Homework

(1) Find moles —

a) 20 g of H_2O

$H_2O = (1\times2) + 16$

$= 18\ g/mol$

H	O
1	8
1	16

moles, $n = \left(\frac{\text{given mass}}{\text{Molar mass}}\right)$

$n = \frac{20\ g}{18\ g/mol} = \frac{10}{9}$

$= 1.11\ mol$

mass of 1 single $H_2O = 18\ u$

mass of 1 mole H_2O (6.022×10^{23}) $= 18\ g$

b) 340 g of NH_3 → $NH_3 = 14 + (1 \times 3) = 17\ g/mol$

N_7^{14}, H_1

$$n = \frac{340\ g}{17\ g/mol} = 20\ mol$$

c) 180 kg of H_2O → $180 \times 10^3\ g$

$$n = \frac{180 \times 1000\ g}{18\ g/mol} = 10{,}000\ mol$$

e) 18 mg of H_2O

18×10^{-3} g

$$n = \frac{18 \times 10^{-3}\ g}{18\ g/mol}$$

$$= 10^{-3}\ mol = 0.001\ mol$$

(2) Find no. of molecules → moles

unitary method

a) 1.7 mg of NH_3 → 17 g/mol

$$n = \frac{1.7 \times 10^{-3}}{17}$$

$$= \frac{17 \times 10^{-4}}{17} = 10^{-4} \text{ mol}$$

1 mol NH_3 = 6.022×10^{23} molecules.

10^{-4} mol NH_3 = $6.022 \times 10^{23} \times 10^{-4}$

$= 6.022 \times 10^{23+(-4)}$

$= 6.022 \times 10^{19}$ molecules

c) 880 g of CO_2 → $12 + (16 \times 2) = 44$ g/mol

$$n = \frac{880\ g}{44\ g/mol} = 20\ mol$$

1 mole $CO_2 = 6.022 \times 10^{23}$ molecules.

20 mol $CO_2 = 20 \times 6.022 \times 10^{23}$

$= 1.2044 \times 10^{25}$ molecules

d) 100 kg of $CaCO_3$ $= 40 + 12 + (48)$

$= 100$ g/mol

$$n = \frac{100 \times 1000\ g}{100\ g/mol} = 1000\ mol$$

1 mol $\longrightarrow$ 6.022×10^{23}

1000 mol $\longrightarrow$ $1000 \times 6.022 \times 10^{23}$

$= 6.022 \times 10^{26}$

$10^3 \times 10^{23} \rightarrow 10^{3+23} = 10^{26}$

Mass (1 mol)

CO_2 = 44 g ✓

SO_2 = 64 g ✓

CO = 28 g ✓

NH_3 = 17 g ✓

$\begin{array}{r} 12 \\ +16 \\ \hline 28 \end{array}$

Volume (1 mol)

CO_2 = 22.4 L

SO_2 = 22.4 L

CO = 22.4 L

NH_3 = 22.4 L

at STP

ST = 273 K

SP = 1 atm

(1 mol)

1 mole of any gas occupies 22.4 L of volume at STP.

Ex -

1 mole of He = 22.4 L

1 mole of O_3 = 22.4 L

① Calculate mass of 1 atom of Silver.

^{108}Ag

mass of 1 single atom of Ag = 108 u

mass of 1 mole Ag atoms = 108 g

mass of 6.022×10^{23} Ag atoms

So, mass of 1 single Ag atom $= \frac{108}{6.022 \times 10^{23}} = 17.93 \times 10^{-23}$ g

Q- Find the mass of 1 single O atom in g.

mass of 1 single O atom = 16 u

mass of 1 mole (6.022×10^{23}) O atoms = 16 g

So, mass of 1 single O atom = $\frac{16}{6.022 \times 10^{23}}$

$= 2.656 \times 10^{-23}$ g

Q. Find the no. of molecules in 11.2L of O_2 gas.

$$\text{no. of moles, } n = \frac{11.2\,L}{22.4\,L} = 0.5 \text{ mol}$$

1 mol of O_2 = 6.022×10^{23} O_2 molecules.

So, 0.5 mol of O_2 = $0.5 \times 6.022 \times 10^{23}$

= 3.011×10^{23} molecules

Q: find the no. of molecules in 44.8 L of Cl_2 gas.

$$n = \frac{44.8\,L}{22.4\,L} = 2\,mol$$

$1\,mol = 6.022 \times 10^{23}$

So, $2\,mol = 2 \times 6.022 \times 10^{23}$

$= 12.044 \times 10^{23}$ ✓

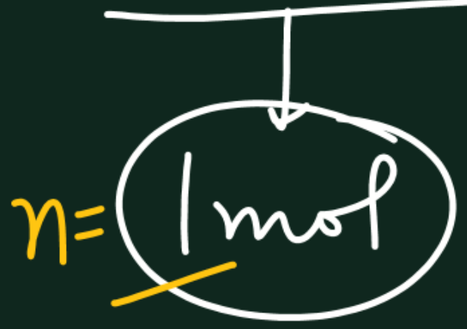
$= 1.2044 \times 10^{24}$ Cl_2 molecules

No. of moles

(FORMULA)

1. mass in g $\longrightarrow$ $n = \dfrac{\text{given mass (g)}}{\text{Molar mass (g/mol)}}$
2. vol of gases $\longrightarrow$ $n = \dfrac{\text{given volume}}{22.4\,L}$
3. no. of particles $\longrightarrow$ $n = \dfrac{\text{given no. of particles}}{6.022 \times 10^{23}}$

Q. 6.022×10^{23} molecules O_2 gas.



$$n = \frac{6.022 \times 10^{23}}{6.022 \times 10^{23}}$$

$$n = 1$$

Q- 3.011×10^{23} molecules CO_2 gas

$n = 0.5$ mol

$$n = \frac{3.011 \times 10^{23}}{6.022 \times 10^{23}}$$

$n = 0.5$ mol

Q. Find no. of moles -

a) 3.011×10^{21} molecules of O_2 (S/L/G)

b) 11.2 mL of Cl_2 gas (G)

c) 440 g of CO_2 gas. (S/L/G)

a) $n = \frac{3.011 \times 10^{21}}{6.022 \times 10^{23}}$

$= 0.5 \times 10^{-2}$

$= 0.005$ mol

b) $n = \frac{11.2\,mL}{22.4\,L} = \frac{11.2 \times 10^{-3}\,L}{22.4\,L}$

$= 0.5 \times 10^{-3}$ mol

c) $n = \frac{440\,g}{44} = 10$ mol

moles = ?

1) 392g of H_2SO_4

2) 44.8 L of CO_2 at STP

3) 6.022×10^{23} molecules of O_2

4) 9 g of Al

$n = \frac{392\,g}{98\,g/mol} = 4\,mol$

H_2SO_4

$2+32+64 = 98\,g$

$n = \frac{44.8\,L}{22.4\,L} = 2\,mol$

$n = \frac{6.022 \times 10^{23}}{6.022 \times 10^{23}} = 1\,mol$

$n = \frac{9\,g}{27\,g/mol} = 0.3\,mol$

Al^{27}_{13}

Exercise

1) Cal. no. of molecules in 22g of CO_2 ?

Soln :- $n = \frac{22\,g}{44\,g/mol} = 0.5$

✓ 1 mol = 6.022×10^{23}

0.5 mol = $0.5 \times 6.022 \times 10^{23}$

$= 3.011 \times 10^{23}$

2. Cal. the mass of CO_2 which contains the same no. of molecules as contained in 40 g of O_2.

Soln:-

$$n = \frac{40\ g}{32\ g/mol} \rightarrow O_2$$

$$= \frac{10}{8}\ mol = 5/4\ mol$$

1 mol of CO_2 = 44 g/mol

So, $\frac{5}{4}$ mol of CO_2 = $\frac{44}{1} \times \frac{5}{4} = 55\ g$ Ans.

Q: Find the total no. of atoms in 44 g of CO_2.

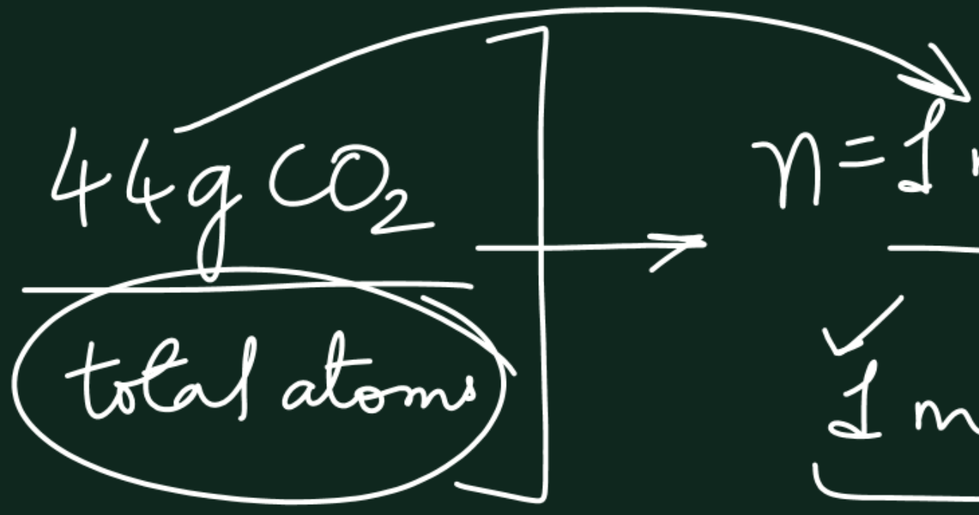
$$n = \frac{44\,g}{44\,g/mol} = 1\,mol$$

Unitary method

- 1 single CO_2 = 1 carbon atoms + 2 "O" atoms.

  12 CO_2 = 12 carbon atoms + 24 "O" atoms.

  1 mole CO_2 = 1 mole carbon atoms + 2 moles 'O' atoms.



$n = 1$ mol CO_2

1 mol C + 2 mol O

= 3 mol total atoms.

$= 3 \times 6.022 \times 10^{23}$

$= 18.066 \times 10^{23}$ ✓ total atoms

$= 1.8066 \times 10^{24}$ ✓ total atoms

Q- Find total no. of atoms in 11.2 L of O_3 gas.

Q. Find no. of moles –

a) 11.2 L of He gas

b) 22400 mL of SO_3 gas

c) 4.84 L of Cl_2 gas

d) 3.011×10^{19} molecules of H_2SO_4

e) 6.022×10^{24} molecules of O_3.

f) 340×10^3 g of NH_3

g) 2.0×10^3 g of H_2O

h) 2.24 mL of O_2 gas

i) 3.011×10^{20} atoms of He.