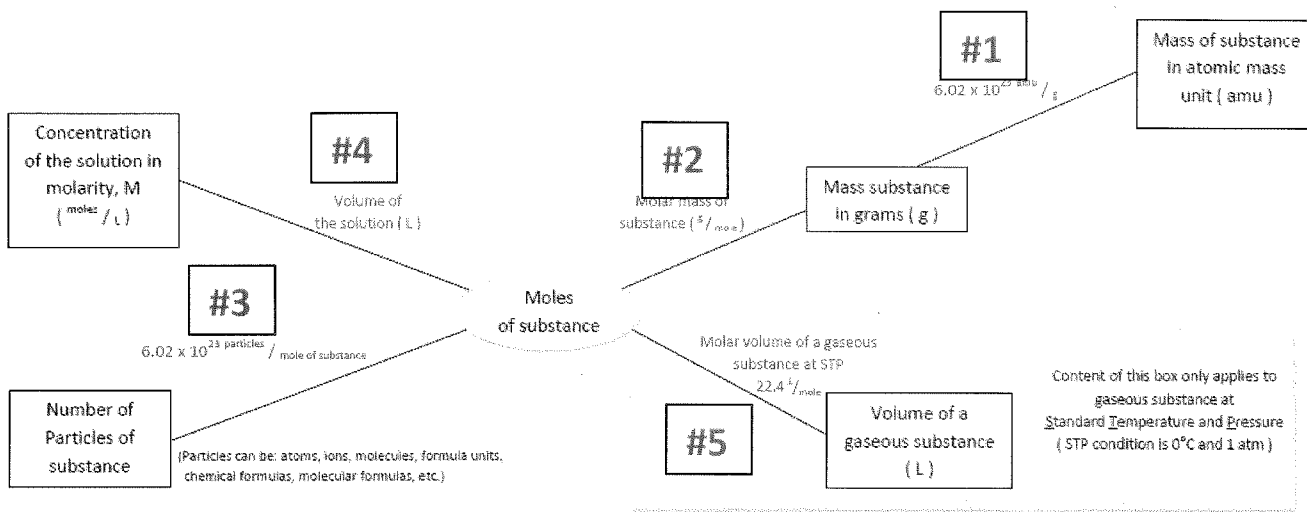


## Mole - Mass - Particles Problems

### Expanded Road Map for "Mole - Mass - Volume - Particles" Calculations



### Your plan of action:

1. One mole of aluminum, Al, is equivalent to

- (a) 26.9815 amu.
- (b)  $6.02\text{E}23$  grams.
- (c)  $6.02\text{E}23$  atoms.
- (d) 26.9815 atoms.

2. How many  $\text{Al}^{3+}$  ions are in 47.2 g of aluminum sulfate,  $\text{Al}_2(\text{SO}_4)_3$ ?

- (a) 7.25  $\text{Al}^{3+}$  ions
- (b)  $1.94\text{E}28$   $\text{Al}^{3+}$  ions
- (c)  $5.68\text{E}25$   $\text{Al}^{3+}$  ions
- (d)  $1.66\text{E}23$   $\text{Al}^{3+}$  ions

3. Calculate the mass of  $3.00\text{E}20$  cobalt, Co, atoms.

- (a)  $1.77\text{E}22$  g
- (b) 0.0294 amu
- (c) 0.0294 g
- (d)  $5.09\text{E}18$  amu

choice (a): mole to amu - #2, #1

#2: Molar mass Al =  $26.98 \text{ g/mole}$

#1:  $6.02 \times 10^{23} \text{ amu/g}$

choice (b): mole to gram - #2

#2: Molar mass Al =  $26.98 \text{ g/mole}$

choice (c) and (d): mole to atoms - #3

#3:  $6.02 \times 10^{23} \text{ Al atoms/mole of Al atoms}$

**Answer: (c)**

choice (a), (b), (c), (d):

mass in grams to ions - #2, #3

#2: Molar mass =  $342.15 \text{ g/mole}$

#3:  $6.02 \times 10^{23} \text{ Al}_2(\text{SO}_4)_3 / \text{mole of Al}_2(\text{SO}_4)_3$

# of ions per formula unit :

$2 \text{ Al}^{3+} \text{ ions} / \text{Al}_2(\text{SO}_4)_3 \text{ formula unit}$

**Answer: (d)**

choice (a) and (c):

atom to gram - #3, #2

choice (b) and (d):

atom to amu - #3, #2, #1

#3:  $6.02 \times 10^{23} \text{ Co atoms} / \text{mole of Co}$

#2: Molar mass =  $58.9331 \text{ g/mole}$

#1:  $6.02 \times 10^{23} \text{ amu/g}$

**Answer: (c)**

4. DDT is a pesticide that is banned in most of the world. The chemical formula is  $C_{14}H_9Cl_5$ . The number of atoms in 27 molecules of DDT is

(a)  $4.6E26$  atoms  
 (b)  $1.3E-21$  atoms  
 (c) 28 atoms  
 (d) 756 atoms  
 (e)  $2.1E26$  atoms

choice (a), (b), (c), (d): atoms in formula unit

- atoms in 1 molecule (formula unit) DDT  
 $14 + 9 + 5 = 28$  atoms

- atoms in 27 molecules of DDT  
 $28 * 27 = 756$  atoms

Answer: (c) (d)

5. The chemical formula of an anti-malarial drug, quinine, is  $C_{20}H_{24}N_2O_2$ . How many hydrogen atoms are in 9.28 moles of quinine?

(a)  $5.59E24$  hydrogen atoms  
 (b) 223 hydrogen atoms  
 (c) 9.28 hydrogen atoms  
 (d)  $1.34E26$  hydrogen atoms

choice (a), (b), (c), (d): moles to atoms

#3:  $6.02 \times 10^{23}$  quinine molecule / mole of quinine

# of atoms per quinine:  $24 \text{ H atoms} / \text{quinine molecule}$

Answer: (d)

6. DDT is a pesticide that is banned in most of the world. The chemical formula is  $C_{14}H_9Cl_5$ . Calculate the mass, in kilograms, of  $1.7E20$  molecules of DDT.

(a)  $6.0E25$  kg  
 (b)  $6.0E19$  kg  
 (c)  $10.0E-5$  kg  
 (d)  $1.0E2$  kg

choice (a), (b), (c), (d): molecules to mass: #3, #2

#3:  $6.02 \times 10^{23}$  DDT molecules / mole of DDT

#2: Molar mass of DDT =  $354.49 \text{ grams} / \text{mole}$

Conversion from grams to kg.

Answer: (c)

7. How many grams of tin, Sn, are in 2.50 moles tin, Sn?

(a)  $4.93E-22$  g  
 (b) 297 g  
 (c)  $4.93E-22$  g  
 (d) 0.0211 g

choice (a), (b), (c), (d): moles to grams : #2

#2: Molar mass of Sn =  $118.71 \text{ grams} / \text{mole}$

Answer: (b)

8. How many grams of phosphorus are in 1.50 mole of phosphorus atoms?

(a)  $7.49E-23$  g  
 (b) 46.5 g  
 (c)  $2.88E25$  g  
 (d) 0.0484 g

choice (a), (b), (c), (d): moles to grams : #2

#2: Molar mass of P =  $30.97 \text{ grams} / \text{mole}$

Answer: (b)

9. Borax,  $Na_2B_4O_7 \cdot 10H_2O$ , is an industrially important mineral and a boron source. How many moles are there in 1.30 kg of borax?

(a)  $3.41E-6$  moles borax  
 (b) 3.41 moles borax  
 (c)  $2.98E23$  moles borax  
 (d)  $2.05E24$  moles borax

choice (a), (b), (c), (d): kilogram to moles : #2

Conversion from kilograms to grams.

#2: Molar mass of borax =  $381.37 \text{ grams} / \text{mole}$

Answer: (b)

10. The common chemical name for aspirin is acetylsalicylic acid. The chemical formula of aspirin is  $C_9H_8O_4$ . How many moles of hydrogen atoms are in 4.48 moles of acetylsalicylic acid?

- (a)  $2.16 \times 10^{25}$  moles of hydrogen
- (b)  $4.86 \times 10^{26}$  moles of hydrogen
- (c) 807 moles of hydrogen
- (d) 35.8 moles of hydrogen

choice (a), (b), (c), (d): moles of aspirin to moles of H atoms in aspirin

8 Hydrogen atoms in 1 molecule (formula unit of aspirin)

$4.48 \text{ moles} \times 8 = 35.8 \text{ moles of hydrogen}$

**Answer: (d)**