

Relative atomic and molecular weights

Problems p.g. 10

1. $n = ?$

a) 5.0 g of H_2 $M_r = 2,016$

$$n = \frac{m}{M_r} = \frac{5}{2,016} = 2,48 \approx 2,5 \text{ moles}$$

b) 2,5 g of NO_2 $M_r = 44,01$

$$n = \frac{m}{M_r} = \frac{2,5}{44,01} = 0,057 \text{ moles}$$

2. $N = ?$

a) 1,4 g of Ar $A_r = 39,95$ ($A_r = M_r$)

$$n = \frac{m}{M_r} \Rightarrow n = \frac{1,4}{39,95} = 0,035 \text{ moles}$$

$$\begin{aligned} \frac{n}{N_A} \Rightarrow N &= n \cdot N_A \Rightarrow N = 0,035 \cdot 6,023 \cdot 10^{23} \\ &\Rightarrow N = 0,21 \cdot 10^{23} \text{ or } 2,1 \cdot 10^{22} \end{aligned}$$

b) 156 g of CO $M_r = 28$

$$n = \frac{m}{M_r} = \frac{156}{28} = 5,57 \text{ mole}$$

$$n = \frac{N}{N_A} \Rightarrow N = n \cdot N_A = 5,57 \cdot 6,023 \cdot 10^{23} = 3,35 \cdot 10^{24}$$

3. $n = 1,45$ moles of H_2O $M_r = 18$
 $m = ?$

$$n = \frac{m}{M_r} \Rightarrow m = n \cdot M_r = 1,45 \cdot 18 = 26,1 \text{ g}$$

4. $m = 50,5$ g of H_2S $M_r = 34,08$
 $n = ?$

$$n = \frac{m}{M_r} = \frac{50,5}{34,08} = 1,48 \text{ moles}$$

5. $n = 7,2$ moles of NH_3
 $N = ?$

$$n = \frac{N}{N_A} \Rightarrow N = n \cdot N_A = 7,2 \cdot 6,023 \cdot 10^{23} = 4,33 \cdot 10^{24}$$

6. $m = 14,9$ g of Na_2SO_4 $M_r = 142,04$
 $n = ?$

$$n = \frac{m}{M_r} = \frac{14,9}{142,04} = 0,105 \text{ moles}$$

7. $m = 15,91$ g of P $A_r = 30,97$

$$n = \frac{m}{M_r} = \frac{15,91}{30,97} = 0,5 \text{ moles}$$

$$n = \frac{N}{N_A} \Rightarrow N = n \cdot N_A \Rightarrow N = 0,5 \cdot 6,023 \cdot 10^{23} = 3,09 \cdot 10^{23}$$

8. $m = 1 \text{ g}$ of Fe $A_r = 55,85$
 $N = ?$

$$n = \frac{m}{M_r} = \frac{1}{55,85} = 0,017 \text{ moles}$$

$$n = \frac{N}{N_A} \Rightarrow N = n \cdot N_A = 0,017 \cdot 6,023 \cdot 10^{23} \\ = 1,07 \cdot 10^{22}$$

9. $m = 75,8 \text{ g}$ of Li_2S $M_r = 45$
 $n = ?$

$$n = \frac{m}{M_r} = \frac{75,8}{45} = 1,68 \text{ moles}$$

10. $m = 500 \text{ g}$ of AgNO_3
 $n = 2,94 \text{ moles}$
 $M_r = ?$

$$n = \frac{m}{M_r} \Rightarrow M_r = \frac{m}{n} = \frac{500}{2,94} = 170,07$$

11. $n = 2,25 \text{ moles}$ of Cl_2
 $V = ?$

$$n = \frac{V}{V_m} \Rightarrow V = n \cdot V_m \Rightarrow V = 2,25 \cdot 22,4 \\ = 50,4 \text{ L}$$

12. $N = 9,033 \cdot 10^{23}$ particles of CO_2 gas
 $n = ?$
 $V = ?$

$$n = \frac{N}{N_A} = \frac{9,033 \cdot 10^{23}}{6,023 \cdot 10^{23}} = 1,5 \text{ moles}$$

$$V = n \cdot V_m \Rightarrow V = 1,5 \cdot 22,4 = 33,6 \text{ L}$$

13. $N = 18,066 \cdot 10^{24}$ particles of SO_2 gas
 $n = ?$
 $V = ?$

$$n = \frac{N}{N_A} = \frac{18,066 \cdot 10^{24}}{6,023 \cdot 10^{23}} = 30 \text{ moles}$$

$$n = \frac{V}{V_m} \Rightarrow V = n \cdot V_m \Rightarrow V = 30 \cdot 22,4 = 672 \text{ L}$$

14. $V = 10 \text{ dm}^3 \text{ O}_2$ ($1 \text{ dm}^3 = 1 \text{ L}$)
 $N = ?$ ($1 \text{ cm}^3 = 1 \text{ ml}$)

$$n = \frac{V}{V_m} \Rightarrow n = \frac{10}{22,4} = 0,446 \text{ moles}$$

$$n = \frac{N}{N_A} \Rightarrow N = n \cdot N_A \Rightarrow N = 0,446 \cdot 6,023 \cdot 10^{23} = 2,68 \cdot 10^{23}$$

15. $n = 4$ mole Hg $A_r = 200,6$

$t = 20^\circ\text{C}$

$d = 13,55 \text{ g}\cdot\text{cm}^{-3}$

$V = ?$

(density: d or ρ)

$$n = \frac{m}{M_r} \quad \textcircled{1} \Rightarrow n = \frac{d \cdot V}{M_r} \Rightarrow$$

$$d = \frac{m}{V} \Rightarrow$$

$$\boxed{m = d \cdot V} \quad \textcircled{1}$$

$$\Rightarrow V = \frac{n \cdot M_r}{d} = \frac{4 \cdot 200,6}{13,55} =$$

$$= 59,9 \text{ L}$$

16. $m = 6$ gr of H_2O $M_r = 18$

$N = ?$

$$n = \frac{m}{M_r} = \frac{6}{18} = 0,33 \text{ moles}$$

$$n = \frac{N}{N_A} \Rightarrow N = n N_A = 0,33 \cdot 6,023 \cdot 10^{23}$$

$$\approx 2 \cdot 10^{23}$$

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$$m = 1 \text{ gr KCN}$$

$$n = ? \text{ CN}^-$$

$$M_r = 65,12$$

$$M_r = 26$$

$$\frac{65,12 \text{ KCN}}{1} \longrightarrow \frac{26 \text{ CN}^-}{x}$$

$$x = \frac{26}{65,12} = 0,4 \text{ gr of CN}^-$$

$$n = \frac{m}{M_r} = \frac{0,4}{26} = 0,015 \text{ moles}$$

18.

$$m = 500 \text{ gr of CuSO}_4 \cdot 5\text{H}_2\text{O} \quad M_r = 249,68$$

$$n = ? \text{ of water} \quad M_r = 18$$

In 1 mole of $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ $M_r = 249,68$
the total mass of H_2O is $5 \cdot 18 = 90$

$$\frac{249,68}{500} \longrightarrow \frac{90}{x}$$

$$x = \frac{90 \cdot 500}{249,68} = 180 \text{ gr}$$

$$n = \frac{m}{M_r} = \frac{180}{18} = 10 \text{ moles}$$

19. $n = 2$ of $ZnCl_2$ $Mr = 136,37$
 $m = ?$ of Zn ($Ar = 65,37$)

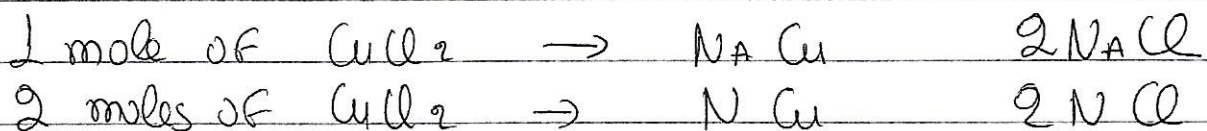
$$ZnCl_2: n = \frac{m}{Mr} \Rightarrow m = n \cdot Mr \Rightarrow m = 2 \cdot 136,37 = 272,74$$

$$\begin{array}{ccc} 136,37 & \rightarrow & 65,37 \\ 272,74 & \rightarrow & x \end{array}$$

$$x = 65,37 \cdot \frac{272,74}{136,37} = 130,74 \text{ gr}$$

20. $n = 2$ moles of $CuCl_2$

$$CuCl_2: n = \frac{N}{N_A} \Rightarrow N = n \cdot N_A = 2 \cdot 6,023 \cdot 10^{23} = 12,046 \cdot 10^{23}$$



$$\begin{array}{l} Cu: N = 12,046 \cdot 10^{23} \approx 1,2046 \cdot 10^{24} \\ Cl: 2N = 2 \cdot 12,046 \cdot 10^{23} = 2,4092 \cdot 10^{24} \end{array}$$