Introduction to the Mole and Molar Mass

1. What is a mole? The quantity of matter that contains 6.02×10^{23} particles.
2. What is Avogadro's number? 6.02×10^{23}
3. What do 1 mole of mercury and 1 mole of silver have in common?
   They both contain 6.02×10^{23} particles (atoms)
4. What do 1 mole of carbon and 1 mole of oxygen have in common?
   They both contain 6.02×10^{23} particles (atoms)
5. Complete the table below.

Molecular formula	# moles	# molecules	# atoms
H	1	6.02×10^{23}	$1 \times (6.02 \times 10^{23}) = 6.02 \times 10^{23}$
Cl	1	6.02×10^{23}	$1 \times (6.02 \times 10^{23}) = 6.02 \times 10^{23}$
HCl	1	6.02×10^{23}	$2 \times (6.02 \times 10^{23}) = 1.204 \times 10^{24}$
NaOH	1	6.02×10^{23}	$3 \times (6.02 \times 10^{23}) = 1.806 \times 10^{24}$
O_2	1	6.02×10^{23}	$2 \times (6.02 \times 10^{23}) = 1.204 \times 10^{24}$
CO_2	1	6.02×10^{23}	$3 \times (6.02 \times 10^{23}) = 1.806 \times 10^{24}$
$CaCl_2$	1	6.02×10^{23}	$3 \times (6.02 \times 10^{23}) = 1.806 \times 10^{24}$
$Mg(OH)_2$	1	6.02×10^{23}	$5 \times (6.02 \times 10^{23}) = 3.01 \times 10^{24}$

$2 \times (6.02 \times 10^{23}) = 1.204 \times 10^{24}$

6. Complete the table below.

K is only 1 atom

Molecular formula	# moles	# molecules	# atoms
K	2	$\frac{1 \text{ mole}}{6.02 \times 10^{23} \text{ molecules}} : \frac{2 \text{ mole}}{x \text{ molecules}}$	$2 \times (6.02 \times 10^{23}) \times 1 = 1.204 \times 10^{24}$
KB	2	$2 \times (6.02 \times 10^{23}) = 1.204 \times 10^{24}$	$2 \times (6.02 \times 10^{23}) \times 2 = 2.408 \times 10^{24}$ (2 atoms: K and B)
N_2O_5	2	$2 \times (6.02 \times 10^{23}) = 1.204 \times 10^{24}$	$2 \times (6.02 \times 10^{23}) \times 7 = 8.428 \times 10^{24}$
H_3PO_4	3	$3 \times (6.02 \times 10^{23}) = 1.806 \times 10^{24}$	$3 \times (6.02 \times 10^{23}) \times 8 = 1.44 \times 10^{25}$
$Zn(NO_3)_2$	4	$4 \times (6.02 \times 10^{23}) = 2.408 \times 10^{24}$	$4 \times (6.02 \times 10^{23}) \times 9 = 2.17 \times 10^{25}$

7. How many atoms of nitrogen are there in 1 mole of NO_2?
   $1 \times (6.02 \times 10^{23}) \times 1 = 6.02 \times 10^{23}$ atoms
8. How many atoms of hydrogen are there in 1 mole of water? → H_2O
   $1 \times (6.02 \times 10^{23}) \times 2 = 1.204 \times 10^{24}$ atoms
9. How many atoms of oxygen are there in 1 mole of water? → H_2O
   $1 \times (6.02 \times 10^{23}) \times 1 = 6.02 \times 10^{23}$ atoms
10. How many atoms of oxygen are there in 1 mole of N_2O_5?

    $1 \times (6.02 \times 10^{23}) \times 5 = 3.01 \times 10^{24}$ atoms

    since in each mole there are 6.02×10^{23} molecules

    * Ratio long way: $\frac{1 \text{ molecule } N_2O_5}{5 \text{ atoms } N_2O_5} : \frac{6.02 \times 10^{23} \text{ molecules } N_2O_5}{x \text{ atoms } N_2O_5}$

11. What is the molar mass of

a) Sulfur — 32.07 g/mol
b) Boron — 10.81 g/mol
c) Lead — 207.20 g/mol
d) Phosphorus — 30.97 g/mol
e) Gold — 196.97 g/mol

12. Calculate the mass of 1.0 mole of

a) NH_3

14.01 + 1.01 × 3 = 17.04 g

b) O_2 16.00 × 2 = 32.00 g

c) S_8 32.07 × 8 = 256.56 g

d) N_2O_5 2(14.01) + 5(16.00) = 108.02 g

14.01 16.00

e) $MgSO_4$ 24.31 + 32.07 + 4(16.00) = 120.38 g

24.31 32.07 16.00

f) $Zn(NO_3)_2$ 65.39 + 2(14.01) + 6(16.00) = 189.41 g

g) $(NH_4)_2SO_4$ 2(14.01) + 8(1.01) + 32.07 + 4(16.00) = 132.17 g

h) CO_2 12.01 + 2(16.00) = 44.01 g

i) $CaCl_2$ 40.08 + 2(35.45) = 110.98 g