REVISION ASSIGNMENT # 12

PHYSICAL CHEMISTRY

MOLE, CONCENTRTION, EUDIOMETRY

CHEMISTRY

SECTION–I : (i) Only One option correct Type

	This section contain (D) out of which O	s 11 multiple choice qu NLY ONE is correct.	estions. Each quest	ion has four choices (A), (B), (C) and 3(-1)	
1.	A sample of iron ore, weighing 0.700g, is dissolved in nitric acid. The solution is then diluted wit water, following with sufficient concentrated aqueous ammonia, to quantitative precipitation the iro as $Fe(OH)_3$. The precipitate is filtered, ignited and weighed as Fe_2O_3 . If the mass of the ignited and dried precipitate is 0.541g, what is the mass percent of iron in the original iron ore sample (Fe = 50				
	(A) 27.0 %	(B) 48.1 %	(C) 54.1 %	(D) 81.1 %	
2.	A sample of pure C formation of black of unoxidized (Cu = 6	u (4.00g) heated in a st oxide of copper (CuO). 7 4)	ream of oxygen for The final mass is 4.9	some time, gains in weight with the 00 g. What percent of copper remains	
	(A) 90 %	(B) 10 %	(C) 20 %	(D) 80 %	
3.	1120 ml of ozonised passing this through	oxygen $(O_2 + O_3)$ at 1 a alkaline pyrogallol solu	tm & 273K weighs tion is -	1.76 gm. The reduction in volume on (T) (72 - 1	
4	(A) 896 ml	(B) 224 ml	(C) 448 ml	(D) 6/2 ml	
4.	alcohol in the solution	on ?	methyl alconol, CH_3OH , is supplied. What is the mole fra [AIEEE		
	(A) 0.086	(B) 0.050	(C) 0.100	(D) 0.190	
5.	For the estimation o	f nitrogen, 1.4 g of an o	organic compound v	vas digested by Kjeldahl method and	
the evolved ammonia was absorbed in 60 mL of $\frac{M}{10}$ sulphuric acid. The unreacted acid required				acid. The unreacted acid required 20	
	mL of $\frac{M}{10}$ sodium hydroxide for complete neutralizaton. The percentage of nitrogen in the compoun				
	is :			[JEE(Main-online)-2014]	
	(A) 3%	(B) 5%	(C) 6%	*(D) 10%	
6.	A solution of sodium in that solution in m (A) 16	n sulfate contains 92 g of ol kg ⁻¹ is: (B) 8	f Na ⁺ ions per kilogr (C) 4	am of water. The molality of Na ⁺ ions [JEE-Main(Jan.)-2019] (D) 12	
7.	The strength of 11.2	volume solution of H ₂	O ₂ is : [Given that]	molar mass of H = 1 g mol ⁻¹	
	and $O = 16 \text{ g mol}^{-1}$ [IEE-Main(april)-2019]				
	(A) 13.6%	(B) 3.4%	(C) 34%	(D) 1.7%	
8.	The mole fraction	n of a solvent in ac	ueous solution o	of a solute is 0.8. The molality	
	(in mol kg ⁻¹) of the aqueous solution is [JEE-Main(april)-2019]				
	(A) 13.88×10^{-1}	(B) 13.88 × 10 ⁻²	(C) 13.88	(D) 13.88×10^{-3}	

- Statement-1: The mass fraction of solute in a solution is always greater than its mole fraction.
 Statement-2: Mole fraction of solvent in an aqueous solution of ethanol must be greater than that of solute.
 - (A) Statement-1 is true, statement-2 is true and statement-2 is correct explanation for statement-1.

(B) Statement-1 is true, statement-2 is true and statement-2 is NOT the correct explanation for statement-1.

- (C) Statement-1 is true, statement-2 is false.
- (D) Statement-1 is false, statement-2 is true.
- 10. At 300 K and 1 atmospheric pressure, 10 mL of a hydrocarbon required 55 mL of O_2 for complete combustion and 40 mL of CO_2 is formed. The formula of the hydrocarbon is :
 - (A) C_4H_8 (B) C_4H_7Cl (C) C_4H_{10} (D) C_4H_6
- 11. 25 g of an unknown hydrocarbon upon burning produces 88 g of CO₂ and 9 g of H₂O. This unknown hydrocarbon contains. [JEE-MAIN(ONLINE-19)]

(A)20g of carbon and 5 g of hydrogen (B) 24g of carbon and 1 g of hydrogen

(C) 18g of carbon and 7 g of hydrogen (D) 22g of carbon and 3 g of hydrogen

(ii) One or more options correct Type

This section contains **3 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONE or MORE** are correct. **4(-1)**

- 12. 10 ml of a gaseous mixture containing C_2H_x and C_3H_8 exactly requires 40 ml O_2 for complete combustion and produces 25 ml CO_2 and 30 ml H_2O vapour. The correct information (s) is/ are -
 - (A) Total volume contraction = 5 ml
 - (B) Volume contraction due to combustion of C_2H_x = 0
 - (C) x = 4

(D) Volume of C_2H_x in the initial mixture = 5 ml

13. The molar concentration of HCl (aq.) is 10^{-5} M. Which of the following statements are correct.

$(d_{solution} = 1 \text{ gm /cc})$

- (A) The mole fraction of HCl $\approx 1.8 \times 10^{-7}$
- (B) The concentration of HCl in ppm is 3.65 ppm
- (C) The molality of HCl solution is approximately 10^{-5} m
- (D) The (w/v)% of solution is 3.65×10^{-5} %
- 14. 100 ml mixture of CO and CO_2 mixed with 30 mL of O_2 and sparked in eudiometer tube. The residual gas after treatment with aq. KOH has a volume of 10 mL which remains unchanged when treated with alkaline pyrogallol. If all the volumes are under the same conditions, point out **correct** options(s):
 - (A) The volume of CO that reacts, is 60 mL
 - (B) The volume of CO that remains unreacted, is 10 mL
 - (C) The volume of O_2 that remains unreacted, is 10 mL
 - (D) The volume of CO_2 that gets absorbed by aq.KOH, is 90 mL.

(iii) Paragraph Type

This section contains **3 paragraphs**, describing theory, experiment, data etc. **6 questions** relate to one paragraphs with two questions. Each question of a paragraph has **only one correct answer** among the four choices (A), (B), (C) and (D). **3(0)**

Comprehension Q.15 and Q.16(2 questions)

Estimation of halogens :

Carius method : A known mass of compound is heated with conc. HNO_3 in the presence of $AgNO_3$ contained in a hard glass tube known as carius tube in a furnce. C and H are oxidised to CO_2 and H_2O . The halogen forms the corresponding AgX. It is filtered, dried, and weighed.

Estimation of sulphur : A known mass of compound is heated with fuming HNO_3 or sodium peroxide (Na_2O_2) in the presence of $BaCl_2$ solution in Carius tube. Sulphur is oxidised to H_2SO_4 and precipitated as $BaSO_4$. It is filerted, dried and weighed.

Q.15 0.15gm of an organic compound gave 0.12 gm of silver bromide by the Carius method. Find the percentage of bromine in the compound. (Ag = 108, Br = 80)

Q.16 0.32 gm of an organic substance when treated by Carius method gave 0.466gm of $BaSO_4$. Calculate the percentage of sulphur in the compound. (Ba = 137)

	Comprehension Q	.17 and Q.18(2 questions	;)
(A) 10.0	(B) 34.0	(C) 20.0	(D) 30.0

(d) Estimation of phosphorous :

A known mass of compound is heated with fuming HNO_3 or sodium peroxide (Na_2O_2) in Carius tube which converts phosphorous to H_3PO_4 . Magnesia mixture ($MgCl_2 + NH_4Cl$) is then added, which gives the precipitate of magnesium ammonium phosphate ($MgNH_4.PO_4$) which on heating gives magnesium pyrophosphate ($Mg_2P_2O_7$), which is weighed.

Q.17 0.124 gm of an organic compound containing phosphorus gave 0.222 gm of $Mg_2P_2O_7$ by the usual analysis. Calculate the percentage of phosphorous in the compound.(Mg = 24, P = 31) (A) 25 (B) 75 (C) 62 (D) 50

Q.18 An organic compound has 6.2 % of phosphorus. On sequence of reaction, the phosphorous present in the 10gm of organic compound is converted to $Mg_2P_2O_7$. Find the weight of $Mg_2P_2O_7$ formed.

(A) 2.22 gm	(B) 10.0 gm	(C) 4.44 gm	(D) 1.11 gm

Comprehension Q.19 and Q.20(2 questions)

 $30 \text{ gm H}_2\text{SO}_4$ is mixed with 20 gram SO_3 to form mixture.

Q.19	Find mole fraction of SO ₃ .				
	(A) 0.2	(B) 0.45	(C) 0.6	(D) 0.8	
Q.20	Determine % labelling of oleum solution.				
	(A) 104.5	(B) 106	(C) 109	(D) 110	

SECTION-II: (Integer Second Decimal) : 4(0)

- This section contains 15 questions.
- The answer to each question is a **NUMERICAL VALUE**.
- For each question, enter the correct numerical value (If the numerical value has more than two decimal places, **truncate/round-off** the value to **TWO** decimal places; e.g. 6.25, 7.00, -0.33, -.30, 30.27, -127.30, if answer is 11.36777.... then both 11.36 and 11.37 will be correct) by darken the corresponding bubbles in the ORS.

For Example : If answer is -77.25, 5.2 then fill the bubbles as follows.

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	$\bullet \bullet \bullet \bullet \bullet \bullet \bullet$
222.	222.
3 3 3 3 3 3	3 3 3 3 3 3
4 4 4 4 4	44444
5 5 5 5 • 5 🔵	55550
66666	66666
$ \bigcirc \bigcirc$	$\bigcirc \bigcirc $
88888	88888
999999	999999

- Answer to each question will be evaluated according to the following marking scheme: *Full Marks* : +4 If ONLY the correct numerical value is entered as answer. *Zero Marks* : 0 In all other cases.
- 1. 0.5 g of NaOH is required by 0.4 gm of a polybasic acid H_nA (Molecular weight = 96gm) for complete neutralization. Value of 'n' would be : (Assume all H atom are replaced)–
- 2. Calculate mass of O atoms in 6 gm CH₃COOH ?
- 3. The Kohinoor diamond was the largest diamond ever found. How many moles of carbon atom were peresent in it, if it is weigh 3300 carat. [Given: 1 carat = 200 mg]
- 4. Calculate % yield of the reaction if 200g KHCO₃ produces 22g of CO₂ upon strong heating.
- 5. The vapour density of a sample of N_2O_4 gas is 35. What percent of N_2O_4 molecules are dissociated into NO_2 ?.
- 6. $Br_2(l)$ reacts with $Cl_2(g)$ to form BrCl and $BrCl_3$, simultaneously. How many moles of $Cl_2(g)$ reacts completely with 3 moles of $Br_2(l)$ to form BrCl and $BrCl_3$ in 5 : 1 molar ratio
- 7. The ammonia prepared by treating ammonium sulphate with calcium hydroxide is completely used by $NiCl_2.6H_2O$ to form a stable coordination compound. Assume that both the reactions are 100% complete. If 1584 g of ammonium sulphate and 952g of $NiCl_2.6H_2O$ are used in the preparation, the combined weight (in grams) of gypsum and the nickel-ammonia coordination compound thus produced is_____. [JEE 2018]

(Atomic weights in g mol⁻¹: H = 1, N = 14, O = 16, S = 32, Cl = 35.5, Ca = 40, Ni = 59)

$$(NH_4)_2 SO_4 + Ca(OH)_2 \rightarrow CaSO_4.2H_2O + 2NH_3$$

$$\operatorname{NiCl}_2 \cdot 6H_2O + 6NH_3 \rightarrow \left[\operatorname{Ni}(NH_3)_6\right]Cl_2 + 6H_2O$$

8. Galena (an ore) is partially oxidized by passing air through it at high temperature. After some time, the passage of air is stopped, but the heating is continued in a closed furnance such that the contents undergo self-reduction. The weight (in kg) of Pb produced per kg of O_2 consumed is ______.

[JEE 2018]

(Atomic weights in g mol^{-1} : O = 16, S = 32, Pb = 207)

- 9. If 0.5 M methanol undergo self dissociation like $CH_3OH \rightleftharpoons CH_3O^- + H^+$ & if concentration of H⁺ is 2.5×10^{-4} M then calculate % dissociation of methanol.
- 10. 45.4 V H_2O_2 solution (500 ml) when exposed to atmosphere looses 11.2 litre of O_2 at 1 atm, & 273 K. New molarity of H_2O_2 solution (Assume no change in volume)
- 11. How much $BaCl_2$ (in gm) would be needed to make 250 ml of a solution having the same concentration of Cl⁻ as one containing 1.825 gm HCl per 100 ml ? (Ba = 137)
- 12. Find out the volume of 98% w/w H_2SO_4 (density = 1.8 gm/ ml), must be diluted to prepare 12.6 litres of 2.0 M sulphuric acid solution.
- 13 500 ml of 2 M NaCl solution was mixed with 200 ml of 2 M NaCl solution. Calculate the molarity of NaCl in final solution.
- 14. $2H_2O_2(aq) \longrightarrow 2H_2O(l) + O_2(g)$

Under conditions where 1 mole of gas occupies 24 dm³, X L of $\frac{1}{24}$ M solution of H₂O₂ produces 3 dm³

of O₂. Thus X is :-

15. A compound H₂X with molar weight of 80 g is dissolved in a solvent having density of 0.4 g /ml, Assuming no change in volume upon dissolution, the molality of a 3.2 molar solution is. [JEE 2014]

SECTION-III (SUBJECTIVE)

- 1. By the reaction of carbon and oxygen, a mixture of CO and CO_2 is obtained. What is the composition (% by mass) of the mixture obtained when 20 grams of O_2 reacts with 12 grams of carbon ?
- 2. 40 ml of a mixture of C_2H_2 and CO is mixed with 100 ml of O_2 gas and the mixture is exploded. The residual gases occupied 104 ml and when these are passed through KOH solution, the volume becomes 48 ml. All the volume are at same temperature and pressure. Determine the composition of original mixture.
- 3. 10 mL of gaseous organic compound containing C, H and O only was mixed with 100 mL of O_2 and exploded under identical conditions and then cooled. The volume left after cooling was 90 mL. On treatment with KOH a contraction of 20 mL was observed. If vapour density of compound is 23, if molecular formula of the compound is $C_x H_y O_z$, then find (x + y + z).
- 4. The concentration of $Ca(HCO_3)_2$ in a sample of hard water is 405 ppm. The density of water sample is 1.0 gm/ml. Calculate the molarity of solution ?
- 5. Nitrogen (N), phosporus (P), and potassium (K) are the main nutrients in plant fertilizers. According to an industry convention, the numbers on the label refer to the mass % of N, P_2O_5 , and K_2O , in that order. Calculate the N : P : K ratio of a 30 : 10 : 10 fertilizer in terms of moles of each elements, and express it as x : y : 1.0. (P = 31, K = 39)

- 6. A mixture of Ferric oxide (Fe_2O_3) and Al is used as a solid rocket fuel which reacts to give Al_2O_3 and Fe. No other reactants and products are involved. On complete reaction of 1 mole of Fe_2O_3 , 200 units of energy is released.
 - (a) Write a balance reaction representing the above change.

(b) What should be the ratio of masses of Fe_2O_3 and Al taken so that maximum energy per unit mass of fuel is released.

- (c) What would be energy released if 16 kg of Fe_2O_3 reacts with 2.7 kg of Al.
- 7. 5.33 mg of salt [Cr(H₂O)₅Cl].Cl₂. H₂O is treated with excess of AgNO₃(aq.) then mass of AgCl precipitate obtained will be : Given : [Cr = 52, Cl = 35.5, Ag = 108]
- 8. To find formula of compound composed of A & B which is given by $A_x B_y$, it is strongly heated in oxygen as per reaction-

 $A_{x}B_{y} + O_{2} \rightarrow AO + Oxide of B$

If 2.5gm of $A_x B_y$ on oxidation gives 3gm oxide of A, Find empirical formula of $A_x B_y$,

[Atomic mass of A = 24 & B = 14]

- 9. The empirical formula of a compounds is CH_2O . 0.25 mole of this compound contains 1 gm hydrogen. The molecular formula of compound is -
- 10. A polystyrene of formula $Br_3C_6H_2(C_8H_8)_n$ was prepared by heating styrene with tribromobenzyl peroxide in the absence of air. It was found to contain 10.46% bromine by weight. Find the value of n. (Br = 80).
- 11. When 4 gm of a mixture of NaHCO₃ and NaCl is heated, 0.66 gm CO_2 gas is evolved. Determine the percentage composition (by mass) of the original mixture.
- 12. Potassium superoxide, KO_2 , is utilised in closed system breathing apparatus. Exhaled air contains CO_2 and H_2O , both of which are removed and the removal of water generates oxygen for breathing by the reaction

 $4\mathrm{KO}_2(\mathrm{s}) + 2\mathrm{H}_2\mathrm{O}(\mathrm{l}) \rightarrow 3\mathrm{O}_2(\mathrm{g}) + 4\mathrm{KOH}(\mathrm{s})$

The potassium hydroxide removes CO_2 from the apparatus by the reaction :

 $KOH(s) + CO_2(g) \rightarrow KHCO_3(s)$

- (a) What mass of KO_2 generates 24 gm of oxygen ?
- (b) What mass of CO_2 can be removed from the apparatus by 100 gm of KO_2 ?

SECTION-IV : Matrix-Match Type

This Section contains 1 question. Question has four statements (A, B, C and D) given in Column I and five statements (P, Q, R, S and T) in Column II. Any given statement in Column I can have correct matching with ONE or MORE statement(s) given in Column II. For example, if for a given question, statement B matches with the statements given in Q and R, then for the particular question, against statement B, darken the bubbles corresponding to Q and R in the ORS. 8(0)

Q.1.		Column-I		Column-II
	(A)	120 g CH ₃ COOH in 1 L solution	(P)	M = 2
		$(d_{sol} = 1.2 \text{ g/mL})$		
	(B)	120 g glucose dissolved in 1 L solution	(Q)	10% w/w solution
		$(d_{sol} = 1.2 \text{ g/mL})$		
	(C)	$X_{\rm NH_2CONH_2} = 1/31$ (aqueous solution)	(R)	12% w/v solution
	(D)	19.6% (w/v) H_2SO_4 solution →		
		$(d_{solution} = 1.2 \text{ g/mL})$	(S)	m = 1.85
			(T)	m = 0.617