X - CHEMISTRY MODEL EVALUATION

LN – 7 ATOMS AND MOLECULES

I. Choose the best answer.

1. Which of the following has the smallest mass?
   a. 6.023×10^{23} atoms of He b. **1 atom of He**
   c. 2 g of He d. 1 mole atoms of He
2. Which of the following is a triatomic molecule?
   a. Glucose b. Helium c. **Carbon dioxide** d. Hydrogen
3. The volume occupied by 4.4 g of CO2 atS.T.P
   a) 22.4 litre b. **2.24 litre** c. 0.24 litre d. 0.1 litre.
4. Mass of 1 mole of Nitrogen atom is
   a. 28 amu b. 14 amu c. 28 g **d. 14 g**
5. Which of the following represents 1 amu?
   a. Mass of a C – 12 atom b. Mass of a hydrogen atom
   c. **1/12th of the mass of a C – 12 atom** d. Mass of O – 16 atom
6. Which of the following statement is incorrect?
   a. One gram of C – 12 contains Avogadro's number of atoms.
   b. One mole of oxygen gas contains Avogadro's number of molecules.
   c. **One mole of hydrogen gas contains Avogadro's number of atoms**.
   d. One mole of electrons stands for 6.023×10^{23} electrons.
7. The volume occupied by 1 mole of a diatomic gas at S.T.P is
   a. **11.2 litre** b. 5.6 litre c. 22.4 litre d. 44.8 litre
8. In the nucleus of $_{20}Ca^{40}$, there are
   a. 20 protons and 40 neutrons b. **20 protons and 20 neutrons**
   c. 20 protons and 40 electrons d. 40 protons and 20 electrons
9. The gram molecular mass of oxygen molecule is
   a. 16 g b. 18 g c. **32 g** d. 17 g
10. 1 mole of any substance contains ____ molecules.
   a. **6.023×10^{23}** b. 6.023×10^{-23} c. 3.0115×10^{23} d. 12.046×10^{23}

II. Fill in the blanks

1. Atoms of different elements having **same** mass number, but **different** atomic numbers are called isobars.
2. Atoms of different elements having same number of **neutrons** are called isotones.
3. Atoms of one element can be transmuted into atoms of other element by **artificial transmutation**
4. The sum of the numbers of protons and neutrons of an atom is called its **mass number**
5. Relative atomic mass is otherwise known as **Standard atomic weight**
6. The average atomic mass of hydrogen is **1.0079** amu
7. If a molecule is made of similar kind of atoms, then it is called **homo** atomic molecule.
8. The number of atoms present in a molecule is called its **atomicity**
9. One mole of any gas occupies **22400 ml** at S.T.P
10 Atomicity of phosphorous is **4(Tetrataomic)**

III. Match the following

1.	8 g of O_2	-	4 moles	**(4)**
2.	4 g of H_2	-	0.25 moles	**(1)**
3.	52 g of He	-	2 moles	**(2)**
4.	112 g of N_2	-	0.5 moles	**(5)**
5.	35.5 g of Cl_2	-	13 moles	**(3)**

IV. True or False: (If false give the correct statement)

1. Two elements sometimes can form more than one compound. **(true**)
2. Noble gases are Diatomic **(false)**
   Noble gases are **mono atomic**
3. The gram atomic mass of an element has no unit **(false)**
   The gram atomic mass of an element has unit expressed in grams
4. 1 mole of Gold and Silver contain same number of atoms **(true**)
5. Molar mass of CO_2 is 42g **(false)**
   Molar mass of CO_2 is 44g

V. Assertion and Reason:

Answer the following questions using the data given below:

i) A and R are correct, R explains the A.
ii) A is correct, R is wrong.
iii) A is wrong, R is correct.
iv) A and R are correct, R doesn't explains A.

1. **Assertion:** Atomic mass of aluminium is 27
   Reason: An atom of aluminium is 27 times heavier than 1/12th of the mass of the C – 12 atoms.
   (A and R are correct, R doesn't explains A.)
2. **Assertion:** The Relative Molecular Mass of Chlorine is 35.5 a.m.u.
   Reason: The natural abundance of Chlorine isotopes is not equal.
   (A is wrong, R is correct.)

VI. Short answer questions

1. Define: Relative atomic mass.
   Relative atomic mass of an element is the ratio between the average mass of its isotopes to 1/ 12th part of the mass of a carbon-12 atom. It is denoted as Ar. It is otherwise called "Standard Atomic Weight".
2. Write the different types of isotopes of oxygen and its percentage abundance.

Isotope	Mass (amu)	% abundance
$_8O^{16}$	15.9949	99.757
$_8O^{17}$	16.9991	0.038
$_8O^{18}$	17.9992	0.205

3. Define : Atomicity
   The number of atoms present in the molecule is called its 'atomicity'.

Atomicity $= \frac{molecular\ mass}{atomic\ mass}$

4. Give any two examples for hetero diatomic molecules.

HCl, CO, HI, NaCl

5. What is Molar volume of a gas?

One mole of any gas occupies 22.4 litre or 22400 ml at S.T.P. This volume is called as molar volume.

6. Find the percentage of nitrogen in ammonia.

Mass % of an element $= \frac{mass\ of\ that\ element\ in\ the\ compound}{molar\ mass\ of\ the\ compound} x100$

$= \frac{14}{17} x100$

Mass % of nitrogen = **82.35%**

VII. Long answer questions

1. Calculate the number of water molecule present in one drop of water which weighs 0.18 g.

No. of molecule $= \frac{avagadro\ number\ x\ given\ mass}{gram\ molecular\ mass}$

$= \frac{6.023x10^{23}\ x0.18}{18}$

$= 6.023x10^{21}$ **molecule (or)**

$0.06023x10^{23}$

2. $N_2 + 3\ H_2 \rightarrow 2\ NH_3$ (The atomic mass of nitrogen is 14, and that of hydrogen is 1)

1 mole of nitrogen (**28**g) + 3 moles of hydrogen (**6 g**) →

2 moles of ammonia (**34 g**)

2. Calculate the number of moles in

i) 27g of Al

No. of moles $= \frac{given\ mass\ or\ mass\ of\ an\ element}{atomic\ mass\ of\ an\ element}$

$= \frac{27}{27}$

= **1 mole**

ii) ii) 1.51×10^{23} molecules of NH_4Cl

No. of moles $= \frac{no\ .of\ molecules}{Avagadro's\ number}$

$= \frac{1.51\ x\ 10^{23}}{6.023\ x\ 10^{23}}$

= **0.25 mole**

3. Give the salient features of "Modern atomic theory".

The salient features of modern atomic theory' are as follows:

- **An atom is no longer indivisible** (after the discovery of the electron, proton, and neutron).
- Atoms of the same element may have different atomic mass. (Discovery of **isotopes** $_{17}Cl^{35}$, $_{17}Cl^{37}$**).**
- Atoms of different elements may have same atomic masses (discovery of **Isobars** $_{18}Ar^{40}$, $_{20}Ca^{40}$**).**
- Atoms of one element can be transmuted into atoms of other elements. In other words, atom is no longer indestructible (discovery of **artificial transmutation**

Ex : $_{92}U^{238} + _{0}n^{1} \longrightarrow _{56}Ba^{143} + _{36}U^{92} + 3\ _{0}n^{1}$

- Atoms may not always combine in a simple whole number ratio (E.g. Glucose $C_6H_{12}O_6$ C:H:O = 6:12:6 or 1:2:1 and Sucrose $C_{12}H_{22}O_{11}$ C:H:O = 12:22:11).
- Atom is the **smallest particle that takes part in a chemical reaction.**
- The mass of an atom can be converted into energy explained by Einstein equation ($E = mc^2$).

E = Energy m = mass c = velocity of light ($3x10^8$m/s)

4. Derive the relationship between Relative molecular mass and Vapour density.

i. **Relative molecular mass: (Hydrogen scale)**

The Relative Molecular Mass of a gas or vapour is the ratio between the mass of one molecule of the gas or vapour to mass of one atom of Hydrogen.

ii. **Vapour Density:**

Vapour density is the ratio of the mass of a certain volume of a gas or vapour, to the mass of an equal volume of hydrogen, measured under the same conditions of temperature and pressure.

Vapour Density (V.D.)

$$= \frac{\text{Mass of a given volume of gas or vapour at S.T.P.}}{\text{Mass of the same volume of hydrogen}}$$

According to Avogadro's law, equal volumes of all gases contain equal number of molecules.

Thus, let the number of molecules in one volume = n, then

V.D. at S.T.P

$$= \frac{\text{Mass of 'n' molecules of a gas or vapour at S.T.P.}}{\text{Mass of 'n' molecules of hydrogen}}$$

Cancelling 'n' which is common, you get

V.D.

$$= \frac{\text{Mass of 1 molecule of a gas or vapour at S.T.P.}}{\text{Mass of 1 molecules of hydrogen}}$$

However, since hydrogen is diatomic

V.D.

$$= \frac{\text{Mass of 1 molecule of a gas or vapour at S.T.P.}}{\text{Mass of 2 atoms of hydrogen}}$$

When you compare the formula of vapour density with relative molecular mass, they can be represented as

V.D.

$$= \frac{\text{Mass of 1 molecule of a gas or vapour at S.T.P.}}{2 \times \text{Mass of 1 atom of hydrogen}} \quad \text{(Eqn 7.1)}$$

Relative molecular mass (hydrogen scale) =

$$\frac{\text{Mass of 1 molecule of a gas or vapour at STP}}{\text{Mass of 1 atom of hydrogen}} \quad \text{(Eqn 7.2)}$$

You can therefore substitute the above equation to an Eqn 7.1 and arrive at the following formula

$$\text{V.D.} = \frac{\text{Relative molecular mass}}{2}$$

Now on cross multiplication, you have

2 × vapour density = Relative molecular mass of a gas

(Or)

Relative molecular mass = 2 × Vapour density

. HOT question

1. Calcium carbonate is decomposed on heating in the following reaction.

$$CaCO_3 \rightarrow CaO + CO_2$$

i. How many moles of Calcium carbonate are involved in this reaction?

One mole of calcium involved in this reaction

ii. Calculate the gram molecular mass of calcium carbonate involved in this reaction

Ca	1x 40	=	40
C	1x 12	=	12
O	3x 16	=	48

Gram molecular mass calcium carbonates 100 g

iii. How many moles of CO_2 are there in this equation?

One mole of carbon dioxide present in this equation

IX. Solve the following problems

1. How many grams are there in the following?

Grams = No. mole x no. of atoms in the molecule x atomic mass of an element

i. 2 moles of hydrogen molecule, H_2 **(2x2x1= 4g)**

ii. 3 moles of chlorine molecule, Cl_2 **(3x 2x35.5 = 213g)**

iii. 5 moles of sulphur molecule, S_8 **(5 x 8 x32 = 1280g)**

iv. 4 moles of phosphorous molecule, P_4 **(4x4x31 = 496g)**

2. Calculate the % of each element in calcium carbonate.
(Atomic mass: C-12, O-16, Ca -40)

$$\text{Mass \%} = \frac{\text{Mass of an element in the cpd.}}{\text{Molar Mass of the cpd.}} \times 100$$

$$\text{\% of 'C'} = \frac{12}{100} \times 100 = 12\%$$

$$\text{\% of Ca} = \frac{40}{100} \times 100 = 40\%$$

$$\text{\% of O} = \frac{48}{100} \times 100 = 48\%$$

3. Calculate the % of oxygen in $Al_2(SO_4)_3$. (Atomic mass: Al-12, O-16, S -32)

$$\textbf{\% of oxygen} = \frac{\textit{mass of oxygen in the compound}}{\textit{molar mass of the compound}} x100$$

$$= \frac{192}{342} x100$$

% of oxygen = 56.1%

Al	2 x 27	=	54
S	3 x 32	=	96
O	12x 16	=	192
			342g

- **O 12x 16 = 192g**

4. Calculate the % relative abundance of B -10 and B -11, if its average atomic mass is 10.804 amu.

The formula when you're looking for one unknown .It's a percentage though, so if one value is x the other must be 100-x

Rearrange the normal equation to give:

10.8 = [(10 x) + (11(100-x))] / 100

then multiply both sides of the equation by 100:

1080 = (10 x) + (11(100-x))

then multilply out the second bracket :

1080 = (10 x) + 1100 - 11x

so: 1080 + x = 1100
therefore x = 20% and
100- x = 80%

PREPARED BY
M. SIVA MSc., MPhil.,BEd.
SRI VIDYA MANDIR MATRIC HR.SEC.SCHOOL
PALACODE, DHARMAPURI DT-636808