STOICHIOMETRY-ATOMIC AND MOLECULAR WEIGHTS
SOLUTIONS

TEACHING TASK

JEE MAINS LEVEL QUESTIONS

1. Calculate the number of Al^{3+} and SO_4^{2-} ions in 342 g of anhydrous $Al_2(SO_4)_3$.
A) 2N, 3N B) 4N, 6N C) 6N, 9N D) 3N, 2N
Solution:To determine the number of Al^{3+} and SO_4^{2-} ions in 342 g of anhydrous $Al_2(SO_4)_3$, let's follow these steps:
Calculate the Molar Mass of $Al_2(SO_4)_3$

$$2(27)+3(32+4(16))$$
$$=342g$$

Determine the Number of Moles in 342 g
Number of moles = Given mass/Molar mass = 342g/342 g/mol= 1 mole
Find the Number of Ions in 1 Mole of $Al_2(SO_4)_3$
Al^{3+} ions:
Each formula unit of$Al_2(SO_4)_3$ contains 2 Al^{3+} ions.
For 1 mole:
2 N_A = 2N ions
(where (N_A) is Avogadro's number, and (N) represents (N_A) in the options.)
$SO4^{2-}$ ions
Each formula unit of $Al_2(SO_4)_3$ contains 3 SO_4^{2-} ions.
For 1 mole:
3 N_A = 3N
Conclusion
The number of Al^{3+} ions is 2N, and the number of $SO4^{2-}$ ions is 3N.
Answer:A

2. Which pair contains the same number of molecules?
A) 28 g N_2 and 32 g O_2 B) 18 g H_2O and 44 g CO_2
C) 16 g CH_4 and 22 g N_2O D) 2 g H_2 and 4 g He
Solution: The number of molecules is directly proportional to the number of moles (Avogadro's Law), substances with the same number of moles will have the same number of molecules.

$$number of moles(n) = \frac{Weight}{GMW}$$

A) 28 g N_2 and 32 g O_2

Number of moles of N_2= $\frac{28}{28}=1mole$,Number of moles of O_2= $\frac{32}{32}=1mole$

B) 18 g H_2O and 44 g CO_2

Number of moles of $H_2O = \frac{18}{18} = 1 mole$,Number of moles of $CO_2 = \frac{44}{44} = 1 mole$

C) 16 g CH4 and 22 g N2O

Number of moles of $CH4 = \frac{16}{16} = 1 mole$, Number of moles of $N2O = \frac{22}{44} = 0.5 mole$

D) 2 g H2 and 4 g He

Number of moles of $H2 = \frac{2}{2} = 1 mole$,Number of moles of $He = \frac{4}{4} = 1 mole$

Answer:A,B,D

3.The total number of gram-atoms of oxygen in 28.4 g of P_4O_{10} is:

A) 0.1 B) 0.4 C) 1.0 D) 4.0

Solution: Molar Mass of P_4O_{10}= 124 + 160 = 284 g/mol

Number of moles= $\frac{28.4}{284} = 0.1 mole$

Each molecule of P_4O_{10} contains 10 oxygen atoms.

Therefore, for 0.1 moles of P_4O_{10}, the number of moles of oxygen atoms=0.1(10)=1

The total number of gram-atoms of oxygen is 1.0.

Answer:C

4.How many atoms are present in one mole of glucose?

A) $24 \times 6.02 \times 10^{23}$ B) $12 \times 6.02 \times 10^{23}$

C) $6 \times 6.02 \times 10^{23}$ D) $3 \times 6.02 \times 10^{23}$

Solution:Total atoms per glucose ($C_6H_{12}O_6$)molecule: 6 + 12 + 6 = 24 atoms

Avogadro's number N_A states that 1 mole of any substance contains 6.023×10^{23} entities (molecules, atoms, etc.).

Since 1 glucose molecule has 24 atoms, 1 mole of glucose will have: $24 \times 6.023 \times 10^{23}$ atoms

Answer:A

5. A sample contains 0.5 moles of phosphorus pentachloride (PCl_5). Total atoms present are:

A) 3.612×10^{23} B) 1.806×10^{24} C) 6.02×10^{23} D) 4.816×10^{23}

Solution:Total atoms per PCl_5 molecule:1 + 5 = 6 atoms

Avogadro's number N_A states that 1 mole of any substance contains 6.023×10^{23} entities (molecules, atoms, etc.).

Since 1 PCl_5molecule has 6atoms, 1 mole of PCl_5 will have: $6 \times 6.023 \times 10^{23}$ atoms

0.5 mole of PCl_5 will have: $0.5 \times 6 \times 6.023 \times 10^{23}$ atoms=18.06×10^{23} =1.806×10^{24}atoms

Answer:B

6. The molecular weight of ozone (O_3) is 48. The mass of 2 moles of O_3 is:

A) 48 a.m.u B) 96 mg C) 96 g D) 48 kg

Solution:Molecular weight of O_3 (ozone) = 48 g/mol

The mass of 2 moles of O_3 =2(48)=96g

Answer:C

7.Number of electrons in 2 moles of helium gas (He):

A) 6.02×10^{23} B) 2.408×10^{24} C) 3.01×10^{23} D) 4.816×10^{24}

Solution:The atomic number of helium (He) is 2, meaning each helium atom has 2 electrons.

Avogadro's number N_A states that 1 mole of any substance contains 6.023×10^{23} entities (molecules, atoms, etc.).

The number of electrons in 2 moles of helium gas $= 2 \times 2 \times 6.023 \times 10^{23} = 24.08 \times 10^{23} = 2.408 \times 10^{24}$

Answer:B

8. Which has the most molecules?

A) 36 g H_2O B) 28 g N_2 C) 32 g O_3 D) 44 g C_3H_8

Solution:To determine which option has the most molecules, we compare the number of moles of each substance, since the number of molecules is directly proportional to the number of moles (Avogadro's Law).

A) 36 g H_2O

Number of moles of $H_2O = \frac{36}{18} = 2 moles$

B) 28 g N_2

Number of moles of $N_2 = \frac{28}{28} = 1 mole$

C) 32 g O_3

Number of moles of $O_3 = \frac{32}{48} = 0.666 moles$

D) 44 g C_3H_8

Number of moles of $C_3H_8 = \frac{44}{44} = 1 mole$

Option A (36 g H_2O) has the highest number of moles (2 moles), meaning it contains the most molecules.

Answer:A

9. Number of moles in 158 g of $KMnO_4$:

A) 0.5 B) 1 C) 2 D) 5

Solution:Total Molar Mass of $KMnO_4$:39 + 55 + (4 (16)) = 39 + 55 + 64 = 158 g/mol

Number of moles of $KMnO_4 = \frac{158}{158} = 1 mole$

Answer:B

10.Number of oxygen atoms in 98 g H_2SO_4 is equal to the number of oxygen atoms in:

A) 32 g O_2 B) 80 g SO_3 C) 64 g SO_2 D) 60 g CH_3COOH

Solution:Molar mass of $H_2SO_4 = 2(1)+32+4(16)=98$

Number of moles Of $H_2SO_4 = \frac{98}{98} = 1 mole$

One mole of H_2SO_4 have 4N oxygen atoms

A) 32 g O_2

Number of moles= $\frac{32}{32} = 1 mole$

1 mole of O_2 have 2N oygen atoms

B) 80 g SO_3

Number of moles= $\frac{80}{80} = 1 mole$

1 mole of SO_3 have 3N oxygen atoms

C) 64 g SO_2

Number of moles= $\frac{64}{64} = 1 mole$

1 mole of SO_2 have 2N oxygen atoms

D) 60 g CH_3COOH

Number of moles= $\frac{60}{60} = 1 mole$

1 mole of CH_3COOH have 2N oxygen atoms

Answer:None of the above

JEE ADVANCED LEVEL QUESTIONS

Multi correct answer type:

11. The Mysterious Diatomic Gas An unknown diatomic gas (X_2) has the following properties:

1 molecule has a mass of 9.6×10^{-23} g

Its molar specific heat at constant volume (Cv) is 20.8 J/mol·K

Which elements could 'X' be?

A) Nitrogen (N) B) Oxygen (O) C) Fluorine (F) D) Neon (Ne)

Solution:Given: Mass of 1 molecule=9.6×10^{-23} g

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

Molar mass (M) = Mass of 1 molecule × N_A

$= 9.6 \times 10^{-23} g \times 6.022 \times 10^{23} = 57.8 g/mol$

Since $X_2$is diatomic, the atomic mass of X=57.8/2=28.9

The closest match to 28.9 g/mol is Nitrogen

Answer:A

12.The Nanoparticle Puzzle A gold nanoparticle contains exactly 1000 gold atoms.

Analysis shows:

It carries a charge of $+1.6 \times 10^{-18}$ C

Its mass is 3.27×10^{-19} g

Which statements are correct?

A) The nanoparticle has lost 10 electrons

B) The atomic mass unit (amu) is 1.66×10^{-24} g

C) The nanoparticle's diameter is ~ 2 nm

D) Gold's atomic weight is 197 g/mol

Solution:A)Number of electrons lost: $\frac{1.61\times10^{-18}C}{1.61\times10^{-19}Celectron}=10electrons$

B)By definition, 1 amu (unified atomic mass unit) = 1.66 × 10 $^{-24}$ g

C)Mass of 1000 gold atoms: $3.27\times10^{-19}g$

Mass of 1 gold atom= $\frac{3.27\times10^{-19}g}{1000}=3.27\times10^{-22}$

Atomic mass of gold (Au): 197 g/mol

Mass of 1 gold atom in amu: $197amugoldatom\times1.66\times10^{-24}g/3.27\times10^{-22}$

Volume of 1 gold atom:

Gold has a density of ~19.3 g/cm³.

Volume of 1000 atoms: $\frac{3.27\times10^{-19}g}{19.3gcm^{3}}=1.7\times10^{-20}cm$

Assuming a spherical nanoparticle, diameter (d) is calculated from volume $V=\frac{\prod d^{3}}{6}$

d˜2nm

D)gold's standard atomic weight is 197 g/mol

Answer:A,B,C,D

Assertion and Reason Type:

13.**Assertion: The mass of 1 atom of helium is 4 times heavier than 1 atom of hydrogen.**

Reason: The atomic mass of helium (4 u) is exactly 4 times that of hydrogen (1 u).

Solution: Atomic Mass of Hydrogen (H):

The most common isotope of hydrogen (protium, ^{1}H) has an atomic mass of ˜1 u (1 proton + 0 neutrons).

Atomic Mass of Helium (He):

The most common isotope of helium (4He) has an atomic mass of ˜4 u (2 protons + 2 neutrons).

Helium (4 u) is indeed 4 times heavier than hydrogen (1 u)

Answer:A

14. **Assertion: At STP, 28 g of nitrogen gas (N_2) and 32 g of oxygen gas (O_2) occupy different volumes despite having the same number of molecules.**

Reason: The molar volume of a gas at STP (22.4 L) depends on its molecular weight.

Solution: Molar Mass and Moles:

N_2: Molar mass = 28 g/mol → 28 g = 1 mole of N_2.

O_2: Molar mass = 32 g/mol → 32 g = 1 mole of O_2.

Number of Molecules:

Both 1 mole of N_2 and 1 mole of O2 contain Avogadro's number (6.022 × 10²³) of

molecules.
Thus, the Assertion's claim that they have the same number of molecules is correct.
Volume at STP:
At STP (Standard Temperature and Pressure: 273 K, 1 atm), 1 mole of any ideal gas occupies 22.4 L.
Therefore:
1 mole of N_2 = 22.4 L
1 mole of O_2 = 22.4 L
The Assertion states that they occupy different volumes, which is incorrect because they occupy the same volume (22.4 L).
Reason Analysis:
The Reason claims that the molar volume (22.4 L) depends on molecular weight, which is false.
Molar volume at STP is the same for all ideal gases, regardless of molecular weight. It depends only on temperature and pressure, not on the gas's identity.
Answer:D
Comprehension Type:
15. What is the standard temperature in Kelvin at S.T.P?
a) 0 K b) 273 K c) 298 K d) 373 K
Solution:Standard Temperature (STP) = 0°C = 273 K
Answer: b
16. What is the standard pressure at S.T.P?
a) 760 mmHg b) 1 Pa c) 1 bar d) 100 kPa
Solution:Standard Pressure (STP) = 1 atm = 760 mmHg
Answer: a
17. What is the volume of 1 gram-molecular volume of a gas at S.T.P?
a) 22.4 mL b) 22.4 L c) 24.0 L d) 22.4 m^3
Solution:1 mole of any gas at STP occupies 22.4 L.
Answer: b
Integer type:
18. The number of moles of carbon dioxide (CO_2) present in 88 grams of CO_2 is ____.
Solution:Number of moles= $\frac{Weight}{GMW} = \frac{88}{44} \quad 2moles$
Answer:2 moles
19. 500 cm^3 of a gas measured at S.T.P. has a mass of 0.715 g. The molecular weight of the gas is ____.
Solution:At STP,Any gas occupies 22400ml
x gms of gas occupies 22400ml
0.715g occupies 500ml

$$\frac{xml}{0.715g} \quad \frac{22400}{500} \quad ml$$

$$xgms \quad \frac{22400 \times 0.715}{500} \quad 32$$

Answer:32gms

Matrix Matching Type:

20.

Substance	**No.of Moles**
a) 4.4 g of CO2	A) 0.25
b) 6.022 × 10^{22} atoms of He	B) 0.1
c) 2.24 L of CH4 at STP	C) 0.5
d) 16 g of O2	D) 0.05

Solution:a) 4.4 g of CO2

Number of moles= $\frac{4.4}{44} = 0.1 moles$

b) 6.022 × 10^{22} atoms of He

1 mole He= 6.022×10^{23} atoms

x moles of He=) 6.022 × 10^{22}

$x moles \quad \frac{6.022 \times 10^{22}}{6.022 \times 10^{23}} \quad 0.1$

c) 2.24 L of CH4 at STP

1 mole=22.4litres

x moles **=2.24litres**

$x moles \quad \frac{2.24}{22.4} \quad 0.1$

d) 16 g of O2

1 mole of O_2=32gms

x moles of O_2=16gms

x moles=16/32=0.5moles

Answer:a-B,b-B,c-B,d-D

LEARNERS TASK

CONCEPTUAL UNDERSTANDING QUESTIONS (CUQ's)

1. 1 atomic mass unit (amu) is closest to the mass of:

A) 1 proton B) 1/12th of a C-12 atom C) 1 hydrogen atom D) 1 neutron

Solution:By definition, 1 amu is exactly 1/12th the mass of a carbon-12 (C-12) atom.

Answer:B

2. The mass of a single oxygen (O_2) molecule is approximately:

A) 16 g B) 32 g C) 5.32 × 10^{-23} g D) 6.022 × 10^{23} g

Solution:Oxygen gas (O_2) consists of two oxygen atoms.

The atomic mass of oxygen (O) is 16 atomic mass units (amu).

Thus, the molecular mass of O_2 is:2x 16 = 32 amu

Answer:C

3. The smallest particle of an element that retains its chemical properties is:

A) Electron B) Atom C) Molecule D) Ion

Solution:An atom is the smallest particle of an element that retains all the chemical properties of that element.

Answer:B

4. The mass of 1 mole of magnesium (Mg) atoms is:

A) 12 g B) 24 g C) 48 g D) 6 g
Solution:The atomic mass of magnesium (Mg) is approximately 24
Answer:B
5. Avogadro's number represents the number of:
A) Electrons in 1 g of hydrogen B) Atoms in 1 gram atomic mass
C) Molecules in 1 liter of gas D) Protons in 1 amu
Solution:Avogadro's number is 6.022×10^{23}, and it represents the number of elementary entities (atoms, molecules, ions, etc.) in 1 mole of a substance.
Answer:B
6. The mass of oxygen present in 1 mole of H_2SO_4 is:
A) 16 g B) 64 g C) 32 g D) 48 g
Solution:1mole of H_2SO_4 have 4 oxygen atoms
mass of oxygen=4(16)=64g
Answer:B
7. The mass of 0.5 gram-atoms of iron (Fe) is:
A) 28 g B) 56 g C) 14 g D) 112 g
Solution:1 gram-atom of an element is equal to its atomic mass expressed in grams (equivalent to 1 mole of atoms of that element).
For iron (Fe), the atomic mass is 56 g/mol
0.5 gram-atoms of Fe means half the mass of 1 mole of Fe atoms
Mass=0.5(56)=28g
Answer:A
8. The mass of 0.2 gram-atoms of phosphorus (P) is:
A) 6.2 g B) 3.1 g C) 12.4 g D) 15.5 g
Solution:1 gram-atom of an element is equal to its atomic mass expressed in grams (equivalent to 1 mole of atoms of that element).
phosphorus (P), the atomic mass is 31 g/mol
Mass=0.2(31)=6.2g
Answer:A
9. The mass of 4 gram-atoms of sodium (Na) is:
A) 23 g B) 46 g C) 92 g D) 11.5 g
Solution:1 gram-atom of an element is equal to its atomic mass expressed in grams (equivalent to 1 mole of atoms of that element).
Mass of Na=23g
Mass of 4 gram-atoms of sodium (Na)=4(23)=92g
Answer:C
10. The mass of 1.5 moles of Al_2O_3 is:
A) 51 g B) 153 g C) 204 g D) 76.5 g
Solution:1 mole mass of Al_2O_3=2(27)+3(16)=102
1.5moles mass of Al_2O_3=1.5(102)=153g
Answer:B
11. The number of moles in 49 grams of H_3PO_4 is:
A) 0.5 B) 1 C) 2 D) 3
Solution:1mole of H_3PO_4 =3+31+4(16)=98g
49g of H_3PO_4=? moles
Number of moles=49/98=0.5moles
Answer:A

12. The mass of 0.25 moles of glucose ($C_6H_{12}O_6$) is:
A) 45 g B) 90 g C) 180 g D) 22.5 g
Solution:1 mole of $C_6H_{12}O_6$=6(12)+12+6(16)=180g
The mass of 0.25 moles of glucose ($C_6H_{12}O_6$) =0.25(180)=45g
Answer:A

JEE MAINS LEVEL QUESTIONS

13.The ratio of the number of atoms in 2g of helium (He) to the number of molecules in 8g of methane (CH4) is:
A) 1:2 B) 1:1 C) 2:1 D) 4:1
Solution:Molar mass of He = 4 g/mol
Number of moles in 2 g=2/4=0.5moles
Molar mass of CH4 = 12 + 4 = 16 g/mol
Number of moles in 8 g CH4 =/16=0.5moles
Ratio of number of He atoms to CH4 molecules=0.5:0.5=1:1
Answer:B
14.Total number of protons in 5g of ammonium phosphate (NH4)3PO4 is:
(Given: N0 = 6.022×10^{23}, atomic numbers: P=15, N=7, O=8, H=1)
A) $3.01\times10^{2}4$ B) $1.51\times10^{2}4$ C) 6.02×10^{23} D) $4.52\times10^{2}4$
Solution:Molecular mass of (NH4)3PO4=3(14+4)+31+4(16)=149gms
149gms have 80N protons
5gms= x Protons

$$x = \frac{80 \times 6.022 \times 10^{23}}{149} = 16.166101.616610^{2323}$$

Answer:B
15.How many moles of oxygen atoms are present in 4.9g of sulfuric acid (H2SO4)?
A) 0.05 B) 0.1 C) 0.2 D) 0.4
Solution:Molecular mass of H2SO4=2+32+64=98gms
98gms have 4 oxygen atoms
4.9gms=?
Number of atoms=4(4.9)/98=0.2atoms
Answer:C
16.Number of gram-atoms of sulfur in 9.6g of sulfur trioxide (SO_3) is:
A) 0.1 B) 0.12 C) 0.24 D) 0.3
Solution:Total Molar Mass of SO_3=32+48=80g/mol
Moles of SO_3=9.6/80=0.12
Answer:B

17.16g of ozone (O3) is equal to:
A) 1 gram-atom of oxygen
B) 1 gram-equivalent of oxygen
C) 2 gram-moles of oxygen
D) None
Solution:1 gram-atom of oxygen = 1 mole of oxygen atoms = 16 g of oxygen (since atomic mass of O = 16).

But 16 g of ozone (O3) contains only 3/3 = 1 , \text{mole of oxygen atoms}) (since each O3 molecule has 3 O atoms).
So, 16 g of ozone does equal 1 gram-atom of oxygen (since it contains 1 mole of O atoms).

Answer:A

18.Moles of water released when 10g of hydrated sodium carbonate ($Na_2CO_3 \cdot 10H_2O$) is heated to anhydrous form?

A) 0.1 B) 0.35 C) 0.5 D) 0.7

Solution:Total Molar Mass of $Na_2CO_3 \cdot 10H_2O$=46 + 12 + 48 + 180 = 286g
1 mole of Na2CO3·10H2O releases 10 moles of H2O when heated.

number moles for 10gms= $\frac{10}{286} = 0.035 moles$

Thus, 0.035 moles of Na2CO3·10H2O will release:0.035(10)=0.35 moles of water.

Answer:B

19.Number of gram-atoms in 14g of nitrogen gas (N2) is:

A) 0.5 B) 1 C) 2 D) 1.5

Solution:No.of moles of N_2=14/28=0.5moles
For nitrogen molecule 2 nitrogen atoms are present
Number of gram-atoms=2(0.5)=1

Answer:B

20.Volume of 0.1M HCl required to neutralize 0.05 moles of Na2CO3 completely is:

A) 250 mL B) 500 mL C) 1 L D) 100 mL

Solution: $Na_2CO_3 + 2HCl \rightarrow 2NaCl + H_2O + CO_2$

for one mole Na_2CO_3 two moles of HCl required

For 0.05moles of Na_2CO_3 =? moles of HCl

Moles of HCl=2(0.05)=0.1moles

Molarity= $\frac{Moles}{V}$, $V = \frac{Moles}{Molarity} = \frac{0.1}{0.1} = 1$

Answer:C

21.Number of gram-atoms in 24g of carbon and 48g of oxygen combined is:

A) 3 B) 5 C) 6 D) 7

Solution:Gram-atoms of C=24/12=2
Gram-atoms of O=48/16=3
Total gram-atoms=Gram-atoms of C+Gram-atoms of O=2+3=5

Answer:B

22.Total moles of atoms in 6g of ethane (C_2H_6) and 7g of nitrogen (N_2) is:

A) 0.5 B) 1.5 C)1 D)2

Solution:No.of moles of C_2H_6=6/30=0.2
For 1mole 8atoms are present
For 0.2 moles of C_2H_6 =0.2(8)=1.6atoms
No.of moles of N_2=7/28=0.25
For 1 mole two nitrogen atoms are present
For 0.25 moles of N_2=0.25(2)=0.5Atoms

Total atoms=1.6+0.5=2.1atoms

Answer:D

23.Mass percentage of iron in ferric oxide (Fe_2O_3) is closest to:

A) 35% B) 70% C) 50% D) 80%

Solution:Molecular mass of Fe_2O_3=2(56)+3(16)=112+48=160

Mass%=$\frac{112}{160}\times 100\%$=70%

Answer:B

24.Number of electrons in 9g of water (H2O) is: (Given: N0 = 6.022×10^{23})

A) 3.01×10^{24} B) 6.02×10^{23} C) 1.5×10^{24} D) 4.5×10^{24}

Solution:Number of moles of water= $\frac{9}{18}=0.5 moles$

Number of molecules=0.5x $6.022\times10^{23}=3.011\times10^{23}$ molecules

Total electrons per H2O molecule:2+8=10electrons

Total electrons=10x$3.011\times10^{23}=3.011\times10^{24}$

Answer:A

JEE ADVANCED LEVEL QUESTIONS

Multi correct answer type:

25. Which of the following statements is/are correct for 1 mole of oygen?

A) Occupies 22.4 L

B) Contains $2\times N_0$ molecules

C) Has the same number of atoms as 4 g of helium (He))

D) Contains $16\times N_0$ protons

Solution:1 O_2 molecule has 16 protons (8 protons per O atom × 2 atoms).

1 mole of O_2 = N0 molecules = N0 × 16 protons = 16 × N0 protons.

Answer:D

26.Which of the following statements is/are true CH_4?

A) Contains N_0 molecules

B) Has $10\times N_0$ electrons

C) Occupies 22.4 L at STP

D) Contains $3\times N_0$ atoms

Solution:Option A: Contains N0 molecules

1 mole of any substance contains Avogadro's number (N0) of molecules.

For CH4, 1 mole = N_0 molecules.(Correct).

Option B: Has $10\times N_0$ electrons

1 CH4 molecule has:

Carbon (C): 6 electrons

4 Hydrogen (H) atoms: 4 × 1 = 4 electrons

Total per CH4 = 6 + 4 = 10 electrons

1 mole of CH4 = N0 molecules × 10 electrons/molecule = 10 × N0 electrons.(Correct)

Option C: Occupies 22.4 L at STP

At STP, 1 mole of any gas occupies 22.4 L.

CH4 is a gas at STP, so 1 mole = 22.4 L.(Correct).

Option D: Contains $3 \times N_0$ atoms
1 CH4 molecule has:
1 C atom + 4 H atoms = 5 atoms.
1 mole of CH4 = N0 molecules × 5 atoms/molecule = $5 \times N_0$ atoms.
But the option says 3 × N0 atoms, which is incorrect.(Incorrect).
Answer:A,B,C
Assertion and Reason Type:
27.Assertion (A): The mass of one atom of carbon-12 is exactly 12 atomic mass units (u).
Reason (R): The atomic mass unit (u) is defined as 1/12th the mass of a carbon-12 atom.
Solution:Atomic Mass Unit (u) Definition:
By definition, 1 u = 1/12th the mass of a carbon-12 atom.
Therefore, the mass of one carbon-12 atom = 12 u (exactly).
Assertion (A):Correct, because the mass of a carbon-12 atom is indeed exactly 12 u (by definition).
Reason (R):Correct, and it directly explains why Assertion (A) is true.
Answer:A
28.Assertion (A): 16 g of methane (CH_4) and 64 g of oxygen (O_2) occupy the same volume at STP.
Reason (R): Both gases contain the same number of molecules at STP.
Solution:Molar Masses:
Methane (CH_4): 12 (C) + 4×1 (H) = 16 g/mol
Oxygen (O_2): 2×16 = 32 g/mol
Number of Moles:
16 g CH_4 = 16 g / 16 g/mol = 1 mole
64 g O_2 = 64 g / 32 g/mol = 2 moles
Volume at STP:
1 mole of any gas at STP = 22.4 L
1 mole CH_4 = 22.4 L
2 moles O_2 = 2 × 22.4 L = 44.8 L
Number of Molecules:
1 mole CH_4 = N0 molecules
2 moles O_2 = 2N0 molecules
Assertion (A):
Incorrect, because 16 g CH_4 (22.4 L) and 64 g O_2 (44.8 L) do not occupy the same volume.

Reason (R):Incorrect, because they do not contain the same number of molecules (CH_4 has N0, O_2 has 2N0).
Conclusion:Assertion (A) is wrong.,Reason (R) is also wrong.
Answer:D
Comprehension Type:
29.What is a gram molecule?
A) The weight of one molecule of a substance

B) The weight of Avogadro's number of molecules of a substance
C) The volume occupied by one mole of a gas at STP
D) The number of atoms in one gram of a substance
Solution: 1 mole = Avogadro's number (N0) of molecules, a gram molecule represents the weight of Avogadro's number of molecules of the substance.
Answer:B
30.What is the correct formula to calculate the number of gram molecules in a given mass of a substance?
A) Number of gram molecules = Mass (g) × Gram molecular weight
B) Number of gram molecules = Mass (g) / Gram molecular weight
C) Number of gram molecules = Gram molecular weight / Mass (g)
D) Number of gram molecules = Mass (g) + Gram molecular weight
Solution:Number of moles (gram molecules)=Mass/ Gram molecular weight (g/mol)
Answer:B
Integer type:
31.Volume occupied by 5.6 g of Nitrogen gas (N_2) at STP is _____ cc.
Solution:1 mole N_2=22400cc=22400ml
1 mole mass =28g
For 5.6g ,V=?
$28 \rightarrow 22400$
$5.6 \rightarrow x$
x=22400(5.6)/28=4480cc
Answer:4480
32.Number of moles of oxygen (O_2) present in 96 grams of ozone (O_3) is _____
Solution:Number of moles ofO_3= 96/48 =2 moles
$2O_3 \rightarrow 3O_2$
For 2 moles of ozone 3 moles of oxygen present
Answer:3
Matrix Matching Type:

	List - I	**List - II**
A)	2.016 g of (H_2) gas	i) 1 gram atom
B)	98 g of (H_2SO_4)	ii) 44.8 L at STP
C)	64 g of (O_2) gas	iii) 1 mole of molecules
D)	27 g of Aluminum (Al)	iv) 3 gram atoms
Solution:A)	2.016 g of (H_2) gas	iii) 1 mole of molecules
B)	98 g of (H_2SO_4)	iii) 1 mole of molecules
C)	64 g of (O_2) gas	ii) 44.8 L at STP
D)	27 g of Aluminum (Al)	i) 1 gram atom

KEY

			Teachers Task						
1	2	3	4	5	6	7	8	9	10
A	ABD	C	A	B	C	B	A	B	None
11	12	13	14	15	16	17	18	19	20
A	ABCD	A	D	B	A	B	2	32	a-B,b-B,c-I
			Learners Task						
1	2	3	4	5	6	7	8	9	10
B	C	B	B	B	B	A	A	C	B
11	12	13	14	15	16	17	18	19	20
A	A	B	B	C	B	A	B	B	C
21	22	23	24	25	26	27	28	29	30
B	D	B	A	D	ABC	A	D	B	B
31	32	33							
4480	3	A-iii,B-iii,C-ii,D-i							