

The mole, molar gas volume, Clapeyron-Mendeleev equation

- To calculate masses of products and reactants using balanced chemical equations we use a unit called mole. One mole of a substance is the amount whose mass equals the molecular or atomic weight (in atomic mass units, amu) of the substance **expressed in grams**. This means that molecular weight of any substance in amu (from periodic table) is equal to molar weight in grams.
- *A mole of anything has 6.022×10^{23} particles.* This is called Avogadro's number, after Amedeo Avogadro, who first suggested that equal volumes of gas have equal numbers of molecules.
- 1 mole of any gas takes a volume of 22.4 liters at "normal conditions". This is a molar gas volume under the normal conditions. Normal conditions are temperature of 0°C (273 K) and pressure of 1 atm (101 325 Pa)
- For conditions that differ from normal we use Clapeyron-Mendeleev equation:
 $pV = nRT$
n – gas mole number
p – gas pressure (atm)
V – gas volume (liters)
T – temperature (K)
R – gas constant (0.0821 l x atm/mole x K)

1. 4 g of hydrogen (H₂) were mixed with 64 g of oxygen (O₂). The mixture exploded forming water (H₂O). Write down the equation of the chemical reaction. How many grams of water did form? How many grams of oxygen remained unreacted?
2. There are 180 g of water in a glass. How many molecules are there? How many moles?
3. The lesser is the density of a gas the better is the lifting force of a hot air balloon filled with it. What is the density of hydrogen (H₂) in (g/L)? What is the density of helium (He) in (g/L)? What gas is more advantageous to use for a hot air balloon?
4. A gas has a density of 3.17 g/L under normal conditions. What is its molar mass and molecular weight? What is the gas? Write down its formula using periodic table of elements. Hint: it has two identical atoms in a molecule.