resulted 3.75 g of water and anhydrous sulphate.

(RAM; M = 23; S = 32; O = 16; H = 1)

i) Calculate the value of x.

(N.B. Marks are awarded only if the steps are shown used in the calculation)

.....

.....

.....

.....

.....

.....

.....

.....

ii) If 6.70 g of the above mentioned hydrated sulphate was dissolved in water and the volume of the solution was raised upto 200 cm^3, What is the concentration of M^+ ions in the solution in mol dm^{-3} ?

.....

.....

.....

.....

.....

(3) **1983 A/L**

a) A chlorohydrocarbon named *Y* contains 65% of chlorine and 33% carbon by mass. (The vapor density of Y = 54.5 and RMM of Y = 109, RAM of C = 12; H = 1; Cl = 35.5)

i) What is the empirical formula of *Y*?

.....

.....

.....

.....

.....

.....

.....

.....

ii) *Y* produces a precipitate with ammonical cuprous chloride. Write the structure of *Y* and name it according to the IUPAC method.

(4) **1983 A/L**

b) In a solution of a salt with a density of 1.03 g grams per militre at 300 *K*, contains salt 3.8% by mass. 75% of salt is sodium chloride and the rest is magnesium chloride.
(RAM Na = 23; Mg = 24; Cl = 35.5)

i) What is the concentration of sodium chloride in the solution in g cm^{-3}?

.....

.....

.....

.....

.....

ii) What is the Mg^{2+} concentration in the solution in mol dm^{-3} ?

.....

.....

.....

.....

.....

(5) **1984 A/L**

a) When an aqueous solution of the hydrate of a salt named *B* was reacted with an aqueous solution of sodium carbonate, carbon dioxide was released. From a quantitative analysis of the salt hydrate, following readings were obtained. Mass percentages (w/w) of Na = 10.07%; S = 14.06%; H = 5.74% and O = 70.13%. (Relative molecular mass of anhydrous B is 120)
(RAM : Na = 23; S = 32; O = 16; H = 1)

.....
.....
.....
.....
.....
.....
.....
.....
.....

(6) **1985 A/L**

a) A mixture of $Na_2CO_3.10H_2O$ and $NaHCO_3$ was heated until a constant mass was obtained. The total loss of mass in the mixture was 2.90 g and 1.10 g of it was dry CO_2. Calculate the mass of $Na_2CO_3.10H_2O$ in the initial solution.

.....
.....
.....
.....
.....
.....
.....
.....
.....
.....

(7) **1986 A/L**

a) i) How much volume of 2.5 mol dm^{-3} H_3PO_4 acid can be prepared by 9.8 cm^3 volume of viscous phosphoric acid provided? (Density of the viscous phosphoric acid is 1.9 g cm^{-3})
N.B. (Percentage of phosphoric acid in viscous phosphoric acid is 100%)

.....
.....
.....
.....
.....

ii) Calculate the required volume of 1.5 mol dm^{-3} $Ba(OH)_2$, to completely neutralize, 50 cm^3 volume of 2.5 mol dm^{-3} H_3PO_4 which is a tri basic acid

.....

.....

.....

.....

.....

.....

.....

(8) **1987 A/L**

a) i) A compound containing only *C*, *H* and *O* has 48.65% of carbon and 8.11% of hydrogen. Find the empirical formula of this compound.

.....

.....

.....

.....

.....

.....

.....

(9) **1987 A/L**

a) i) An element named *R* reacts with aqueous NaOH to produce hydrogen gas and Na_2RO_3 compound. Assuming the water too participate as a reactant, write down a balanced chemical equation for the reaction.

.....

ii) In the acidic medium per magnate (MnO_4^-) ions react with oxalate ions ($C_2O_4^{2-}$) to produce Mn^{2+} and CO_2 gas. State how do the oxidation numbers of manganese and carbon differ by filling the blanks appropriately in the following statements.

N B State the charge of oxidation numbers.

The oxidation number of Manganese become ..... to .....

The oxidation number of Carbon become ..... to .....

iii) By considering the change of the above oxidation numbers or another method, calculate the mass of $KMnO_4$ needed to react with 1.00 g of $Na_2C_2O_4$ completely in the acidic medium.

(Na = 23.0; K = 39.0; Mn = 54.9; O = 16.0; C = 12.0)

.....

.....

.....

.....

.....

(10) **1988 A/L**

a) i) State clearly what is meant by the 'empirical formula' of a compound.

.....

.....

.....

ii) A compound containing only carbon, hydrogen, nitrogen has, 57.14% of carbon and 40.00% of nitrogen. What is the empirical formula of the compound?
(C = 12; H = 1; N = 14)

.....

.....

.....

.....

.....

.....

.....

.....

(11) **1988 A/L**

a) Write down the balanced chemical equation for the reduction process takes place when $Cr_2O_7^{2-}$ and electrons react with each other. (Write the half ionic equation for the reduction process)

.....

b) Write down the balanced chemical equation for the oxidation of $Cr(OH)_3$ by NaOBr in the presence of NaOH.

.....

c) Although BF_3 molecule is planar, in $H_3N.BF_3$ complex BF_3 group is pyramidal. Briefly explain this observation.

.....

.....

.....

.....

.....

(12) **1989 A/L**

a) A compound contains 42.6% of carbon, 3.6% of hydrogen, 21.3% of nitrogen and oxygen only. If the relative molecular mass of the compound is around 200, determine the molecular formula of the compound. (C= 12; H =1; N = 14; O = 16)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(13) **1989 A/L**

a) i) What is the oxidation number of oxygen in K_2O_2? .....

(N.B. If there's a symbol for oxidation number, if should be stated clearly.)

ii) When oxygen gas is subjected for electric discharge under certain conditions, ozone gas produces. What is the oxidation number of oxygen in ozone?

.....

(N.B. If there's a symbol for oxidation number, if should be stated clearly.)

b) Write down the ionic equation for oxidation of I^- to I_2 by MnO_4^- in acidic medium.

.....

c) You are provided with 1.0 mol l^{-1} $Ba(OH)_2$ solution and 1.0 mol l^{-1} HCl solution. You are not provided with acid – base indicators electric appliances such as pH metres or conductive cells that can be used to measure or identify H^+ ions or OH^- ions.

Under these conditions, briefly explain how you would try to determine the stoichiometry of the reaction experimentally in between $Ba(OH)_2$ and HCl in the laboratory.

.....

.....

.....

.....

.....

.....

(14) **1990 A/L**

a) The compound *A* contains 51.7% of Carbon, 3.0% of Hydrogen 24.6% of Fluorine and Oxygen only. If the relative molecular mass of A is around 250, determine the molecular formula. (C = 12; H = 1; F = 19; O = 16)

.....

.....

.....

.....

.....

.....

.....

.....

(15) **1990 A/L**

c) i) Explain what is meant by the atomic mass unit.

.....

ii) Calculate the value of the atomic mass unit, if the Avogadro constant is 6.022×10^{23} mol $^{-1}$

.....

.....

.....

.....

.....

.....

(16) **1990 A/L**

a) Assume that the divalent metal named M react with H_2SO_4 to produce only the metal sulphate, hydrogen sulphide and water.
Write down the balanced chemical equation for this reaction.

.....

b) An alloy consists of Magnesium and Calcium only. A 1.000 g of this alloy reacts with dilute HCl to produce 0.784 l of hydrogen under STP. If the molar volume of hydrogen is 22.4 *l* under STP, calculate the percentage by mass of magnesium in the alloy.
(Mg = 24; Ca = 40)

.....

.....

.....

.....

.....

.....

.....

(17) **1991 A/L**

a) **A certain organic compound contains 60.8% carbon, 35.4% nitrogen and hydrogen only. If the relative molecular mass of the compound is around 170, determine the molecular formula of the compound. (H = 1; C = 12; N = 14)**

.....

.....

.....

.....

.....

.....

.....

.....

(18) **1991 A/L**

a) i) **Write down a balanced chemical equation to show that $Zn(OH)_2$ react as an acid.**

N. B. Balanced chemical equation should be written.

.....

ii) **Write down a balanced chemical equation for the reduction process when MnO_4^- and electrons are allowed to react with each other in the acidic medium. (Write down the half – ionic equation for this reaction.)**

.....

b) **The trivalent metal M react with dilute HNO_3 to produce NH_3. With the excess HNO_3 present in the reactant mixture, NH_3 reacts to produce NH_4NO_3. Assuming that the other products of the reaction are metal nitrate and water, write down the balanced chemical equation for the reaction.**

.....

c) **A mixture of NaBr and KBr was dissolved in water, and dilute HNO_3 and aqueous $AgNO_3$ was added to analyse quantitatively. A 0.325 g of this mixture produced 0.564 g of AgBr. Calculate the molar percentage of KBr in this mixture. (Na = 23; K = 39, Br = 80; Ag = 108)**

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Essay

a) A certain organic compound contains 31.4% of carbon, 1.3% hydrogen and 18.3% of oxygen only. The relative molecular mass of the compound is around 250. Determine the molecular formula of the compound. (H = 1; C = 12; N = 14; O = 16)

.....

.....

.....

.....

.....

.....

(20) 1992 A/L

a) i) Define the term Relative Molecular Mass.

.....

.....

ii) Write down the chemical formulae of the following compounds in the given boxes.

(Magnesium phosphate)	
(Ferric thiosulphate)	

b) An alloy contains Magnesium, Aluminium and Copper. A 0.600 g sample of the alloy was reacted with dilute NaOH first. The obtained H_2 gas volume at STP was 336 cm^3. The metallic residue remained from this reaction was reacted with dilute HCl. The H_2 gas volume formed was 112 cm^3 at STP. Calculate the percentage by mass of Magnesium and Aluminium in the alloy.
Molar volume of Hydrogen at STP is 22.4 dm^{3-1} (RAM : Mg = 24; Al = 27)

.....

.....

.....

.....

.....

.....

.....

.....

.....

21) **1993 A/L**

a) A is a compound with the molecular formula RCOOH. *R* contains only carbon and hydrogen. When *A* is completely burnt, CO_2 and H_2O were resulted in 44 : 9 mass ratio. If the relative molecular formula of A is around 160, determine the molecular formula of *A*. (C = 12; H = 1; O = 16)

.....

.....

.....

.....

.....

(22) **1993 A/L**

a) Write down the balanced chemical equation for the oxidation process of $C_2O_4^{2-}$ ions by CrO_4^{2-} in acidic medium.

.....

(23) **1994 A/L**

a) Following is the stoichiometric equation for the combustion of the gaseous hydrocarbon with the molecular formula C_xH_y

$C_xH_y(g) + (x + y/4)\,O_2(g) \rightarrow x\,CO_2(g) + y/2\,H_2O(l)$

i) What is the ratio of the volume of CO_2 produced and the volume of hydrocarbon consumed in this combustion reaction?

.....

.....

ii) In which number the gaseous molecules will reduce when this reaction is taken place?

.....

.....

iii) A 5 cm^3 of the above gaseous hydrocarbon and 45 cm^3 of oxygen gas were mixed together. This mixture was ignited by an electrical method, and it was allowed to cool. Then it was observed that the total volume is 35 cm^3. When this gaseous mixture was treated with a solution of concentrated KOH, the new volume of the gaseous mixture turned to be 20 cm^3. Determine the molecular formula of the compound, assuming that all of the above volumes were measured at STP.

.....

.....

.....

.....

(24) **1994 A/L**

a) Define the Relative Atomic Mass.

.....

.....

(25) **1994 A/L**

a) Assume tetravalent metal *M*, reacts with nitric acid to produce ammonium nitrate as one product. Write down the balanced chemical equation for this reaction.

.....

b) A 0.511 g of a mixture containing $CaCO_3$ and $(NH_4)_2CO_3$ was heated thoroughly to decompose completely. The mass of the residue resulted was 0.098 g. Calculate the $CaCO_3 : (NH_4)_2CO_3$ ratio in the mixture. (H = 1; C = 12; N = 14; O = 16; Ca = 40)

.....

.....

.....

.....

.....

.....

.....

(26) **1995 A/L**

a) The organic compound named *A* contains only *C*, *H* and *O*. *A* molecule of *A* contains two carboxylic groups and found no other functional groups. When A is burnt, CO_2 and H_2O were produced in 2 : 1 molar ratio. The relative molecular formula of A is around 115. Determine the molecular formula of *A*.
(C = 12; H = 1; O = 16)

.....

.....

.....

.....

.....

.....

.....

.....

.....

(27) **1995 A/L**

a) Assume the trivalent metal X, reacts with sulphuric acid to produce only the metal sulphate, Hydrogen supplied and water. Write down the balanced chemical equation for this reaction.

.....

b) An alloy contains only Nickel and Silver A 0.258 g of this alloy was heated with excess sulphur for complete reaction. Afterwards, this reactant mixture was heated thoroughly and the unreacted sulphur was removed completely. The mass of resulted sulphide mixture was 0.336 g. Calculate the molar fraction of Nickel in the alloy. (Ni = 59; Ag = 108; S = 32)

.....

.....

.....

.....

.....

.....

.....

.....

.....

(28) **1996 A/L**

a) The organic compound, A contains only C, H and N. When a certain mass of the compound A was subjected to appropriate combustion, carbon dioxide and water were obtained in the mole ratio of 4 : 3. Nitrogen was also obtained in this combustion. The accurate relative molecular mass of A is exactly 164. Determine the molecular formula of A.
($C = 12$; $H = 1$; N = 14)

.....

.....

.....

.....

.....

.....

(29) **1996 A/L**

a) When iodine reacts with excess chlorine water, HIO_3 and HCl are produced. Write down the balanced chemical equation for this reaction.

.....

b) A 0.305 g sample of a mixture containing solid anhydrous sodium bicarbonate and solid anhydrous sodium carbonate was heated thoroughly. The obtained residue was dissolved in water and excess aqueous calcium chloride was added. The resulted precipitate of calcium carbonate was filtered, dried and was weighed. The mass of this calcium carbonate was 0.200 g. Calculate the molar ratio of sodium bicarbonate and sodium carbonate in the above mixture. (H = 1; Na = 23; Ca = 40; O = 16; C = 12)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(30) **1997 A/L**

a) The organic compound P contains 47.4% carbon, 2.63% hydrogen, 18.4% nitrogen and oxygen only. The relative molecular mass of P is about 150. Determine the molecular formula of P. (H = 1; N = 14; O = 16; C = 12)

.....

.....

.....

.....

.....

.....

.....

.....

(31) **1997 A/L**

a) Balance the following chemical changes, relative to difference atoms and electrical charges.

i) $C_2O_4^{2-} \longrightarrow CO_2 + ...$

ii) $CrO_4^{2-} + ... H^+ + ... \longrightarrow Cr^{3+} + ... H_2O$

b) Write down the balanced chemical equation for the reaction when K_2CrO_4, $K_2C_2O_4$ and aqueous H_2SO_4 heated together, using the balanced equations obtained above or another method.

.....

(32) **1998 A/L**

a) *Y* is a gaseous hydrocarbon 15 cm^3 of *Y* was mixed with as excess of oxygen gas. This mixture was ignited by an electrical method, and it was allowed to attain normal temperature and pressure.
Then it was observed that the volume of the gaseous mixture decreased by 30cm^3. When this gaseous mixture was treated with a solution of concentrated KOH, the volume of the gaseous mixture decreased further by 45 cm^3. Calculate the molecular formula of *Y* in the usual manner.
N.B. Assume that all of the above volumes were measured at s.t.p.

.....
.....
.....
.....
.....
.....
.....
.....
.....

(33) 1998 A/L

a) i) Define the term. "Avagadro constant"

.....
.....

ii) Write the numerical value of the Avagadro constant.

.....

iii) If there's a unit pertaining to the above value, indicate it below. If there's no unit, state that fact below, specifically.....

(34) 1998 A/L

a) i) Write the balanced chemical equation for the complete precipitation reaction occurring between aqueous H_3PO_4 and aqueous $Ba(OH)_2$.

.....

ii) Calculate the volume of 0.2 mol dm^{-3} aqueous $Ba(OH)_2$ solution required for the complete precipitation of PO_4^{3-} ions obtainable from 25 cm^3 of 0.12 mol dm^{-3} aqueous H_3PO_4 solution.

.....
.....
.....
.....
.....
.....
.....

(35) 1999 A/L

a) The organic compound, *Y* contains *C*, *H* and *O* only. When *Y* is subjected to complete combustion, CO_2 and H_2O are obtained in the mole ratio of 2 : 1, respectively. The accurate relative molecular mass of Y is equal to 152. The percentage of O in Y is less than 40% by weight. Determine the molecular formula of *Y*.

The relevant relative atomic masses are as follows:

(C = 12.0; H = 1.00; O = 16.0)

.....
.....
.....
.....
.....
.....
.....
.....

(36) 1999 A/L

a) i) Define the term, 'atomic mass unit' (amu)

.....

ii) It is possible that the mass of a certain molecule of carbon dioxide supplied to you is not equal to 44.0 amu. Give two reasons for this possibly.

.....
.....

(37) **1999 A/L**

a) Assume that $Na_2S_2O_3$ reacts with HNO_3 under a certain condition forming NO_2, $NaHSO_4$ and water only. Write a balanced chemical equation for this reaction, either by considering the relevant oxidation numbers or by another method.

.....

b) A finely powdered mixture has been prepared so that the $CaCO_3$: $MgCO_3$ mole ratio is 1 : X. It contains no other substances. 1.30 g of this mixture was heated strongly, until it was converted completely into CaO and MgO. The mass of the mixture of oxide thus obtained was 0.640 g.
The relative atomic masses relevant here are as follows.
Ca = 40.0; Mg = 24.0; O = 16.0; C = 12.0

i) Now consider *P*, *Q*, *R* and *S* in the mathematical expression given below.

$$\frac{100 + P \times X}{Q + R \times X} = \frac{1.30g}{S}$$

Write the values appropriate for *P*, *Q*, *R* and *S* in the table provided below.

P	
Q	
R	
S	

ii) Substitute these values appropriately in the mathematical expression given above, and calculate the value of *x*.

.....

.....

.....

(38) **2000 A/L**

a) When a Mn^{2+} salt is heated with PbO_2 in acid medium, a purple coloured solution is formed and PbO_2 is converted to Pb^{2+}.

i) Write down below the relevant balanced ionic half reactions.

.....

.....

ii) Write down below the stoichiometry between Mn^{2+} and PbO_2.

Mn^{2+} : PbO_2 ..... : .....

b) Calcium oxalate is converted to calcium carbonate, on heating according to the equation.

$$CaC_2O_4(s) \longrightarrow CaCO_3(s) + CO(g)$$

Incomplete thermal decomposition of 2.00 g of pure $CaC_2O_4(s)$ yielded 1.78 g of the product. This product contained $CaCO_3$ and undecomposed CaC_2O_4. Calculate below the mass of undecomposed CaC_2O_4 remaining in the product.
(Relative atomic masses : Ca = 40; O = 16; C = 12)

.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....

(39) 2001 A/L

a) A compound *X* of molecular formula $C_8H_{18}O_6$ contains hydroxyl groups. When *X* is reacted with excess ethanol chloride, the product obtained has a relative molecular mass of 378. Calculate the number of hydroxyl groups in *X*.
(Relative atomic masses : C = 12; H = 1; O = 16; Cl = 35.5)

.....
.....
.....
.....
.....
.....
.....
.....

(40) 2001 A/L

a) On complete thermal decomposition in an inert environment, an inorganic salt *X* gave 1.52 g of Cr_2O_3, 0.72 g of H_2O and 0.28 g of N_2 as the only products.
(Relative atomic masses : H = 1; N = 14; O = 16; Cr = 52)

i) Deduce the empirical formula of *X*.

.....
.....
.....
.....
.....
.....

ii) One mole of *X* contains two moles of Cr. Compound *X* does not contain H_2O molecules. Identify below the cation and anion present in *X*.

cation ..... Anion .....

iii) Write below the chemical formula of *X*.

.....

b) i) **Z is a metallic element.**
Oxalate ($C_2O_4^{2-}$) ions are converted to CO_2 by ZO_4^- ions in an acidic medium.
ZO_4^- ions are converted to ZO^+ ions during this reaction.
Write below the relevant balanced ionic half reactions.

.....

.....

ii) **Write below the stoichiometry of the above reaction between $C_2O_4^{2-}$ and ZO_4^- ions.**
$C_2O_4^{2-} : ZO_4^-$

.....

(41) **2002 A/L**

a) **A place of pure magnesium was completely burnt in a mixture of N_2 and O_2 and the mix of MgO and Mg_3N_2 so obtained had a mass of 1.8 g. When this mixture was heated with excess water and the product obtained ignited, only MgO was formed. The mass of this MgO was 2.0 g.**
Write balanced chemical equations for all the relevant reactions (Ignore the reaction between MgO and H_2O)

.....

.....

.....

.....

Calculate the mole ratio MgO : Mg_3N_2 in the mixture formed by burning the piece of magnesium. (Mg = 24; O = 16; N = 14)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

b) **6 moles of I^- ions react completely with one mole of $M_2O_7^{2-}$ ions in acidic medium, forming I_2 and M^{n+}. What is the value of *n* in M^{n+}?** .....
Write down the balanced equation representing the half reaction for the conversion of $M_2O_7^{2-}$ to M^{n+}

.....

(42) **2003 A/L**

a) When a sample of potassium hydrogen oxalate, $\begin{matrix}COOH\\|\\COOK\end{matrix} . x\ H_2O$ was heated srongly CO, CO_2, 1.38 g of K_2CO_3 and 0.90 g of H_2O were obtained as the only products.

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

.....

ii) Calculate the value of x, (K = 39.0; H = 1.0; C = 12.0; O = 16.0)

.....

.....

.....

.....

.....

.....

b) When NH_4NO_3 is heated, it gives N_2O and H_2O as the only products. Write balanced chemical equations for the relevant oxidation and reduction half reactions.

i) Oxidation half reaction.

.....

ii) Reduction half reaction.

.....

(43) **2004 A/L**

a) i) $CrO_3(s)$ when heated decomposes to give $Cr_2O_3(s)$ and $O_2(g)$ as the only products, 0.4000 g of a sample of CrO_3 contaminated with Cr_2O_3 when heated gave 0.3184 g of Cr_2O_3. Calculate the mass percentage of CrO_3 in the sample. (Cr = 52.0; O = 16.0)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

ii) Write a balanced equation for the ionic half reaction corresponding to the conversion of Cr_2O_3 to CrO_4^{2-} in basic medium.

.....

(44) 2005 A/L

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*.

.....

.....

.....

.....

.....

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

.....

.....

.....

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

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

.....

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

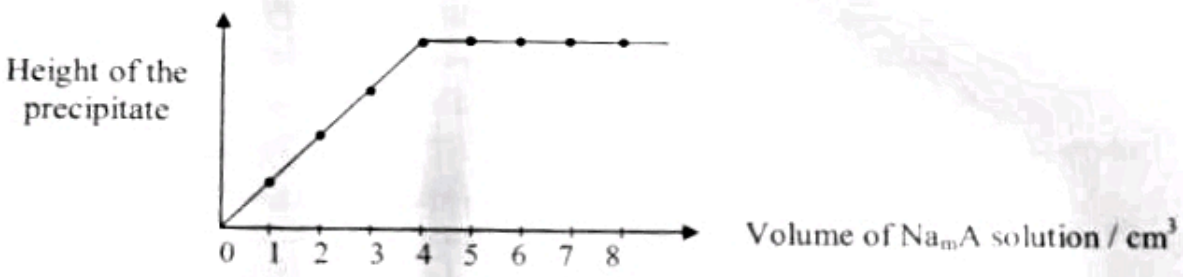
.....

.....

(45) 2006 A/L

a) **MCl_n and Na_mA are two water soluble salts. Aqueous solutions of these react together forming an immediate precipitate M_mA_n'**

In an experiment to determine the stoichiometry of this reaction, 9 cm^3 portions of 0.2 mol dm^{-3} MCl_n solution were mixed, in test tubes, with varying volumes of 0.3 moldm^{-3} Na_mA solution, and the height of the precipitate after the precipitate had settled down, was measured. The results are given in the following graph.



i) Deduce the stoichiometry of the reaction.

.....

.....

.....

.....

.....

.....

.....

ii) Is the above method suitable for determining the stoichiometry of the reaction between $Al_2(SO_4)_3$ and NH_4OH?
Yes / No (Delete the inappropriate word)
Give two reasons to support your answer.

.....

.....

.....

(46) **2007 A/L**

a) i) Magnetic, Fe_3O_4 is a mixed oxide of iron. Write the formulae of the constituent oxides of this mineral.

.....

ii) A mixture contains Fe_2O_3 and Fe_3O_4. A 5.52 g sample of this mixture when dissolved in dil. H_2SO_4 required 20.0 cm^3 of 0.10 mol dm^{-3} $KMnO_4$ for complete reaction. (Fe = 56, O = 16) Calculate the molar ratio Fe_2O_3 : Fe_3O_4 in the mixture.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

iii) Calculate the maximum mass of iron that can be extracted from 1.0 kg of the mixture in ii).

.....

.....

.....

.....

.....

(47) **2007 A/L**

a) The elements present in an organic compound A and their mass percentages are given below.

	C	H	N	Cl
mass %	55.6	6.2	10.8	27.4

i) Deduce the empirical formula of A (C = 12, H = 1.0, N = 14, Cl = 35.5)

.....

.....

.....

.....

.....

.....

ii) A is soluble in water and the solution is acidic. An aqueous solution containing 1.30 g. A required 25.0 cm^3 of 0.40 mol dm^{-3} NaOH solution when titrated using phenol phenopthalein as the indicator. Determine the relative molar mass of A.
(1 mol of A reacts with 1 mol of NaOH)

.....

.....

.....

.....

.....

iii) Write the molecular formula of *A*.

.....

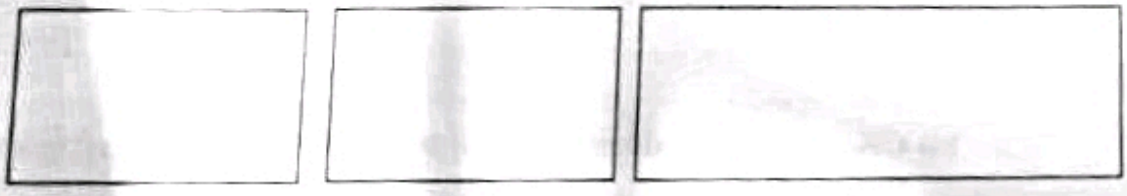
.....

.....

iv) A undergoes the following reaction.

$$A \xrightarrow[0 - 5\ ^\circ C]{\text{aq. } NaNO_2} B \xrightarrow[0 - 5\ ^\circ C]{C_6H_5OH,\ \text{aq. NaOH}} C$$

Further, an aqueous solution of A gives a white precipitate with $AgNO_3$ solution. Write the structures of A, B and C in the relevant cages.



A B C

(48) **2008 A/L**

a) A sample of Na_2SO_4 is contaminated with some NaCl. The following procedure was used to determine the percentage of NaCl in the sample.
1.000 g of the sample was dissolved in water in a 250 cm^3 volumetric flask and diluted upto the mark to form the solution *A*.
The following solutions (1) – (5) were prepared by diluting a 4.0×10^{-4} mol dm^{-3} Cl^- ion solution.

	(1)	(2)	(3)	(4)	(5)
4.0×10^{-4} mol dm^{-3} Cl^- ion solution/cm^3	1.00	2.00	3.00	4.00	5.00
Distilled water cm^3	9.00	8.00	7.00	6.00	5.00

Into each of the solutions (1) – (5), 1.00 cm^3 of dil. HNO_3 and 1.00 cm^3 of $AgNO_3$ were added. Similarly into 10.00 cm^3 of solution A, 1.00 cm^3 dil. HNO_3 and 1.00 cm^3 $AgNO_3$ were added.
It was observed that the turbidity produced by solution A was equal to that of solution (3).
Calculate the mass percentage of NaCl in the sample of Na_2SO_4 (Na = 23.0, Cl = 35.5)

.....
.....
.....
.....
.....
.....
.....

(49) **2009 A/L**

a) An industrially important organic compound *X*, contains carbon, hydrogen and oxygen only.
i) Write a balanced chemical equation for the complete combustion of *X* taking its molecular formula as $C_xH_yO_z$.

.....

ii) The combustion of 62 mg of X (relative molecular mass, of (M = 62) gives 88 mg of CO_2 and 54 mg of H_2O. Deduce values for X, Y and Z in the molecular formula $C_xH_yO_Z$ (C = 12.0 H = 1.0, O = 16.0)

.....
.....
.....
.....
.....
.....
.....
.....

iii) The reaction of 62 mg of *X* with sodium gives 2 mg of hydrogen gas. Deduce the structure of *X*.

.....

.....

.....

.....

.....

.....

.....

.....

(50) **2009 A/L**

a) Define "atomic mass unit"

.....

c) $^{4}_{2}X + \_\_\_ {}^{}_{4}Be \rightarrow {}^{12}_{6}C + \_\_\_ Y$

i) Fill in the blanks denoted by dotted lines (.....) at three places in the above equation.

ii) Identify *X* and *Y*.

X = ... Y = ...

(51) **2009 A/L**

a) $X.H_2O$ is a white crystalline salt. The elements present in *X* and their mass percentages are given below.

Element	C	H	N	O
Mass %	19.4	6.4	22.6	51.6

(C = 12.0, H = 1.0, N = 14.0, O = 16.0)

i) Deduce the empirical formula of X.

.....

.....

.....

.....

.....

.....

.....

ii) On heating, one mole of *X* produces two moles of NH_3 as the only nitrogen containing product. Write the molecular formula of *X*.

.....

iii) A warm aqueous solution of *X* decolorizes an acidified $KMnO_4$ solution. Write the chemical name of *X*.

.....

(52) **2010 A/L**

b) *X* and *Y* are two elements in the same period of the periodic table where the atomic number of *X* is less than the atomic number of *Y*. The chlorides that are formed by X and *Y* with the maximum number of chlorine atoms are XCl_3 and YCl_5.

i) Write the chemical symbols of *X* and *Y*.

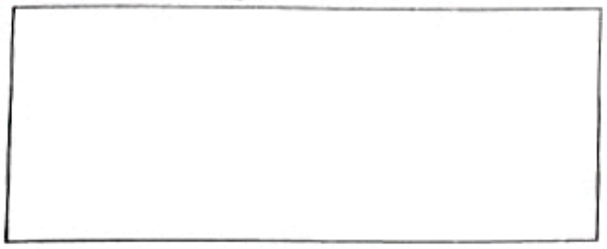
X : ..... Y : .....

ii) Name the shapes of XCl_3 and YCl_5 molecules.

.....

.....

iii) XCl_3 reacts with YH_3 forming the compound *Z*. Draw the structure of *Z* in the box given below showing all the bonds.



iv) Name the shapes (spatial arrangement of bonds) around *X* and *Y* in the molecule *Z*.

X ..... Y .....

(53) **2010 A/L**

a) An alloy contains elements Mg and Al. The minimum volume of 3.60 mol dm^{-3} HCl that is required to completely dissolve a sample of the alloy of mass 0.396 g is 10.0 cm^3. Calculate the mass percentage of Mg in the alloy. (Mg = 24, Al = 27)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....