

Q1. Calculate the percentage of naturally occurring isotopes  $^{35}\text{Cl}$  and  $^{37}\text{Cl}$  that accounts for the atomic mass of chlorine taken as 35.45.

Q2. How many significant figures should be present in the answer of the following calculations?

$$\frac{2.5 \times 1.25 \times 3.5}{2.01}$$

Q3. What is the mass per cent of carbon in carbon dioxide?

Q4. Chlorine is prepared in the laboratory by treating manganese dioxide ( $\text{MnO}_2$ ) with aqueous hydrochloric acid (HCl) according to the reaction.



How many grams of HCl react with 5.0 g of manganese dioxide? [Atomic mass of Mn = 55u]

Q5. Calculate the molarity of a solution of ethanol in water in which the mole fraction of ethanol is 0.040.

Q6. How many moles of iron can be made from  $\text{Fe}_2\text{O}_3$  by the use of 16 moles of carbon monoxide in the following reaction?



Q7. (a) A sample of phosphorus trichloride ( $\text{PCl}_3$ ) contains 1.4 moles of the substance. How many atoms are there in the sample?

(b) How many grams of NaOH will be required to neutralise 12.2 g of benzoic acid?

Q8. (a) The cost of table salt ( $\text{NaCl}$ ) and table sugar ( $\text{C}_{12}\text{H}_{22}\text{O}_{11}$ ) is Rs. 2 per kg and Rs. 6 per kg, respectively. Calculate their costs per mol.

(b) Calculate the concentration of sugar ( $\text{C}_{12}\text{H}_{22}\text{O}_{11}$ ) in  $\text{mol L}^{-1}$  if its 20 g are dissolved in enough water to make a final volume upto 2L.

Q9. Define molarity. What will be the molarity of solution which contains 5.85 g of  $\text{NaCl}(\text{s})$  per 500 mL?

Q10.(a) Calculate the mass of  $112 \text{ cm}^3$  of hydrogen at STP.

(b)  $9.7 \times 10^{17}$  atoms of iron weigh as much as 1 cc of  $\text{H}_2$  at STP. What is the atomic mass of iron?

Q11. (a) What is the percentage of cation in ammonium dichromate?

(b) Calculate the number of moles of oxygen present in 1 L of air under standard conditions, if air contains 21% oxygen.

Q12. (a) Calculate the total number of electrons present in 2.8 g of nitrogen gas.

(b) How many oxygen atoms contained in 53 g of  $\text{Na}_2\text{CO}_3$ ?

- Q13. (a) If one atom of an element weighs  $1.8 \times 10^{-22}$  g. What is its atomic mass?  
(b) Calculate the mass of  $\text{BaCO}_3$  produced when excess of  $\text{CO}_2$  is bubbled through a solution of 0.205 mol  $\text{Ba(OH)}_2$ .

Q14. What will be the molality of the solution containing 18.25 g of HCl gas in 500 g of water?

- Q15. (a) How much copper can be obtained from 100 g of copper sulphate ( $\text{CuSO}_4$ )?  
(b) The mass of one litre of oxygen at standard conditions of temperature and pressure is 1.43 g and that of one litre of  $\text{SO}_2$  is 2.857 g. What is the mass in grams of a single molecule of  $\text{SO}_2$ ?  
(c) Hydrogen gas is prepared in the laboratory by reacting dilute HCl with granulated zinc, following reaction takes place:



Calculate the volume of hydrogen gas liberated at STP when 32.65 g of zinc reacts with HCl. [Atomic mass of zinc is 65.34]

- Q16. (a) A gas is found to have a formula  $(\text{CO})_x$ . Its vapour density is 70. What is the value of  $x$ ?  
(b) For the reaction,  $\text{Fe}_2\text{O}_3 + 3\text{CO} \longrightarrow 2\text{Fe} + 3\text{CO}_2$ , what is the volume of carbon monoxide required to reduce one mole of ferric oxide?  
(c) Calculate the amount of  $\text{H}_2\text{S}$  required to precipitate 1.69 g  $\text{BaS}$  from  $\text{BaCl}_2$  solution.

Q17. In an organic compound, C, H and N are present in 9 : 1 : 3.5 ratio by weight. If molecular weight of the compound is 108, then calculate the molecular formula of the compound.

Q18. A compound containing sodium, sulphur, hydrogen and oxygen gave the following result on analysis : Na = 14.28%, S = 9.92% and H = 6.20%.

If all the atoms of hydrogen in the compound are present in combination with oxygen as water of crystallisation, what is the structure of the anhydrous compound? The molecular mass of crystalline salt is 322.

- Q19. (a) A gaseous hydrocarbon on combustion gives 0.72 g of water and 3.08 g of  $\text{CO}_2$ . What is the empirical formula of the hydrocarbon?  
(b) How many moles of magnesium phosphate,  $\text{Mg}_3(\text{PO}_4)_2$  will contain 0.25 mole of oxygen atoms?  
(c) How many moles of electron weigh one kilogram?

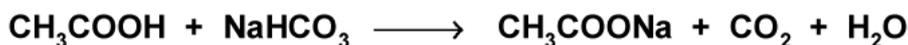
Q20. Consider the reaction:



What mass of  $\text{MgCl}_2$  will be formed when 250 mL of 0.76 M HCl reacts with 1000 g  $\text{MgCO}_3$ ? Name the limiting reagent. Calculate the number of moles of  $\text{MgCl}_2$  formed in the reaction.

- Q21. (a) If 6.3 g of  $\text{NaHCO}_3$  are added to 15.0 g of  $\text{CH}_3\text{COOH}$  solution, the residue is found to weigh 18.0 g. What is the mass of  $\text{CO}_2$  released in the reaction? Also, find the mass of unreacted reactant, if any.

Consider the chemical reaction involved



- (b) The gas has molecular formula  $(\text{CH})_n$ . If vapour density of the gas is 39, what should be the molecular formula of the compound?

- Q22. (a) A sample of nitric acid is 69% by mass and it has a concentration of  $15.44 \text{ mol L}^{-1}$ . Calculate its density.
- (b) Calculate the amount of silver obtained (in g) on strongly heating 2.76 g of  $\text{Ag}_2\text{CO}_3$ .
- (c) Calculate the amount of  $\text{CuCl}_2$  which is required to get 1.0 g of copper after reaction with aluminium. (Cu = 63.5, Cl = 35.5, Al = 27)
- Q23. In Ostwald's process for the manufacturing of nitric acid, the first step involves the oxidation of ammonia gas by oxygen gas to give nitric oxide gas and steam. What is the maximum weight of nitric oxide that can be obtained starting only with 10.0 g of ammonia and 20.0 g of oxygen?
- Q24. An organic compound containing carbon and hydrogen has 49.3% carbon, 6.84% hydrogen and its vapour density is 73. What is the molecular formula of the compound?
- Q25. (a) An organic compound having molecular mass 60 is found to contain C = 20%, H = 6.67% and N = 46.67% while rest is oxygen. On heating, it gives  $\text{NH}_3$  along with a solid residue. The solid residue gives violet colour with alkaline copper sulphate solution. Find out the structure of the compound.
- (b) Formic acid is a stronger acid than acetic acid. Why?

SMARTACHIEVERS LEARNING Pvt. Ltd.  
www.smartachievers.in

**S1.** Suppose  $^{35}\text{Cl}$  present =  $x\%$ , therefore  $^{37}\text{Cl}$  present =  $(100 - x)\%$

$$\therefore \text{Average atomic mass} = \frac{35x + (100 - x) \times 37}{100} = 35.45$$

$$\text{or} \quad 35x + 3700 - 37x = 3545$$

$$2x = 155$$

$$x = 77.5\%$$

$$^{35}\text{Cl} = 77.5\%$$

$$\text{and} \quad ^{37}\text{Cl} = 100 - 77.5 = 22.5\%$$

**S2.** Least precise term 2.5 or 3.5 has two significant figures. Hence, the answer should also have two significant figures.

**S3.** Here, Molecular mass of  $\text{CO}_2 = 1 \times 12 + 2 \times 15 = 44 \text{ g}$

1 g molecules of  $\text{CO}_2$  contains 1 g atom of carbon

$\therefore$  44 g of  $\text{CO}_2$  contains = 12 g atoms of carbon

$$\therefore \quad \% \text{ of C in } \text{CO}_2 = \frac{12}{44} \times 100 = 27.27\%$$

Hence, the mass per cent of carbon in  $\text{CO}_2$  is 27.27%.

**S4.** According to the reaction, 1 mole of  $\text{MnO}_2$ , i.e., 87 g [55 + 32] of  $\text{MnO}_2$  react with 4 moles of HCl, i.e., [4 × 36.5] = 146 g of HCl.

$$\text{Thus, 5 g of } \text{MnO}_2 \text{ will react with HCl} = \frac{146}{87} \times 5.0 = 8.40 \text{ g.}$$

**S5.**

$$X_{\text{C}_2\text{H}_5\text{OH}} = \frac{n_{\text{C}_2\text{H}_5\text{OH}}}{n_{\text{C}_2\text{H}_5\text{OH}} + n_{\text{H}_2\text{O}}}$$

Then, find out the molarity of a solution of ethanol means the number of moles of ethanol in 1 L of the solution, i.e., 1 L of water.

$$\text{Number of moles in 1 L of water} = \frac{1000 \text{ g}}{18 \text{ g mol}^{-1}} = 55.55 \text{ moles}$$

$$\therefore \quad X_{\text{C}_2\text{H}_5\text{OH}} = 0.040 = \frac{n_{\text{C}_2\text{H}_5\text{OH}}}{n_{\text{C}_2\text{H}_5\text{OH}} + 55.55}$$



**S10. (a)** 1 mol of  $H_2 = 2 \text{ g} = 22400 \text{ cm}^3$  at STP

Thus,  $22400 \text{ cm}^3$  of  $H_2$  at STP has mass = 2 g

$$\therefore 112 \text{ cm}^3 \text{ of } H_2 \text{ at STP will have mass} = \frac{2}{22400} \times 112 = 0.01 \text{ g}$$

(b) Mass of 1 cc of  $H_2$  at STP =  $\frac{2}{22400} = 9.0 \times 10^{-5} \text{ g}$

$$\therefore 9.7 \times 10^{17} \text{ atoms of iron have mass} = 9.0 \times 10^{-5} \text{ g}$$

$$\therefore \text{Mass of one mole, i.e., } 6.02 \times 10^{23} \text{ atoms of Fe} = \frac{9.0 \times 10^{-5} \times 6.02 \times 10^{23}}{9.7 \times 10^{17}} = 55.9 \text{ g.}$$

**S11. (a)** Molecular formula of ammonium dichromate is  $(NH_4)_2Cr_2O_7$ .

$$\text{Molecular weight} = 2 \times (14 + 4) + 2 \times 52 + 7 \times 16 = 252$$

Number of parts of cation by weight, i.e.,  $2NH_4^+$

$$= 2 \times (14 + 4) = 36$$

$$\% \text{ of } NH_4^+ = \frac{36}{252} \times 100 = 14.29\%$$

(b)  $\therefore$  Air contains 21% oxygen.

$$\therefore \text{Volume of oxygen} = \frac{21}{100} = 0.21 \text{ L}$$

$\therefore$  Number of moles of oxygen present in 0.21 L at

$$\text{STP} = \frac{\text{Volume at STP}}{22.4 \text{ Lit}} = \frac{0.21}{22.4} = 0.00937$$

**S12. (a)** Given,

$$2.8 \text{ g of } N_2 = \frac{2.8}{28} \text{ mol} = 0.1 \text{ mol}$$

$$1 \text{ mol of } N_2 = 6.02 \times 10^{23} \text{ molecules}$$

$$0.1 \text{ mol of } N_2 = 6.02 \times 10^{23} \times 0.1 \text{ molecules}$$

$$= 6.02 \times 10^{22} \text{ molecules}$$

As, 1 molecules of  $N_2$  contains 14 electrons, therefore,

$$6.02 \times 10^{22} \text{ molecules contain} = 6.022 \times 10^{22} \times 14 = 8.43 \times 10^{23} \text{ electrons.}$$

(b) 106 g of  $Na_2CO_3 = 1 \text{ mole of } Na_2CO_3$

$$\therefore 53 \text{ g of } Na_2CO_3 = \frac{53}{106} \text{ mole of } Na_2CO_3$$

Now, 1 mole of  $Na_2CO_3$  contains = 3 moles of O-atoms

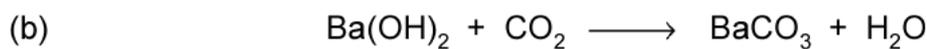
$$\therefore \frac{53}{106} \text{ mole of } Na_2CO_3 \text{ contains} = 3 \times \frac{53}{106} \text{ mole of O-atoms}$$

As, 1 mole of O-atom =  $6.02 \times 10^{23}$  atoms

$$\begin{aligned} \therefore 3 \times \frac{53}{106} \text{ mol of O-atoms} &= 6.02 \times 10^{23} \times 3 \times \frac{53}{106} \\ &= 9.03 \times 10^{23} \text{ O-atoms.} \end{aligned}$$

**S13. (a)** Given, Mass of 1 atom =  $1.8 \times 10^{-22}$  g  
 Mass of  $6.023 \times 10^{23}$  atoms =  $6.02 \times 10^{23} \times 1.8 \times 10^{-22}$  g  
 $= 6.02 \times 1.8 \times 10 \text{ g} = 108.36 \text{ g}$

Hence, atomic mass of element = 108.36 g.



$\therefore$  1 mol of  $\text{Ba(OH)}_2$  gives 1 mol of  $\text{BaCO}_3$ .

$\therefore$  0.205 mol of  $\text{Ba(OH)}_2$  will give 0.205 mol of  $\text{BaCO}_3$ .

$$\begin{aligned} \text{Weight of 0.205 mol of BaCO}_3 &= 0.205 \times 197 \\ &= 40.385 \text{ g.} \end{aligned}$$

**S14.** Molality is defined as the number of moles of solute present in 1 kg of solvent. It is denoted by m.

Thus, 
$$\text{Molality (m)} = \frac{\text{Moles of solute}}{\text{Mass of solvent (in kg)}} \quad \dots (i)$$

Given that, Mass of solvent ( $\text{H}_2\text{O}$ ) = 500 g = 0.5 kg

Weight of HCl = 18.25 g

Molecular weight of HCl = 1 + 1 + 35.5 = 36.5 g

$$\text{Moles of HCl} = \frac{18.25}{36.5} = 0.5$$

$\therefore$  
$$\text{Molality (m)} = \frac{0.5}{0.5} = 1 \text{ m} \quad \text{[From Eq. (i)]}$$

**S15. (a)** Molar mass of  $\text{CuSO}_4$  = 63.54 + 32.06 + (4 × 16) = 159.6 g mol<sup>-1</sup>

159.6 g of  $\text{CuSO}_4$  contains = 63.54 g of Cu

$$1 \text{ g of CuSO}_4 \text{ contains} = \frac{63.54}{159.6} \text{ g of Cu}$$

$\therefore$  100 g  $\text{CuSO}_4$  contains =  $\frac{63.54 \times 100}{159.6} \text{ g} = 39.812 \text{ g.}$

(b) Number of molecules of  $\text{SO}_2$  = Number of moles of  $\text{SO}_2$  ×  $6.022 \times 10^{23}$

$$= \frac{1}{22.4} \times 6.022 \times 10^{23} \text{ molecules}$$

$$\text{Mass of SO}_2 = \frac{2.857}{6.01 \times 10^{23}} \times 22.4 = 1,0629 \times 10^{-22} \text{ g.}$$

- (c) As, 1 mol of Zn liberates = 1 mol of H<sub>2</sub>  
 or 65.3 g of Zn liberates = 22.4 L of H<sub>2</sub> STP

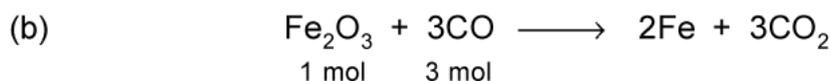
$$\therefore 32.65 \text{ g of Zn liberates} = \frac{22.4 \times 32.65}{65.3} \text{ g} = 11.2 \text{ L of H}_2.$$

**S16. (a)** Molecular weight = 2 × Vapour density  
 = 2 × 70 = 140

$$\therefore (\text{CO})_x = 140$$

$$\therefore (12 + 16)x = 140$$

$$\therefore 28x = 140 \Rightarrow x = 5.$$



Volume of 1 mole carbon monoxide

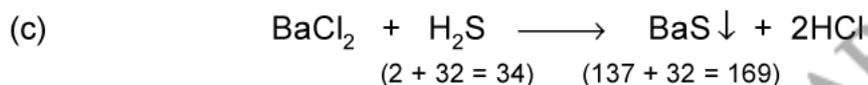
$$= 22.4 \text{ L (at STP)}$$

1 mole of ferric oxide is reduced by = 3 moles of CO

$$= 3 \times 22.4 \text{ L of CO}$$

$$= 67.2 \text{ L of CO}$$

$$= 67.2 \text{ dm}^3 \text{ of CO}$$



∴ 169 g of BaS is obtained by 34 g H<sub>2</sub>S

$$\therefore 1.69 \text{ g BaS will be obtained by H}_2\text{S} = \frac{34 \times 1.69}{169} = 0.34 \text{ g.}$$

**S17.**

Element	Percentage ratio	Atomic weight	Relative number of atoms	Simplest ratio of atoms
C	9	12	0.75	$\frac{0.75}{0.25} = 3$
H	1	1	1	$\frac{1.00}{0.25} = 4$
N	3.5	14	0.25	$\frac{0.25}{0.25} = 1$

So, Empirical formula = C<sub>3</sub>H<sub>4</sub>N  
 Empirical formula weight = 36 + 4 + 14 = 54

$$n = \frac{\text{Molecular weight}}{\text{Empirical formula weight}} = \frac{108}{54} = 2$$

∴ Molecular formula = (C<sub>3</sub>H<sub>4</sub>N)<sub>2</sub> = C<sub>6</sub>H<sub>8</sub>N<sub>2</sub>.

**S18.** Percentage of oxygen = 100 – [Sum of percentages of Na, S and H]

$$\therefore \% \text{ of O} = 100 - [14.28 + 9.92 + 6.20] = 100 - 20.40 = 69.60$$

Element	Symbol	% of element	Atomic mass of element	Moles of element = $\frac{\%}{\text{Atomic mass}}$	Simplest molar ratio	Simplest whole number ratio
Sodium	Na	14.28	23	$\frac{14.28}{23} = 0.62$	$\frac{0.62}{0.31} = 2$	2
Sulphur	S	9.92	32	$\frac{9.92}{32} = 0.31$	$\frac{0.31}{0.31} = 1$	1
Hydrogen	H	6.20	1	$\frac{6.20}{1} = 6.20$	$\frac{6.20}{0.31} = 20$	20
Oxygen	O	69.60	16	$\frac{69.60}{16} = 4.35$	$\frac{4.35}{0.31} = 14$	14

Hence, the empirical formula of the compound is  $\text{Na}_2\text{SH}_{20}\text{O}_{14}$ .

$$\begin{aligned} \text{Empirical formula mass} &= [2 \times \text{Atomic mass of Na}] + [\text{Atomic mass of S}] \\ &\quad + [20 \times \text{Atomic mass of H}] + [14 \times \text{Atomic mass of O}] \\ &= (2 \times 23) + (32) + (20 \times 1) + (14 \times 16) = 322 \\ &= \frac{\text{Molecular mass}}{\text{Empirical formula mass}} = \frac{322}{322} = 1 \end{aligned}$$

Hence, molecular formula of the anhydrous compound =  $1 \times \text{Na}_2\text{SH}_{20}\text{O}_{14} = \text{Na}_2\text{SH}_{20}\text{O}_{14}$

As all the atoms of H are present in the form of  $\text{H}_2\text{O}$ , as 20 atoms of H would combine with 10 atoms of O to give 10 molecules of  $\text{H}_2\text{O}$ . Hence, molecular formula of crystalline salt is  $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$  and that of anhydrous salt is  $\text{Na}_2\text{SO}_4$ .

**S19.** (a) 16 g of  $\text{H}_2\text{O}$  contains 2 g H.

$$\therefore 0.72 \text{ g } \text{H}_2\text{O} \text{ will contain} = \frac{2}{18} \times 0.72 = 0.08 \text{ g H}$$

Similarly, 44 g  $\text{CO}_2$  will contain 12 g C.

$$\therefore 3.08 \text{ g } \text{CO}_2 \text{ will contain} = \frac{12}{44} \times 3.08 = 0.84 \text{ g C}$$

$$\therefore \text{C} : \text{H} = \frac{0.84}{12} : \frac{0.08}{1} = 0.07 : 0.08 = 7 : 8$$

$$\therefore \text{Empirical formula} = \text{C}_7\text{H}_8.$$

(b) 8 moles of O-atom are contained by 1 mole of  $\text{Mg}_3(\text{PO}_4)_2$ .

Hence, 0.25 mole of O-atom will be contained by

$$= \frac{1}{8} \times 0.25 \text{ mole of } \text{Mg}_3(\text{PO}_4)_2$$

$$= 2.125 \times 10^{-2} \text{ mole of } \text{Mg}_3(\text{PO}_4)_2.$$

(c) Mass of an electron =  $9.108 \times 10^{-31}$  kg

$$\text{Number of electrons in 1 kg} = \frac{1}{9.108 \times 10^{-31}}$$

$$\begin{aligned}\text{Moles of electrons in 1 kg} &= \frac{1}{9.108 \times 10^{-31} \times 6.023 \times 10^{23}} \text{ mol} \\ &= \frac{1 \times 10^8}{9.108 \times 6.023} = 1.82 \times 10^6 \text{ mol.}\end{aligned}$$

**S20.**  $1000 \text{ g of MgCO}_3 = \frac{1000}{84} \text{ mol} = 11.90 \text{ mol}$

$$\begin{aligned}250 \text{ mL of } 0.76 \text{ M HCl} &= 250 \times 0.76 \text{ millimol} \\ &= 190 \text{ millimol} = 0.19 \text{ mol}\end{aligned}$$

According to the reaction,

1 mol of  $\text{MgCO}_3$  reacts with 2 mol of HCl.

$\therefore$  11.90 mol of  $\text{MgCO}_3$  will react with  $2 \times 11.90 = 23.8$  mol of HCl

But only 0.19 mol of HCl are available.

Hence, HCl will be the limiting reagent.

2 mol of HCl produces = 1 mol  $\text{MgCl}_2$

$$\begin{aligned}\therefore 0.19 \text{ mol of HCl will produce} &= \frac{1}{2} \times 0.19 \text{ mol} \\ &= 0.095 \text{ mol of MgCl}_2.\end{aligned}$$

**S21.** (a) We have  $6.3 \text{ g NaHCO}_3 \equiv \frac{6.3}{(23 + 1 \cdot 12 + 3 \times 16)} = \frac{6.3}{84} = \frac{0.3}{4} \text{ mol}$

and  $15 \text{ g CH}_3\text{COOH} \equiv \frac{15}{12 + 3 \times 1 + 12 + 2 \times 16 + 1} = \frac{15}{60} = \frac{1}{4} \text{ mol}$

Since, amount of  $\text{NaHCO}_3$  is less, it will act as a limiting agent.

From question, 1 mol  $\text{NaHCO}_3 \equiv 1 \text{ mol CH}_3\text{COOH} \equiv 1 \text{ mol CO}_2$

$$\begin{aligned}\text{Thus, } \frac{0.3}{4} \text{ mol NaHCO}_3 &\equiv \frac{0.3}{4} \text{ mol CH}_3\text{COOH} \equiv \frac{0.3}{4} \text{ mol CO}_2 \\ &= \frac{0.3}{4} \times 44 \text{ g CO}_2 = 3.3 \text{ g CO}_2\end{aligned}$$

Thus, 3.3 g  $\text{CO}_2$  is released in the process.

As  $\text{CH}_3\text{COOH}$  is in excess with respect to  $\text{NaHCO}_3$ , hence it will be found unreacted in the

residue. Amount of unreacted  $\text{CH}_3\text{COOH} = \left( \frac{1}{4} - \frac{0.3}{4} \right) \text{ mol} = \frac{0.7}{4} \times 60 \text{ g} = 10.5 \text{ g}$

Thus, residue contains 10.5 g of unreacted  $\text{CH}_3\text{COOH}$ .

(b) Molecular weight =  $2 \times VD = 2 \times 39 = 78$   
 $(CH)_n = (13)_n$  or  $13 \times n = 78$   
 $n = \frac{78}{13} = 6.$

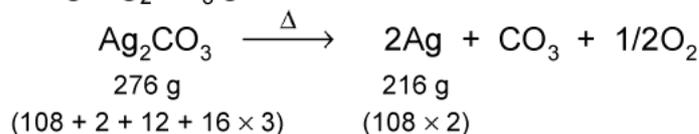
**S22.** (a) Mass per cent of 69% means that 100 g of nitric acid solution contains 69 g of nitric acid by mass

$$\text{Molarity} = \frac{69}{63.5} \times \frac{1}{100/d} \times 1000$$

$$15.44 = \frac{69}{63.5} \times \frac{1}{100/d} \times 1000$$

$$\Rightarrow d = \frac{63.5 \times 15.33}{69 \times 10} = 1.42 \text{ g cc}^{-1}.$$

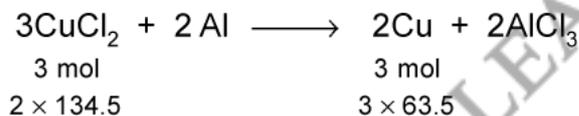
(b) On strongly heating.  $\text{Ag}_2\text{CO}_3$  gives silver and carbon dioxide.



$$276 \text{ g of Ag}_2\text{CO}_3 = 216 \text{ g of Ag}$$

$$\therefore 2.76 \text{ g of Ag}_2\text{CO}_3 = 2.16 \text{ g of Ag}$$

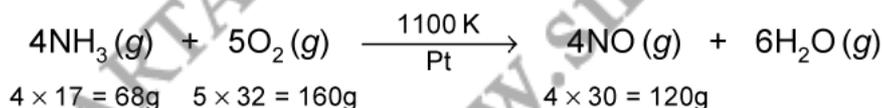
(c) Molecular weight of  $\text{CuCl}_2 = 63.5 + 2 \times 35.5 = 134.5$



$$\therefore 3 \times 63.5 \text{ g of Cu is obtained from } 3 \times 134.5 \text{ g of CuCl}_2$$

$$\therefore 1.0 \text{ g of Cu is obtained from } \frac{3 \times 134.54}{3 \times 63.5} = 2.11 \text{ g of CuCl}_2.$$

**S23.** The amount of NO produced, is decided by the amount of limiting reagent. So, first find the limiting reagent by writing a balanced chemical reaction and applying unitary method. Then, find the amount of NO produced from the limiting reagent.



$$68 \text{ g of NH}_3 \text{ reacts with } = 160 \text{ g of O}_2$$

$$\therefore 1 \text{ g of NH}_3 \text{ will react with } = \frac{160 \times 1}{68} \text{ g of O}_2$$

$$\therefore 10 \text{ g of NH}_3 \text{ will react with } = \frac{160 \times 10}{68} = 23.5 \text{ g of O}_2$$

But available amount of  $O_2$  is 20.0 g which is less than the amount which is required to react with 10 g of  $NH_3$ . So,  $O_2$  is the limiting reagent and it limits the amount of NO produced. From the above balanced equation.

160 g of  $O_2$  produces 120 g of NO.

1 g of  $O_2$  produces  $\frac{120 \times 1}{160}$  g of NO.

$\therefore$  20 g of  $O_2$  produces  $\frac{120 \times 1 \times 20}{160} = 15$  g of NO.

**S24.**

Element	Percentage	Relative number of moles	Simple ratio
C	59.3	$\frac{49.3}{12} = 4.1$	$\frac{4.1}{2.74} = 1.5 \times 2 = 3$
H	6.64	$\frac{6.84}{1} = 6.84$	$\frac{6.84}{2.74} = 2.5 \times 2 = 5$
O	43.86	$\frac{43.86}{16} = 2.74$	$\frac{2.74}{2.74} = 1 \times 2 = 2$

The empirical formula is  $C_3H_5O_2$ .

$$\begin{aligned} \text{Empirical formula weight} &= 3 \times 12 + 5 \times 1 + 16 \\ &= 36 + 5 + 32 = 73 \end{aligned}$$

Molecular weight of the compound =  $2 \times VD = 2 \times 72 = 146$

$$n = \frac{\text{Molecular weight}}{\text{Empirical formula weight}} = \frac{146}{73} = 2$$

Molecular formula = Empirical formula  $\times 2 = C_6H_{10}O_4$ .

**S25. (a)**

Element	Percentage	Relative number of moles	Simple ratio
C	20.0	$\frac{20.2}{12} = 1.66$	$\frac{1.66}{1.66} = 1$
H	6.67	$\frac{6.67}{1} = 6.67$	$\frac{6.67}{1.66} = 4$
N	46.67	$\frac{46.67}{14} = 3.33$	$\frac{3.33}{1.66} = 2$
O	26.66	$\frac{26.66}{16} = 1.66$	$\frac{1.66}{1.66} = 1$

Empirical formula =  $CH_4N_2O$

Empirical formula weight =  $12 + (4 \times 1) + (2 \times 14) + 16$

$$= \frac{\text{Molecular formula weight}}{\text{Empirical formula weight}} = \frac{60}{60} = 1$$

$\therefore$  Molecular formula =  $CH_4N_2O$ .

As the given compound gives biuret test with alk.  $\text{CuSO}_4$  and release ammonia gas upon heating, hence it must be urea  $(\text{NH}_2)_2\text{CO}$ .

- (b) Electron withdrawing group has  $-I$ -effect while electron donating group has  $+I$ -effect. In  $\text{CH}_3\text{COOH}$ , the alkyl group ( $-\text{CH}_3$ ) due to its greater  $+I$ -effect increases the electron density on oxygen atom of the  $\text{O}-\text{H}$  bond. Due to this, the release of  $\text{H}^+$  ion in acetic acid will be more difficult as compared to that in formic acid ( $\text{HCOOH}$ ) where no such  $+I$ -effect exerting group is present.

SMARTACHIEVERS LEARNING Pvt. Ltd.  
[www.smartachievers.in](http://www.smartachievers.in)