Chemistry 11

Mole Conversion Practice Test

Name: Key
Date:
Block:

1 L = 1000 mL 1 kg = 1000 g 1 g = 1000 mg

C 1. The percentage of calcium (by mass) in the molecule $Ca_3Fe_2(SiO_4)_3$ is
a) 7.89 % b) 22.0 % c) 23.7 % d) 54.4 %

Show your work below:

$Ca_3Fe_2(SiO_4)_3 = (3\times40.08) + (2\times55.85) + (3\times28.09) + (12\times16.00) = 508.21\ g/mol$

$\frac{mass\ Ca}{total} = \frac{(3\times40.08)}{508.21} \times 100\% = 23.66\%$

A 2. A molecular formula tells us:
a) The actual number of atoms of each element in a compound
b) The lowest ratio of atoms of each element in a compound → empirical
c) All possible multiples of an empirical formula
d) The concentration of that compound in a solution

C 3. What are the units for molarity?
a) g / L b) mol / mL c) mol / L d) L / mol $M = \frac{mol}{L}$

D 4. The empirical formula tells us:
a) the actual number of atoms in a compound
b) the concentration of a compound
c) the molar mass of a compound
d) the lowest ratio of each element in a compound

A 5. Another term for molarity is:
a) concentration b) molar mass c) molecular formula d) moles/ gram

A 6. What is the mass of a single molecule of water? H_2O
a) 3.0×10^{-23} grams b) 1.0 gram c) 6.0×10^{-22} gram d) 18.0 grams e) 2.9×10^{23} grams

$1\ molecule\ H_2O \times \frac{1\ mol}{6.022\times10^{23}\ molecule} \times \frac{18.02\ g\ H_2O}{1\ mol}$

A 7. At the same temperature and pressure, which sample of gas contains the same number of particles as one liter of oxygen, O_2?
a) one liter of He
b) three liters of CO_2
c) two liters of Ne
d) two liters of H_2
e) four liters of SO_3

At STP, 22.4 L / mol for all gases

Written:

1. How many atoms are in $Ni(H_2O)_2(NH_3)_3Cl_2$?

Ni - 1 N - 3
H - 4+9 Cl - 2
O - 2

Total = 21 atoms

2. What is the mass of a 250.0 mL sample of hydrogen sulfide (H_2S) at STP?

4sf

$$250.0\,mL \times \frac{1\,L}{1000\,mL} \times \frac{1\,mol}{22.4\,L} \times \frac{34.09\,g}{1\,mol} = 0.380468 = 0.3805\,g\,H_2S$$

4sf

3. At STP, argon gas has a molar volume of 22.4 L.

4. How many molecules of potassium iodide are in 10.0g of potassium iodide?

KI

$$10.0\,g \times \frac{1\,mol}{166.00\,g} \times \frac{6.022 \times 10^{23}\,molecules}{1\,mol} = 3.6277 \times 10^{22} = 3.63 \times 10^{22}\,molecules_{KI}$$

3sf

5. A 0.600 mol sample of an unknown gas has a mass of 52.8 g. This gas is a compound of carbon and fluorine. Find the molecular formula.

$$\frac{52.8\,g}{0.600\,mol} = 88.0\,g/mol$$

C = 12.01 g/mol
F = 19.00 g/mol

CF_4

6. An experiment is conducted to calculate the molar volume. The following data is collected:

Moles of N_2 gas	0.00166 mol
Volume of N_2 collected	47.2 mL
Room temperature	21.0°C
Pressure	100.4 kPa

Calculate the molar volume of N_2 at 21.0°C and 100.4 kPa using the data.

→ L/mol

3sf

$$\frac{47.2\,mL}{0.00166\,mol} \times \frac{1\,L}{1000\,mL} = 28.4\,L/mol$$

7. Find the volume occupied by 21.6g of N_2H_4 gas at STP.

$$21.6\,g \times \frac{1\,mol}{32.06\,g} \times \frac{22.4\,L}{1\,mol} = 15.1\,L_{N_2H_4}$$

3sf

8. The molar volume of H_2 at 21.0°C, 100.4 kPa is 24.3 L/mol. Calculate the mass of 0.213L of H_2.

$$0.213\,L \times \frac{1\,mol}{24.3\,L} \times \frac{2.02\,g}{1\,mol} = 0.0177\,g\,H_2$$

3sf

9. Aspartame is an artificial sweetener that is 160 times sweeter than sucrose (table sugar) when dissolved in water. It is marketed as NutraSweet. The molecular formula for aspartame is $C_{14}H_{18}N_2O_5$.

a. Calculate the molar mass of aspartame.

$$(14\times12.01)+(18\times1.01)+(2\times14.01)+(5\times16.00) = 294.34\,g/mol\ C_{14}H_{18}N_2O_5$$

b. How many moles of molecules are present in 10.0 g of aspartame?

$$10.0\,g \times \frac{1\,mol}{294.34\,g} \times \frac{6.022\times10^{23}\,molecules}{1\,mol} = 2.05\,molecules\ C_{14}H_{18}N_2O_5$$

3sf

c. Calculate the mass in grams of 1.56 mol of aspartame.

$$1.56\,mol \times \frac{294.34\,g}{1\,mol} = 459.17 = 459\,g\ C_{14}H_{18}N_2O_5$$

3sf

d. How many molecules are in 5.0 mg of aspartame?

$$5.0\,mg \times \frac{1\,g}{1000\,mg} \times \frac{1\,mol}{294.34\,g} \times \frac{6.022\times10^{23}\,molecules}{1\,mol} = 1.0\times10^{19}\,molecules\ C_{14}H_{18}N_2O_5$$

2sf

10. Nitrosyl chloride (NOCl) is a gas used in the synthesis of some pharmaceutical compounds. Find the mass of a 5.62 mL sample of nitrosyl chloride at STP.

$$5.62\,mL \times \frac{1\,L}{1000\,mL} \times \frac{1\,mol}{22.4\,L} \times \frac{65.46\,g}{1\,mol} = 0.0165\,g\,NOCl$$

3sf

11. Find the empirical formula for the following compounds:

a) 15.9% B, 84.1% F

$B: 15.9\,g \times \frac{1\,mol}{10.81\,g} = 1.47\,mol_B \rightarrow$ Smallest = 1 B

$F: 84.1\,g \times \frac{1\,mol}{19.00\,g} = 4.43\,mol_F \rightarrow \frac{4.43\,mol_F}{1.47\,mol_B} = \sim 3\,F$

BF_3

b) 70.0% Fe, 30.0% O

$Fe: 70.0\,g \times \frac{1\,mol}{55.85\,g} = 1.25\,mol_{Fe} \rightarrow$ Smallest = 1 Fe

$O: 30.0\,g \times \frac{1\,mol}{16.00\,g} = 1.88\,mol_O \rightarrow \frac{1.88\,mol_O}{1.25\,mol_{Fe}} = 1.50$ } x2

Fe_2O_3

12. What molar concentration of KCl is produced by measuring out 1.0g KCl and adding water up to 0.350L of solution?

$\frac{mol}{L}$

$\frac{1.0\,g}{0.350\,L} \times \frac{1\,mol}{74.55\,g} = 0.038\,M\ KCl$

2 sf