

STOICHIOMETRY

12. MOLE CONCEPT

SOLUTIONS

TEACHING TASK

JEE MAIN LEVEL QUESTIONS

1. Which of the following is a hexa-atomic molecule
A) Phosphorus B) Sulphur C) Ethane D) Methane

Answer:None

Solution:Phosphorus (P): Exists as tetra-atomic molecules (P_4).

Sulphur (S): Exists as octa-atomic molecules (S_8).

Ethane (C_2H_6): Has a total of eight atoms (two carbon and six hydrogen).

Methane (CH_4): Has a total of five atoms (one carbon and four hydrogen).

2. The no. of electrons present in one mole of Azide ion are (N_3^-)
A) 21N B) 20N C) 22N D) 43N

Answer:C

Solution: N_3^- ion:

Each N atom has 7 electrons $\rightarrow 3N$ atoms = 21 electrons.

Extra 1 electron due to -1 charge \rightarrow Total = 22 electrons per ion.

For 1 mole (N ions), total electrons = $22 \times N = 22N$.

3. The number of neutrons in one mole of hydrogen is
A) N B) 0.5N C) 0 D) 2N

Answer:C

Solution:Hydrogen (1H) has no neutrons (only 1 proton).

1 mole of H atoms = N atoms \times 0 neutrons = 0 neutrons.

4. The total number of atoms of all elements present in 1 mole of ammonium dichromate is

- A) 14 B) 19 C) 6×10^{29} D) 114×10^{23}

Answer:D

Solution:Formula unit: $(NH_4)_2Cr_2O_7 \rightarrow 2N + 8H + 2Cr + 7O = 19$ atoms.

1 mole contains $19 \times N$ atoms. = $19 \times 6 \times 10^{23} = 114 \times 10^{23}$

5. How many moles of Barium carbonate will contain 1.5 moles of oxygen atoms
A) 1 mole B) 0.5 mole C) 0.25 mole D) 0.4 mole

Answer:B

Solution: $BaCO_3$ has 3 oxygen atoms per mole.

To get 1.5 moles of O, divide by 3: Moles of $BaCO_3 = \frac{1.5}{3} = 0.5 \text{ mole}$

6. Total number of species present in 1 mole of potash alum in terms of avogadro number, 'N' are

A) 3N

B) 5N

C) 8N

D) 32N

Answer:D

Solution: The chemical formula of potash alum is $K_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$

Avogadro's number is represented by N.

Count the total number of species

Total K^+ ions: 2

Total Al^{3+} ions: 2

Total SO_4^{2-} ions: 3

Total H_2O molecules: 24

Total species: $2+2+3+24=32$

Total species in 1 mole: 32N

7. Which of the following contain 9×10^{23} oxygen atoms ?

A) 0.25 moles of glucose

B) 0.5 moles of ethyl alcohol

C) 1.0 mole of dimethyl ether

D) 0.01 moles of sucrose

Answer:A

Solution: 0.25 moles glucose ($C_6H_{12}O_6$) $\rightarrow 1.5N$ O atoms

0.5 moles ethanol (C_2H_5OH) $\rightarrow 0.5N$ O atoms

1.0 mole dimethyl ether (CH_3OCH_3) $\rightarrow 1N$ O atoms

0.01 moles sucrose ($C_{12}H_{22}O_{11}$) $\rightarrow 0.11N$ O atoms

1) 0.25 moles glucose gives 9.03×10^{23} O atoms).

8. How many atoms are contained in one mole of sucrose ($C_{12}H_{22}O_{11}$)?

A) $45 \times 6.02 \times 10^{23}$ atoms/moleB) $5 \times 6.62 \times 10^{23}$ atoms/moleC) $5 \times 6.02 \times 10^{23}$ atoms/mole

D) None of these

Answer:A

Solution: Understand the Formula of Sucrose ($C_{12}H_{22}O_{11}$):

Carbon (C): 12 atoms

Hydrogen (H): 22 atoms

Oxygen (O): 11 atoms

Total atoms per molecule: $12(C)+22(H)+11(O)=45$ atoms.

1 mole of any substance contains Avogadro's number (N) of molecules, where $N=6.022 \times 10^{23}$

For sucrose: Total atoms = $45 \text{ atoms/molecule} \times 6.022 \times 10^{23} \text{ molecules/mole}$.

Total atoms = $45 \times 6.022 \times 10^{23} \text{ atoms/mole}$.

9. A sample of phosphorus trichloride (PCl_3) contains 1.4 moles of the substance. How many atoms are there in the sample?

- A) 4 B) 5.6 C) 8.431×10^{23} D) 3.372×10^{24}

Answer:D

Solution: Understand the Molecular Structure of PCl_3 :

Phosphorus trichloride (PCl_3) consists of: 1 phosphorus (P) atom, 3 chlorine (Cl) atoms

Total atoms per molecule of PCl_3 : $1(\text{P}) + 3(\text{Cl}) = 4$ atoms.

Calculate Total Atoms in 1.4 Moles of PCl_3 :

1 mole of PCl_3 contains Avogadro's number (N) of molecules, where $N = 6.022 \times 10^{23}$

Atoms per mole of PCl_3 :

$4 \text{ atoms/molecule} \times 6.022 \times 10^{23} \text{ molecules/mole} = 2.4088 \times 10^{24} \text{ atoms/mole}$.

For 1.4 moles: $1.4 \text{ moles} \times 2.4088 \times 10^{24} \text{ atoms/mole} = 3.372 \times 10^{24} \text{ atoms}$.

10. The number of electrons in a mole of hydrogen molecule is

- A) 6.02×10^{23} B) 12.046×10^{23} C) 3.0115×10^{23} D) Indefinite

Answer:B

Solution: Understand the Hydrogen Molecule (H_2):

Each hydrogen atom (H) has 1 electron.

A hydrogen molecule (H_2) consists of 2 hydrogen atoms, so it has: 2 electrons per H_2 molecule.

Calculate Electrons in 1 Mole of H_2 :

1 mole of any substance contains Avogadro's number (N) of molecules, where $N = 6.022 \times 10^{23}$

For H_2 : Total electrons = $2 \text{ electrons/molecule} \times 6.022 \times 10^{23} \text{ molecules/mole}$.

Total electrons = 12.044×10^{23}

11. How many years it would take to spend Avogadro's number of rupees at the rate of 10 lac rupees per second?

- A) 1.9090×10^{15} year B) 1.9099×10^{10} year
C) 1.9800×10^5 year D) 1.978×10^{20} year

Answer:B

Solution: Given Data:

Avogadro's number (N) = 6.022×10^{23} rupees.

Spending rate = 10^6 rupees/second.

$$\text{Time (seconds)} = \frac{\text{Total rupees}}{\text{Rate}} = \frac{6.023 \times 10^{23}}{10^6} = 6.023 \times 10^{17} \text{ Seconds}$$

Convert Seconds to Years:

$$1 \text{ year} = 60 \times 60 \times 24 \times 365 \text{ seconds} = 3.154 \times 10^7 \text{ seconds}$$

$$\text{Time (years)} = \frac{6.022 \times 10^{17}}{3.154 \times 10^7} \approx 1.909 \times 10^{10} \text{ years}$$

12) Maximum number of atoms are present in

- A) 11.2 lit. of SO_2 at STP B) 22.4 lit. of Helium at STP
C) 22.4 lit of hydrogen D) 11.2 litres of methane at STP

Answer:D

Solution: At STP (Standard Temperature and Pressure):

1 mole of any gas occupies 22.4 L.

Number of atoms = Number of molecules \times atoms per molecule.

Option 1: 11.2 L of SO_2

Moles of $\text{SO}_2 = 11.2/22.4 = 0.5$ mole.

SO_2 molecule: 1 S + 2 O = 3 atoms/molecule.

Total atoms = $0.5 \times 6.022 \times 10^{23} \times 3 = 9.033 \times 10^{23}$.

Option 2: 22.4 L of He

Moles of He = $22.4/22.4 = 1$ mole.

He is monatomic: 1 atom/molecule.

Total atoms = $1 \times 6.022 \times 10^{23} \times 1 = 6.022 \times 10^{23}$

Option 3: 22.4 L of H_2

Moles of $\text{H}_2 = 1$ mole.

H_2 molecule: 2 atoms/molecule.

Total atoms = $1 \times 6.022 \times 10^{23} \times 2 = 12.044 \times 10^{23}$

Option 4: 11.2 L of CH_4

Moles of $\text{CH}_4 = 0.5$ mole.

CH_4 molecule: 1 C + 4 H = 5 atoms/molecule.

Total atoms = $0.5 \times 6.022 \times 10^{23} \times 5 = 15.055 \times 10^{23}$

Option 4 (11.2 L of CH_4) has the maximum number of atoms.

ADVANCED LEVEL QUESTIONS

MULTIPLE CORRECT ANSWER TYPE

13. Which of the following contains same number of atoms

- A) 1 mole of H_2 B) 2mole of CO_2 C) 2 mole of He D) 0.5 mole of O_3

Answer:A,C

Solution: 1) 1 mole of $\text{H}_2 = 2$ atoms

Total Atoms = $2(N) = 2N$

2) 2mole of $\text{CO}_2 = 1 + 2 = 3$ Atoms

Total atoms = $3 \times 2 \times N = 6N$

3) 2 mole of He = $2(1) = 2$ atom

Total atoms = $2 \times N = 2N$

4) 0.5 mole of $\text{O}_3 = 0.5 \times 3 = 1.5$ atoms

Total atoms = $1.5N$

Option 1 (1 mole of H_2) and Option 3 (2 mole of He) both contain $2N$ atoms.

14. The gas having same number of molecules as 0.5 mole of oxygen is

- A) 0.5 moles of O_3 B) 0.5 moles of SO_3
C) 0.5 mole of SO_2 D) 0.5 mole of hydrogen

Answer: A, B, C, D

Solution: Avogadro's Law: Equal volumes of gases at the same temperature and pressure contain equal numbers of molecules.

Moles \rightarrow Molecules: Depends only on the number of moles, not the gas identity.

STATEMENT TYPE

15. Assertion (A): Mole is equal to 6.022×10^{23} particles.

Reason (R): 6.022×10^{23} particles is known as avagadro number

Answer: A

Solution: Assertion : True — By definition, 1 mole of any substance contains 6.022×10^{23} entities (atoms, molecules, ions, etc.)

Reason : True — This is the definition of Avogadro's number.

COMPREHENSION TYPE

16. The numbers of atoms present in 0.166 moles of ozone is

- A) N_A B) $3N_A$ C) $\frac{N_A}{6}$ D) $\frac{N_A}{2}$

Answer: D

Solution: We are given: Amount of ozone (O_3) = 0.166 moles

We need to find the number of atoms, not molecules.

Let N_A = Avogadro's number = 6.022×10^{23}

1 molecule of ozone (O_3) contains 3 atoms of oxygen.

So, 1 mole of O_3 molecules contains: $1 \text{ mole} \times 3 \times N_A = 3N_A$ atoms.

Therefore, "0.166 moles of O_3 contains: $0.166 \times 3N_A = 0.498N_A = N_A/2$

17. Which of the following is a reasonable value for the numbers of atoms in 0.25 moles of helium ?

- A) 0.25 B) 4.0 C) 4.1×10^{-23} D) 1.5×10^{23}

Answer: D

Solution: Number of atoms = Number of moles \times Avogadro's number (N).

Avogadro's number (N) = 6.022×10^{23} atoms/mole.

Helium (He) is a monatomic gas (1 atom per molecule).

Calculation:

Number of atoms = $0.25 \text{ moles} \times 6.022 \times 10^{23} \text{ atoms/mole} = 1.5055 \times 10^{23} \text{ atoms}$.

INTEGER TYPE

18. The number of oxygen atoms present in 0.25 moles of calcium carbonate

Answer: 4.5165×10^{23}

Solution: Formula of Calcium Carbonate: CaCO_3

Contains 3 oxygen atoms per molecule.

Total Oxygen Atoms:

Number of atoms = Moles \times Avogadro's number \times Atoms per molecule

= $0.25 \text{ moles} \times 6.022 \times 10^{23} \times 3 = 4.5165 \times 10^{23}$ oxygen atoms

19. 1 mole of Sulphuric acid contains _____ moles of hydrogen atoms

Answer: 2

Solution: Formula of Sulphuric Acid: H_2SO_4

Contains 2 hydrogen atoms per molecule.

Moles of Hydrogen Atoms:

1 mole $\text{H}_2\text{SO}_4 \times 2 \text{ H atoms/molecule} = 2 \text{ moles of H atoms}$.

MATRIX MATCHING TYPE

20. **Answer: 1-C, 2-A, D-3, 4-B**

Column-I (For 1 mole)

- 1) Nitric oxide
- 2) Hydronium ion
- 3) Silver ions
- 4) Glucose

Column-II

- C) 1.204×10^{24} atoms
- A) 2.408×10^{24} atoms
- D) 2.770×10^{25} electrons
- B) 1.445×10^{25} atoms

Solution: 1) Nitric oxide (NO)

Formula: $\text{NO} \rightarrow 1 \text{ N} + 1 \text{ O} = 2 \text{ atoms/molecule}$.

Total atoms in 1 mole: $2 \times 6.022 \times 10^{23} = 1.204 \times 10^{24} \text{ atoms}$.

2) Hydronium ion (H_3O^+)

Formula: $\text{H}_3\text{O}^+ \rightarrow 3 \text{ H} + 1 \text{ O} = 4 \text{ atoms/ion}$.

Total atoms in 1 mole: $4 \times 6.022 \times 10^{23} = 2.408 \times 10^{24} \text{ atoms}$.

3) Ag^+ has 46 electrons (Ag atomic number = 47, minus 1 lost electron).

Total electrons: $46 \times 6.022 \times 10^{23} = 2.770 \times 10^{25} \text{ electrons}$.

Glucose ($C_6H_{12}O_6$)

Formula: $C_6H_{12}O_6 \rightarrow 6C + 12H + 6O = 24$ atoms/molecule.

Total atoms in 1 mole: $24 \times 6.022 \times 10^{23} = 1.445 \times 10^{25}$ atoms

LEARNER'S TASK

CONCEPTUAL UNDERSTANDING QUESTIONS (CUQ's)

- Atomicity is the number of
 - Protons present in the atom
 - Neutrons present in the atom
 - Atoms present in the molecule
 - Atoms present in 1 gram mole of a substance

Answer:C

Solution: Atomicity refers to the number of atoms in one molecule of a substance (e.g., $O_2 \rightarrow$ atomicity = 2).

- Which of the following is the smallest particle of matter that exist independently?

A) Atom B) Molecule C) element D) compound

Answer:B

Solution: Molecules (e.g., O_2 , H_2O) can exist independently, while atoms (e.g., He, Ne) may or may not.

- Which of the following is correct match
 - Atomic hydrogen - 6.022×10^{23} atoms
 - Zinc vapour - 6.022×10^{23} atoms
 - Ammonia - 6.023×10^{23} molecules
 - All the above

Answer:D

Solution: 1 mole of any substance contains Avogadro's number (6.022×10^{23}) of particles:

Atomic hydrogen (H): 6.022×10^{23} atoms.

Zinc vapour (Zn): 6.022×10^{23} atoms.

Ammonia (NH_3): 6.022×10^{23} molecules.

- Which of the following is the correct formula to calculate number of moles

A) No. of moles = $\frac{\text{Number of particles}}{6.023 \times 10^{23}}$
 B) No. of moles = $6.023 \times 10^{23} / \text{Number of particles}$
 C) Both A & B D) None

Answer:A

Solution: No. of moles = $\frac{\text{Number of particles}}{6.023 \times 10^{23}}$

- Number of atoms present is one mole of Hydrogen gas
 - 1 mole
 - 2 moles
 - 3 moles
 - 4 moles

Answer:B

Solution: H_2 has 2 atoms/molecule \rightarrow 1 mole $H_2 = 2 \times 6.022 \times 10^{23}$ atoms = 2 moles of atoms.

6. Number of electrons present in 1 mole of sodium ion

- A) 10 moles B) 11 moles C) 12 moles D) 9 moles

Answer:A

Solution: Na (atomic number 11) loses 1 electron to form $Na^+ \rightarrow$ 10 electrons/ion.

1 mole $Na^+ = 10 \times 6.022 \times 10^{23}$ electrons = 10 moles of electrons.

7. Number of atoms present in 2 moles of Hydrogen sulphide

- A) 12.046×10^{23} B) 18.069×10^{23} C) 6.023×10^{23} D) 3.0115×10^{23}

Answer:B

Solution: H_2S has 3 atoms/molecule \rightarrow 2 moles $H_2S = 2 \times 3 \times 6.022 \times 10^{23} = 3.613 \times 10^{24}$ atoms.

Closest option: 18.069×10^{23} (typo; likely meant 3.613×10^{24}).

8. Number of moles of sub atomic particles present in 1 mole of Hydrogen atoms

- A) 0 B) 1 C) 2 D) 4

Answer:C

Solution: Hydrogen atom (1H): 1 proton + 1 electron = 2 subatomic particles/atom.

1 mole H = $2 \times 6.022 \times 10^{23}$ particles = 2 moles of subatomic particles.

9. The number of revolving sub atomic particles in 1 mole of helium is

- A) 0 B) 2 C) 1 D) 4

Answer:B

Solution: Helium (He): 2 electrons/atom (revolving) + 2 protons/neutrons (non-revolving).

1 mole He = $2 \times 6.022 \times 10^{23}$ electrons = 2 moles of revolving particles.

10. if 10^{23} molecules are removed from 1 mole of NO_2 the number of molecules remaining are

- A) 6.023 B) 5.023 C) 5.023×10^1 D) 5.023×10^{23}

Answer:D

Solution: 1 mole $NO_2 = 6.022 \times 10^{23}$ molecules.

Remaining molecules = $6.022 \times 10^{23} - 1 \times 10^{23} = 5.022 \times 10^{23}$.

JEE MAIN LEVEL QUESTIONS

11. One mole of CO_2 contains

- a) 6.02×10^{23} atoms of C b) 6.02×10^{23} atoms of O
c) 18.1×10^{23} molecules of CO_2 d) 3 gram of carbon.

Answer:A

Solution: Understand 1 Mole of CO_2

Avogadro's number (N)= 6.022×10^{23} entities/mole.

1 mole of CO_2 contains: 6.022×10^{23} molecules of CO_2

1 atom of C and 2 atoms of O per molecule.

12. Which of the following contains maximum number of atoms ?

- a) 2.0 mole of S_8 . b) 6.0 mole of S
c) 5.5 mole of SO_2 . d) 4 moles of CO

Answer:C

Solution: a) S8: 8 atoms/molecule $\rightarrow 2 \times 8 \times 6.022 \times 10^{23} = 9.635 \times 10^{24}$ atoms.

b) S: 1 atom/molecule $\rightarrow 6 \times 6.022 \times 10^{23} = 3.613 \times 10^{24}$ atoms.

c) SO₂: 3 atoms/molecule $\rightarrow 5.5 \times 3 \times 6.022 \times 10^{23} = 9.936 \times 10^{24}$ atoms.

d) CO: 2 atoms/molecule $\rightarrow 4 \times 2 \times 6.022 \times 10^{23} = 4.818 \times 10^{24}$ atoms.

13. 1 mole of ${}^{14}_7\text{N}^{-3}$ ions contains

- A) $7 \times 6.023 \times 10^{23}$ electrons
B) $7 \times 6.023 \times 10^{23}$ protons
C) $7 \times 6.023 \times 10^{23}$ neutrons
D) $14 \times 6.023 \times 10^{23}$ protons

Answer: B, C

Solution: Atomic number (Z) = 7 \rightarrow 7 protons

Mass number (A) = 14

Neutrons = $14 - 7 = 7$ neutrons

Charge = 3- → means 3 extra electrons than protons

So, electrons = $7 + 3 = 10$ electrons

Avogadro's number $N_A = 6.022 \times 10^{23}$

$$\text{Number of:Electrons} = 10N_A$$
$$\text{Protons} = 7N_A$$
$$\text{Neutrons} = 7N_A$$

14. One mole of sodium represents

- A) 6.02×10^{23} atoms of sodium B) 6.02×10^{23} molecules of sodium
C) Both A & B D) None

Answer:A

Solution: 1 mole of any substance, be it atoms/molecules /ions or even sub-atomic particles like

electrons, protons or neutrons, they all contain Avogadro Number 6.02×10^{23} particles.

So, 1 mole of sodium = 6.02×10^{23} atoms of sodium

or, 1 mole of sodium = 23 g, which is its atomic mass per mole.

ADVANCED LEVEL QUESTIONS

MULTIPLE CORRECT ANSWER TYPE

21) A pair of gasses having same number of atoms are

- A) 1 mole of H_2 B) 2 moles of He C) 0.25 moles of CO_2 D) 1 mole of N_2

Answer:A,B,D

Solution: Calculate Total Atoms for Each Option:

Avogadro's number (N) = 6.022×10^{23} entities/mole.

Option 1: 1 mole of H_2

H_2 is diatomic (2 atoms/molecule).

Total atoms = $1 \times 2 \times N = 2N$.

Option 2: 2 moles of He

He is monatomic (1 atom/molecule).

Total atoms = $2 \times 1 \times N = 2N$.

Option 3: 0.25 moles of CO_2

CO_2 has 3 atoms/molecule (1 C + 2 O).

Total atoms = $0.25 \times 3 \times N = 0.75N$.

STATEMENT TYPE

22. Assertion (A): 1 mole of magnesium ion contains 12 moles of protons

Reason (R): Mole is equal to 6.022×10^{23} particles.

Answer:B

Solution: Evaluate Assertion (A):

Magnesium ion (Mg^{2+}):

Atomic number of Mg = 12 \rightarrow 12 protons per ion.

1 mole of Mg^{2+} = $12 \times 6.022 \times 10^{23}$ protons = 12 moles of protons.

Conclusion: Assertion (A) is correct.

Evaluate Reason (R):

Definition of mole:

1 mole = 6.022×10^{23} particles (Avogadro's number).

Conclusion: Reason (R) is correct.

INTEGER TYPE

23. The number of moles of electrons in 2 moles of Aluminium ions is _____

Answer:20

Solution: Atomic number of Al = 13 \rightarrow Neutral Al has 13 electrons.

Al^{3+} loses 3 electrons \rightarrow 10 electrons per ion.

Total Electrons in 2 Moles of Al^{3+} :

Electrons = 2 moles $Al^{3+} \times 10$ electrons/ion = 20 moles of electrons

24. 1 mole of protons charge in faraday is _____

Answer:1

Solution: Charge of 1 Proton:

Proton charge = $+1.602 \times 10^{-19} \text{C}$.

Charge of 1 Mole of Protons:

$1 \text{ mole protons} \times 1.602 \times 10^{-19} \text{C/proton} \times 6.022 \times 10^{23} \text{ protons/mole} = 96,485 \text{C} = 1 \text{ Faraday (F)}$.

MATRIX MATCHING TYPE

25) Answer: A-4, B-3, C-2, D-1

List - I

(No. of moles of compound)

A) 1.5 Moles of BaCO_3

B) 2 moles of H_2SO_4

C) 2.5 moles of ZnCO_3

D) 0.5 mole of glucose

List - II

(No. of moles of the oxygen atoms)

4) 4.5

3) 8

2) 7.5

1) 3

Solution:

A) 1.5 Moles of BaCO_3

Total moles of O: $1.5 \times 3 = 4.5$

B) 2 moles of H_2SO_4

Total moles of O: $2 \times 4 = 8$

C) 2.5 moles of ZnCO_3

Total moles of O: $2.5 \times 3 = 7.5$

D) 0.5 mole of glucose ($\text{C}_6\text{H}_{12}\text{O}_6$)

Total moles of O: $0.5 \times 6 = 3$

KEY

TEACHING TASK									
JEE MAIN LEVEL QUESTIONS									
1	2	3	4	5	6	7	8	9	10
none	C	C	D	B	D	A	A	D	B
11	12								
B	D								
ADVANCED LEVEL QUESTIONS									
13	14	15	16	17	18	19	20		
A,C	A,B,C,D	A	D	D	4.5165×10	2	1-C,2-A,D-3,4-B		
LEARNER'S TASK									
CONCEPTUAL UNDERSTANDING QUESTIONS (CUQ's)									
1	2	3	4	5	6	7	8	9	10
C	B	D	A	B	A	B	C	B	D
JEE MAIN LEVEL QUESTIONS									
11	12	13	14	15	16	17	18	19	20
A	C	B,C	A	A	A	A,D	A	D	D
ADVANCED LEVEL QUESTIONS									
21	22	23	24	25					
A,B,D	B	20	1	A-4,B-3,C-2,D-1					

Educational Operating System



Educational Operating System