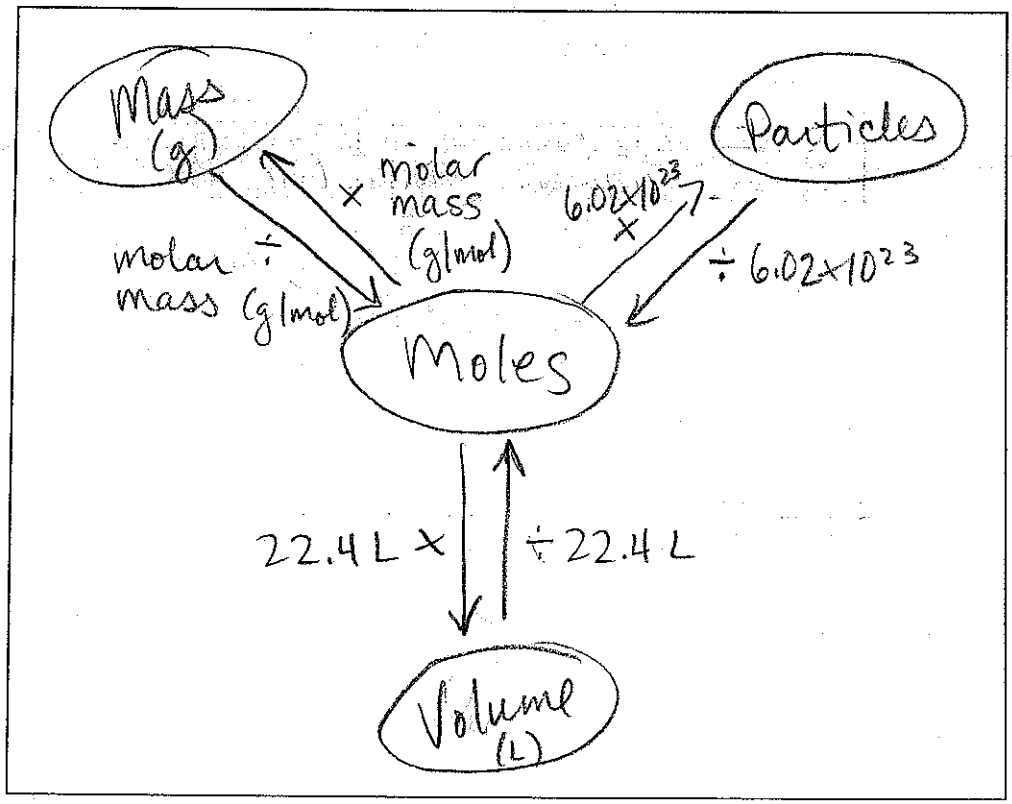
KEY

Ch. 10 Study Guide

Chemistry – Chapter 10:

- ✓ What is a mole? Avogadro's number?
- ✓ Be able to determine which representative particle is used to label different compounds. (atom, ion, molecule, formula unit)
- ✓ Know how to calculate molar mass.
- ✓ State Avogadro's hypothesis.
- ✓ What is meant by STP?
- ✓ What is the molar volume of any gas at STP?
- ✓ Which elements are diatomic? What does that mean?
- ✓ Know how to perform all calculations: molar mass, moles ←→ grams, moles ←→ atoms, moles ←→ volume, mass ←→ atoms, mass ←→ volume
- ✓ Know how to calculate percent composition by mass of a compound.
- ✓ Know how to draw the graphic organizer to help you with conversions on the test. Practice this below:



Representative Particles:
What type of compound does a formula unit represent?

ionic

What type of compound does a molecule represent?

molecular/covalent

What is an ion?

element/compound w/ a charge

Decide if each of the following is a:
formula unit (a), molecule (b), ion (c), or atom (d).

1) $Ca(CO_3)$ A → 40.1+12+(3×16.0)=100.1 g/mol
(40.1/100.1)×100=40.1%, (12/100.1)×100=12.0%, (48/100.1)×100=48.0%

2) N^{3-} C 100% N

3) Cu_3N A → (63.5×3)+14=204.5 g/mol
(190.5/204.5)×100=93.2%, (14/204.5)×100=6.8%

4) Mn D 100% Mn

5) OBr_2 B → 16.0+(80.0×2)=176.0 g/mol
(16/176)×100=9.1%, (160/176)×100=90.9%

6) $(SO_4)^{2-}$ C → 32.1+(4×16)=96.1 g/mol
(32.1/96.1)×100=33.4%, (64/96.1)×100=66.6%

7) N_2O_3 B → (14×2)+(16×3)=76 g/mol
(28/76)×100=36.8%, (48/76)×100=63.2%

8) CF_3 B → 12+(19×3)=69 g/mol
(12/69)×100=17.4%, (57/69)×100=82.6%

9) BaO A → 137.3+16=153.3 g/mol
(137.3/153.3)×100=89.6%, (16/153.3)×100=10.4%

10) FeO A → 55.8+16=71.8 g/mol
(55.8/71.8)×100=77.7%, (16/71.8)×100=22.3%

11) Rb^+ C 100% Rb

12) Iron D 100% Fe

Percent Composition Practice:
Find the percent composition of each of the elements in the compounds above (#1, 3, 5-10). Show work in the margins.

There are three mole equalities. They are:

1 mol = 6.02×10^{23} particles
1 mol = molar mass (periodic table)
1 mol = 22.4 L for a gas at STP

Each equality can be written as a set of two conversion factors. They are:

Mole → Particles	Mole → Molar mass	Mole → Volume
$\frac{6.02\times10^{23}}{1\text{ mole}}$ OR $\frac{1\text{ mole}}{6.02\times10^{23}}$	$\frac{\text{Molar mass}}{1\text{ mole}}$ OR $\frac{1\text{ mole}}{\text{Molar mass}}$	$\frac{22.4\text{ L}}{1\text{ mole}}$ OR $\frac{1\text{ mole}}{22.4\text{ L}}$

Mole-Particle Conversions **SHOW YOUR WORK**

1. How many moles of magnesium is 3.01×10^{22} atoms of magnesium?

$$3.01\times10^{22}\text{ atoms} \left| \frac{1\text{ mole}}{6.02\times10^{23}\text{ atoms}} \right. = 0.05\text{ mole}$$

2. How many molecules are there in 4.00 moles of glucose, $C_6H_{12}O_6$?

$$4.00\text{ moles} \left| \frac{6.02\times10^{23}\text{ molecules}}{1\text{ mole}} \right. = 2.41\times10^{24}\text{ molecules}$$

3. How many moles are 1.20×10^{25} atoms of phosphorous?

$$1.20\times10^{25}\text{ atoms} \left| \frac{1\text{ mole}}{6.02\times10^{23}\text{ atoms}} \right. = 19.9\text{ moles}$$

4. How many atoms are in 0.750 moles of zinc?

$$0.750\text{ moles} \left| \frac{6.02\times10^{23}\text{ atoms}}{1\text{ mole}} \right. = 4.52\times10^{23}\text{ atoms}$$

5. How many molecules are in 0.400 moles of N_2O_5?

$$0.400\text{ moles} \left| \frac{6.02\times10^{23}\text{ molecules}}{1\text{ mole}} \right. = 2.41\times10^{23}\text{ molecules}$$

Mole-Mass Conversions **SHOW YOUR WORK**

6. How many moles in 28 grams of CO_2? $32+12=44.0$

$$\frac{28\ g}{} \left| \frac{1\ mole}{44\ g} \right. = 0.64\ mol$$

7. What is the mass of 5 moles of Fe_2O_3? $\rightarrow (55.8\times2)+(16.0\times3)=159.6$

$$\frac{5\ moles}{} \left| \frac{159.6\ g}{1\ mole} \right. = 798.0\ g$$

8. Find the number of moles of argon in 452 g of argon. $\rightarrow 39.9$

$$\frac{452\ g}{} \left| \frac{1\ mole}{39.9\ g} \right. = 11.3\ mol$$

9. Find the grams in 1.26×10^{-4} mol of $HC_2H_3O_2$. $\rightarrow 4+24+32=60$

$$\frac{1.26\times10^{-4}\ mol}{} \left| \frac{60.0\ g}{1\ mol} \right. = 0.0076\ g$$

10. Find the mass in 2.6 mol of lithium bromide. $\rightarrow 79.9+6.9=86.8$ (LiBr)

$$\frac{2.6\ mol}{} \left| \frac{86.8\ g}{1\ mol} \right. = 225.7\ g$$

Mole-Volume Conversions **SHOW YOUR WORK**

11. Determine the volume, in liters, occupied by 0.030 moles of a gas at STP.

$$\frac{0.030\ mole}{} \left| \frac{22.4\ L}{1\ mole} \right. = 0.67\ L$$

12. How many moles of argon atoms are present in 11.2 L of argon gas at STP?

$$\frac{11.2\ L}{} \left| \frac{1\ mole}{22.4\ L} \right. = 0.5\ mol$$

13. What is the volume of 0.05 mol of neon gas at STP?

$$\frac{0.05\ mol}{} \left| \frac{22.4\ L}{1\ mol} \right. = 1.12\ L$$

14. What is the volume of 1.2 moles of water vapor at STP?

$$\frac{1.2\ mol}{} \left| \frac{22.4\ L}{1\ mol} \right. = 26.9\ L$$

Mixed Mole Conversions **SHOW YOUR WORK**

Given unit → Moles → Desired unit

18. How many oxygen molecules are in 3.36 L of oxygen gas at STP?

$$3.36\ \text{L} \left| \frac{1\ \text{mol}}{22.4\ \text{L}} \right| \frac{6.02\times10^{23}\ \text{molecules}}{1\ \text{mol}} = 9.03\times10^{22}\ \text{molecules}$$

19. Find the mass in grams of 2.00 x 10^{23} molecules of F_2. → 19 x 2 = 38.0

$$2.00\times10^{23}\ \text{molecules} \left| \frac{1\ \text{mol}}{6.02\times10^{23}\ \text{molecules}} \right| \frac{38.0\ \text{g}}{1\ \text{mol}} = 12.62\ \text{g}$$

20. Determine the volume in liters occupied by 14 g of nitrogen gas at STP. → 14.0 g/mol

$$14\ \text{g} \left| \frac{1\ \text{mol}}{14.0\ \text{g}} \right| \frac{22.4\ \text{L}}{1\ \text{mol}} = 22.4\ \text{L}$$

21. Find the mass, in grams, of 1.00 x 10^{23} molecules of N_2. → 28 g/mol

$$1.00\times10^{23}\ \text{molecules} \left| \frac{1\ \text{mol}}{6.02\times10^{23}\ \text{molecules}} \right| \frac{28.0\ \text{g}}{1\ \text{mol}} = 4.65\ \text{g}$$

22. Find the mass, in grams, of one copper atom. → 63.5

$$1\ \text{atom} \left| \frac{1\ \text{mol}}{6.02\times10^{23}\ \text{atoms}} \right| \frac{63.5\ \text{g}}{1\ \text{mol}} = 1.05\times10^{-22}\ \text{g}$$

23. Determine the number of oxygen atoms in 15.2 grams of carbon dioxide. → 12 + 32 = 44 g/mol

$$15.2\ \text{g} \left| \frac{1\ \text{mol}}{44.0\ \text{g}} \right| \frac{6.02\times10^{23}\ \text{atoms}}{1\ \text{mol}} = 2.08\times10^{23}\ \text{atoms}$$

24. Aspartame is an artificial sweetener that is 160 times sweeter than sucrose (table sugar) when dissolved in water. It is marketed by G.D. Searle as *Nutra Sweet*. The molecular formula of aspartame is $C_{14}H_{18}N_2O_5$.

a) Calculate the molar mass of aspartame.

14 x 12 = 168.0 g/mol
18 x 1 = 18.0 g/mol
2 x 14 = 28.0 g/mol
5 x 16 = 80.0 g/mol
} 294.0 g/mol

57%
6%
9.5%
27.2%

b) How many moles are in 10.0 g of aspartame?

$$\frac{10.0\ \text{g}}{} \left| \frac{1\ \text{mole}}{294.0\ \text{g}} \right. = 0.03\ \text{moles}$$

c) How many molecules are in 5 mg of aspartame?

$$\frac{5\ \text{mg}}{} \left| \frac{1\ \text{g}}{1000\ \text{mg}} \right| \frac{1\ \text{mole}}{294.0\ \text{g}} \left| \frac{6.02\times10^{23}\ \text{molecules}}{1\ \text{mole}} \right. = 1.02\times10^{19}\ \text{molecules}$$

e) How many moles of nitrogen are in 1.2 grams of aspartame?

$$\frac{1.2\ \text{g}}{} \left| \frac{1\ \text{mole}\ C_{14}H_{18}N_2O_5}{294.0\ \text{g}} \right| \frac{6.02\times10^{23}\ \text{molecules}}{1\ \text{mole}} = 2.46\times10^{21}\ \text{molecules}\ C_{14}H_{18}N_2O_5$$

f) How many atoms of nitrogen is this?

$$\frac{2.46\times10^{21}\ C_{14}H_{18}N_2O_5\ \text{molecules}}{} \left| \frac{2\ \text{atoms N}}{1\ \text{molecule}\ C_{14}H_{18}N_2O_5} \right. = 4.92\times10^{21}\ \text{atoms N}$$

$$\frac{4.92\times10^{21}\ \text{atoms N}}{} \left| \frac{1\ \text{mol}}{6.02\times10^{23}\ \text{atoms}} \right. = 0.008\ \text{moles N}$$