Elements and Compounds Chemistry Questions with Solutions

Q1: 500 mL of a 5 M sample is diluted to 1500 mL. What will be the molarity of the new solution formed?

a. 1.59 M
b. 1.66 M
c. 0.017 M
d. 1.5 M

Answer: (b.)

Explanation: From the molarity formula: $M_1V_1 = M_2V_2$
Here M_1 = 5 M, V_1 = 500 mL, M_2 = ? and V_2 = 1500 mL
Hence, 5 M x 500 mL = M_2 x 1500 mL
M_2 = 5/3 = 1.66 M

Q2. At STP, one mole of oxygen gas is equal to _____.

a. 16 g of oxygen
b. 32 atoms of oxygen
c. 6.022×10^{23} atoms of oxygen
d. 6.022×10^{23} molecules of oxygen

Answer: (d.)

Explanation: 1 mole of oxygen gas at STP = 6.022×10^{23} molecules of oxygen = 32 g of oxygen

Q3. Five grams of each of the following gases are taken at 87 ^{o}C and 750 mm pressure. Predict which of these gases will have the least volume.

a. HF
b. HCl
c. HBr
d. HI

Answer: (d.)

Explanation: From the mole concept: Number of moles = given mass/ molecular formula mass
Hence, number of moles in 5 g of HF = 5/ 20 mol
Number of moles in 5 g of HCl = 5/36.5
Number of moles in 5 g of HBr = 5/81
Number of moles in 5 g of HI = 5/121

From the calculation of the number of moles, it is clear that 5 g of HI has the least number of moles among other gases. Hence, the least number of moles correspond to least volume.

Q4. 8 g of O_2 has the same number of molecules as

a. 7 g of CO
b. 11 g of CO_2
c. 16 g of SO_2
d. All of the above

Answer: (d.)

Explanation: As Number of moles = given mass/ molecular formula mass
Number of moles in 8 g of O_2 = 8/32 = 0.25 mol
Number of moles in 7 g of CO = 7/28 = 0.25 mol
Number of moles in 16 g of SO_2 = 16/64 = 0.25 mol

Q5. What are Polymorphs? Give an example.

Answer: The compound that exists in different crystalline forms is said to exhibit the property of Polymorphism. The different crystalline forms of the compound are called Polymorphs.
For example: ZnS has two polymorphs namely Zinc Blende and Wurtzite. Both Zinc Blende and Wurtzite have the chemical formula ZnS but differ in their structures. Zinc Blende has a cubic while wurtzite has a hexagonal structure.

Q6. What is the difference between the molecular mass and the gram molecular mass?

Answer: The molecular mass of a molecule is the actual mass of the molecule expressed in grams. However, the gram molecular mass is the mass of Avagadro's number of molecules (6.022×10^{23} molecules) in grams.

Q7. The two isotopes of chlorine account for its molecular mass i.e. 35.45 amu. Calculate the percentage of both the naturally occurring isotopes of chlorine.

Answer: Chlorine has two isotopes: ^{35}Cl and ^{37}Cl.
Let us assume that the percentage of ^{35}Cl in naturally occurring chlorine is x% and that of ^{37}Cl is (100-x)%.
Hence, Average atomic mass = (%^{35}Cl x mass of ^{35}Cl) + (%^{37}Cl x mass of ^{37}Cl) / 100
Average atomic mass = (x x 35) + {(100 - x)} / 100 = 35.45 (given average atomic mass)
So, x = 77.5 % and (100 - x) = 22.5%
Hence, ^{35}Cl = 77.5% and ^{37}Cl = 22.5%.

Q8. Calculate the molecular mass of water that contains 50% heavy water (D_2O).

Answer: As is given in the question, the sample of water contains 0.5 mole of H_2O and 0.5 mole of D_2O.
Mass of 1 mole of H_2O = 18 g
Mass of 0.5 moles of H_2O = 0.5 x 18 g = 9 g
Similarly, Mass of 1 mole of D_2O = 20 g
Mass of 0.5 moles of D_2O = 0.5 x 20 g = 10 g
Since the mass of 1 mole of a substance is called its molar mass. The molar mass of the given sample of water = 10 g + 9 g = 19 g mol^{-1}.

Q9. The mass of the black dot used at the end of a sentence is considered to be 1 Attogram. If the black dot is made of carbon, calculate the number of moles of carbon present in the black dot.

Answer: Given: mass of carbon in the black dot = 1 Attogram = 10^{-18} g
Now, 12 g carbon contains atoms = 6.022 x 10^{23} atoms
10^{-18} g of carbon contains atoms = (6.022 x 10^{23} atoms / 12 g) x 10^{-18} g = 5.02 x 10^4 atoms
So, the black dot contains 5.02 x 10^4 atoms of carbon.

Q10. What will be the minimum molecular mass of Insulin that contains 3.4% S?

Answer: The minimum molecular mass of Insulin will be the mass that contains the mass of at least 1 atom of S. The atomic mass of S = 32 amu
Now that 3.4 amu of S is present in Insulin = 100 amu
32 amu os S will be present in Insulin = (100/3.4) x 32 amu = 941.2 amu
Hence, the minimum molecular mass of Insulin that contains 3.4% S is 941.2 amu.

Q11. Find the normality of the acid solution when 10 mL of HCl solution is treated with excess of $AgNO_3$ to give 0.1435 g of AgCl.

Answer: 143.5 g AgCl contains Cl = 35.5 g
0.1435 g of AgCl contains Cl = (35.5 / 143.5) x 0.1435 g = 0.0355 g
Now, 35.5 g Cl is contained in HCl = 36.5 g
0.0355 g Cl is contained in HCl = (36.5 / 35.5) x 0.0355 g = 0.0365 g
Now that, Number of gram equivalents = mass of solute (g) / Equivalent mass of solute
Hence, Gram equivalents of 0.0365 g HCl = (0.0365 / 36.5) g eq. = 0.001 g eq.
10 mL of HCl contains 0.001 g eq.
1000 mL of HCL will contain g eq. = (0.001/10) x 1000 = 0.1 g eq.
As we know, the gram equivalents present in 1 L of the solution is called Normality.
Hence, the Normality of the given acidic solution is 0.1 N.

Q12. Calculate the atomicity of a molecule of H_2SO_4.

Answer: The total number of atoms present in a molecule accounts for its atomicity.
Hence, the atomicity of H_2SO_4 = 2 + 1 + 4 = 7.

Q13. Count the number of significant figures in 1.050×10^4.

Answer: In the scientific notation ($N \times 10^n$), the number of digits present in N are counted in significant figures. Hence, 1.050×10^4 has 4 significant figures.

Q14. What is the S.I. unit of Density?

Answer: The density formula is: Density = Mass / Volume
The S.I. unit of mass is kg, while that of volume is m^3. Hence, the S.I. unit of Density is kg m^{-3}.

Q15. Match the following:

(i)	88 g of CO_2	(a.)	0.25 mol
(ii)	96 g of O_2	(b.)	6.022×10^{23} molecules
(iii)	1 mole of any gas	(c.)	2 mol
(iv)	5.6 L of CO_2 at STP	(d.)	3 mol

Answer: (i)-(c.), (ii)-(d.), (iii)-(b.), (iv)-(a.)

Explanation: (i) Mass of 1 mole of CO_2 = 44 g
Hence, 88 g of CO_2 corresponds to 2 moles.
(ii) 32 g of O_2 = 1 mol
96 g of O_2 = (1 / 32) x 96 mol = 3 mol
(iii) 1 mole of any gas = 6.022×10^{23} molecules
(iv) 22.4 L of CO_2 at STP = 1 mol
5.6 L of CO_2 at STP = (1 / 22.4) x 5.6 mol = 0.25 mol

Practise Questions on Elements and Compounds

Q1. The Empirical formula of hydrogen peroxide is_____.

Answer: HO

Explanation: The Empirical formula is the chemical formula of a compound written in its simplest whole number ratio.

Q2. Calculate the mass percent of carbon in carbon dioxide.

Answer: 44 g of CO_2 contains carbon = 12 g
Hence, % of C in CO_2 = (12/ 44) x 100 = 27.27%
So, the mass percent of carbon in carbon dioxide is 27.27%.

Q3. What is the difference between 2.5 x 10^3 g and 2.50 x 10^3 g?

Answer: 2.5 x 10^3 g has only 2 significant figures; while 2.50 x 10^3 g has 3 significant figures. More significant figures imply more accuracy in the calculations. Hence, 2.50 x 10^3 g represents greater accuracy than 2.5 x 10^3.

Q4. Why is molality preferred over molarity in expressing the concentration of a solution?

Answer: The molality is defined as the number of moles of solute present in 1 kg of the solvent. While, molarity accounts for the number of moles of solute present in 1 L of the solution. Since the volume of a solution keeps changing with the change in temperature, molarity is not considered as an ideal unit of expression for the concentration of the solution. Hence, molality is preferred over molarity.

Q5. How much of Cu can be obtained from 100 g of copper sulphate ($CuSO_4$)?

Answer: The molar mass of $CuSO_4$ is 159.5 g mol^{-1}.
Amount of Cu that can be obtained from 159.5 g of $CuSO_4$ = 63.5 g
So, amount of Cu that can be obtained from 100 g of $CuSO_4$ = (63.5 / 159.5) x 100 g = 39.81 g
Hence, the amount of Cu that can be obtained from 100 g of copper sulphate ($CuSO_4$) is 39.81 g.