KEY

Mole - Review

Name - _____

1.) How many atoms are there in each of the following?

a.) 5 *molecules* of $C_6H_2Cl_4$

Answer - $5\ molec\ C_6H_2Cl_4 \times \frac{12\ atoms}{1\ molec} = 60\ atoms$

b.) 10 *molecules* of $Co(ClO_4)_2 \cdot 6H_2O$

Answer - $10\ molec\ Co(ClO_4)_2 \cdot 6H_2O \times \frac{29\ atoms}{1\ molec} = 290\ atoms$

2.) How many molecules are there in each of the following?

a.) A flask containing 50.0 *mL* of $NH_{3\,(g)}$ at STP

Answer - $0.0500\ L\ NH_3 \times \frac{1\ mol}{22.4\ L} \times \frac{6.022\times10^{23} molec}{1\ mol} = 1.34 \times 10^{21}\ molecules\ NH_3$

b.) 75.0 *g* of sugar ($C_{12}H_{22}O_{11}$)

Answer - $75.0\ g\ C_{12}H_{22}O_{11} \times \frac{1\ mol}{342.34\ g} \times \frac{6.022\times10^{23} molec}{1\ mol} = 1.32 \times 10^{23}\ molecules\ C_{12}H_{22}O_{11}$

3.) What is the volume occupied by each of the following gases at STP?

a.) 10.0 *g* of $H_{2\,(g)}S$

Answers - $10.0\ g\ H_2S \times \frac{1\ mol}{34.08\ g} \times \frac{22.41\ L}{1\ mol} = 6.58\ L\ H_2S$

b.) 8.5×10^{25} *molecules* of $B_2H_{6\,(g)}$

Answer - $8.5 \times 10^{25} molec\ B_2H_6 \times \frac{1\ mol}{6.022\times10^{23}\ molec} \times \frac{22.41\ L}{1\ mol} = 3.2 \times 10^3\ L\ B_2H_6$

4.) What is the mass of each of the following?

a.) 1 *atom* of Au

Answer - $1\ atom\ Au \times \frac{1\ mol}{6.022\times10^{23}\ atoms} \times \frac{196.97\ g}{1\ mol} = 3.271 \times 10^{-22} g\ Au$

b.) 1.5×10^{15} *molecules* of AgCl

Answer - $1.5 \times 10^{15} molec\ AgCl \times \frac{1\ mol}{6.022\times10^{23}\ molec} \times \frac{143.32\ g}{1\ mol} = 3.6 \times 10^{-7} g\ AgCl$

c.) 250.0 *mL* of $C_3H_{6\,(g)}$ at STP

Answer - $0.2500\ L\ C_3H_6 \times \frac{1\ mol}{22.41\ L} \times \frac{42.09\ g}{1\ mol} = 0.4695\ g\ C_3H_6$

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5.) How many moles are in each of the following?

a.) 5.00 g of $C_{10}H_8$

Answer - $5.00\ g\ C_{10}H_8 \times \frac{1\ mol}{128.18\ g} = 0.0390\ mol\ C_{10}H_8$

b.) 1.00 mL of $O_{3\,(g)}$ at STP

Answer - $1.00\ mL\ O_3 \times \frac{1\ L}{1000\ mL} \times \frac{1\ mol}{22.41\ L} = 4.46 \times 10^{-5}\ mol\ O_3$

c.) $4.55 \times 10^{12}\ atoms$ Pt

Answer - $4.55 \times 10^{12}\ atoms\ Pt \times \frac{1\ mol}{6.022 \times 10^{23}\ atoms} = 7.56 \times 10^{-12}\ mol\ Pt$

d.) $6.02 \times 10^{16}\ molecules$ of PCl_5

Answer - $6.02 \times 10^{16}\ molecules\ PCl_5 \times \frac{1\ mol}{6.022 \times 10^{23}\ molec} = 1.00 \times 10^{-7} mol\ PCl_5$

6.) What is the molar mass of each of the following?

a.) A protein molecule having a mass of $1.25 \times 10^{-17}\ g$

Answer - $\frac{1.25 \times 10^{-17} g}{1\ molecule\ protein} \times \frac{6.022 \times 10^{23}\ molecule}{1\ mol} = 7.53 \times 10^{6} \frac{g}{mol}\ protein$

b.) $0.179\ moles$ of a substance having a mass of $74.0\ g$

Answer - $\frac{74.0\ g\ substance}{0.179\ mol\ substance} = 413 \frac{g}{mol}\ substance$

c.) $Na_2S_2O_3 \cdot 5H_2O$

Answer - $(2 \times 22.99) + (2 \times 32.06) + (3 \times 16.00) + (10 \times 1.01) + (5 \times 16.00) = 248.2 \frac{g}{mol}\ Na_2S_2O_3 \cdot 5H_2O$

7a.) What is the molar volume of gold? (density = $19.31 \frac{g}{mL}$)

Answer - $\frac{19.31\ g\ Au}{1\ mL} \times \frac{1000\ mL}{1\ L} \times \frac{1\ mol}{196.97\ g} = 98.04 \frac{mol}{L}\ Au$

b.) What is the density of liquid octane, C_8H_{18} if $0.100\ moles$ of octane has a volume of $16.2\ mL$?

Answer - $\frac{0.100\ mol\ C_8H_{18}}{16.2\ mL} \times \frac{1000\ mL}{1\ L} \times \frac{114.26\ g}{1\ mol} = 705 \frac{g}{L}\ C_8H_{18}$

c.) What is the density of $NOCl_{(g)}$ at STP?

Answer - $\frac{65.46\ g\ NOCl}{1\ mol} \times \frac{1\ mol}{22.4\ L} = 2.92 \frac{g}{L}\ NOCl$

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d.) What volume is occupied by $0.0875\ mol$ of silver if silver has a density of $10.5\frac{g}{mL}$?

Answer - $0.0875\ mol\ Ag \times \frac{107.87\ g}{1\ mol} \times \frac{1\ mL}{10.5\ g} \times \frac{1\ L}{1000\ mL} = 8.99 \times 10^{-4}\ L\ Ag$

8a.) How many molecules are there in $64.0\ g$ of $FeS_{(s)}$?

Answer - $64.0\ g\ FeS \times \frac{1\ mol}{87.91\ g} \times \frac{6.022 \times 10^{23} molec}{1\ mol} = 4.38 \times 10^{23}\ molecules\ FeS$

b.) How many moles are in $25.0\ mL$ of $HCN_{(g)}$ at STP?

Answer - $25.0\ mL\ HCN \times \frac{1\ L}{1000\ mL} \times \frac{1\ mol}{22.41\ L} = 1.12 \times 10^{-3}\ mol\ HCN$

c.) What is the mass of $3.01 \times 10^{22}\ atoms$ of Pt?

Answer - $3.01 \times 10^{22} atoms\ Pt \times \frac{1\ mol}{6.022 \times 10^{23}\ atoms} \times \frac{195.08\ g}{1\ mol} = 9.75\ g\ Pt$

9a.) How many molecules are there in $75.0\ L$ of O_3 at STP?

Answer - $75.0\ L\ O_3 \times \frac{1\ mol}{22.4\ L} \times \frac{6.022 \times 10^{23}\ molec}{1\ mol} = 2.02 \times 10^{24}\ molecules\ O_3$

b.) What is the molar mass of a molecule having a mass of $6.23 \times 10^{-22}\ g$?

Answer - $\frac{6.23 \times 10^{-22} g}{1\ molecule} \times \frac{6.022 \times 10^{23}\ molecule}{1\ mol} = 375\frac{g}{mol}$

c.) How many atoms are there in $3\ molecules$ of $CH_3COOCH_2CH_3$?

Answer - $3\ molecules\ CH_3COOCH_2CH_3 \times \frac{14\ atoms}{1\ molec} = 42\ atoms\ CH_3COOCH_2CH_3$

d.) If $5.54\ mL$ of carbon oxysulphide gas has a mass of $14.9\ mg$ at STP, what is the molar mass of carbon oxysulphide?

Answer - $\frac{14.9\ mg}{5.54\ mL} \times \frac{1\ g}{1000\ mg} \times \frac{1000\ mL}{1\ L} \times \frac{22.41\ L}{1\ mol} = 60.272\frac{g}{mol}$ $60.3\frac{g}{mol}$

e.) What is the volume of $0.0694\ mol$ of molybdenite, MoS_2, having a density of $4.80\frac{g}{mL}$?

Answer - $0.0694\ mol \times \frac{160.06\ g}{1\ mol} \times \frac{1\ mL}{4.80\ g} = 2.31\ mL$

f.) How many molecules are there in $5.00\ g$ of $OF_{2\ (g)}$?

Answer - $5.00\ g\ OF_2 \times \frac{1\ mol}{54.00\ g} \times \frac{6.022 \times 10^{23}\ molecule}{1\ mol} = 5.58 \times 10^{22}\ molec$

g.) What is the density of a calcite crystal, $CaCO_3$, if $0.0316\ mol$ of $CaCO_3$ has a volume of $1.167\ mL$?

Answer - $\frac{0.0316\ mol}{1.167\ mL} \times \frac{1000\ mL}{1\ L} \times \frac{100.09\ g}{1\ mol} = 2710\frac{g}{L}$

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10.) Calculate the percentage composition of $(NH_4)_2Sn(OH)_6$.

Answer – $(2 \times 14.01) + (8 \times 1.01) + (118.71) + (6 \times 16.00) + (6 \times 1.01) = 256.87 \frac{g}{mol}$

$N\% \rightarrow \frac{28.02}{256.87} \times 100 = 10.91\%$ $H\% \rightarrow \frac{14.14}{256.87} \times 100 = 5.505\%$

$Sn\% \rightarrow \frac{118.71}{256.87} \times 100 = 46.214\%$ $O\% \rightarrow \frac{96.00}{256.87} \times 100 = 37.37\%$

11.) Find the empirical formula for a compound that is 50.5% C, 5.26% H, and 44.2% N.

Answer – *assume 100 g of substance*

$50.5\ g\ C \times \frac{1\ mol}{12.01\ g} = 4.2048\ mol\ C$ $5.26\ g\ H \times \frac{1\ mol}{1.01\ g} = 5.2079\ mol\ H$

$44.2\ g\ N \times \frac{1\ mol}{14.01\ g} = 3.1549\ mol\ N$

$\frac{4.2048\ mol\ C}{3.1549\ mol\ N} = 1.33$ $\frac{5.2079\ mol\ H}{3.1549\ mol\ N} = 1.65$ $\frac{3.1549\ mol\ N}{3.1549\ mol\ N} = 1.00$

$1.33 \times 3 = 3.99 \approx 4\ C$ $1.65 \times 3 = 4.95 \approx 5\ H$ $1.00 \times 3 = 3\ N$

$C_4H_5N_3$

12.) A gas has an empirical formula CH_2. If 0.500 L of the gas at STP has a mass of 1.876 g, what is the molecular formula of the compound?

Answer – molar mass of $CH_2 \rightarrow (1 \times 12.01) + (2 \times 1.01) = 14.03 \frac{g}{mol}$

molar mass of unknown sample $\rightarrow \frac{1.876\ g}{0.500\ L} \times \frac{22.41\ L}{1\ mol} = 84.0823 \frac{g}{mol}$

$\frac{84.08232}{14.03} = 5.99$ $CH_2 \times 6 = C_6H_{12}$

Answers - 1a.) 60 *atoms* 1b.) 290 *atoms* 2a.) 1.34×10^{21} *molecules* 2b.) 1.32×10^{23} *molecules* 3a.) 6.57 *L*

3b.) 3200 *L* or 3.2×10^3 *L* 4a.) 3.271×10^{-22} *g* 4b.) 3.6×10^{-7} *g* 4c.) 0.4695 *g* 5a.) 0.0390 *mol* 5b.) 4.46×10^{-5} *mol*

5c.) 7.56×10^{-12} *mol* 5d.) 1.00×10^{-8} *mol* 6a.) $7.53 \times 10^6 \frac{g}{mol}$ 6b.) $413 \frac{g}{mol}$ 6c.) $248.2 \frac{g}{mol}$ 7a.) $98.04 \frac{mol}{L}$ 7b.) $705 \frac{g}{L}$

7c.) $2.92 \frac{g}{L}$ 7d.) 0.000899 *L* 8a.) 4.38×10^{23} *molecules* 8b.) 0.00112 *mol* 8c.) 9.75 *g* 9a.) 2.02×10^{24} *molecules* 9b.) $375 \frac{g}{mol}$

9c.) 42 *atoms* 9d.) $60.2 \frac{g}{mol}$ 9e.) 23.1 *mL* 9f.) 5.58×10^{22} *molecules* 9g.) $2710 \frac{g}{L}$

10.) 10.91% N, 5.505% H, 46.214% Sn, 37.37% O 11.) $C_4H_5N_3$ 12.) C_6H_{12} 13.) 0.001901 *M* 14a.) 2.66 *M* 14b.) 0.143 *M*

15.) 1500 *g* 16.) 6.162 *M* 17.) $2990 \frac{g}{L}$ 18a.) 0.417 *L* 18b.) 0.204 *M*