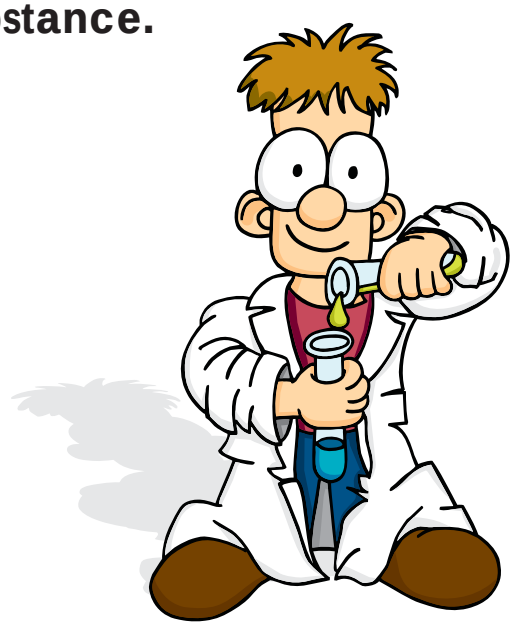
THE DENSITY OF GASES

Object: To determine the density of a Gaseous substance.



MATERIALS

- Ohaus Scout Pro® balance (readability 0.01g)
- Conical flask (ca. 1 liter)
- Measuring cylinder (ca. 1 liter)
- Vessel containing water
- CO_2 He, H_2 or O_2 from a cylinder
- Thermometer (room temperature)
- Barometer

PROCEDURE

1. The conical flask is tared filled with air. Gas is passed into the flask for a few seconds via rubber tubing fitted with a glass tube which reaches the bottom of the vessel.
2. When the display of the balance no longer changes, the gas flow is discontinued and the mass Δm read.
3. The conical flask is then filled with water and volume V determined with a measuring cylinder.
4. The volume can be found more accurately and just as conveniently with the aid of a balance and the assumption that the density of water = 1.00 g/cm³.

EVALUATION

The gas density is the quotient of the gas and its volume. The gas mass has not been measured directly, but is calculated:

$$m_{gas} = m \text{ (flask with gas)} - m \text{ (flask with air)} + m_{air}$$

$$= \Delta m + m_{air}$$

Mass difference between gas and air	Δm	in g
Mass of air (not measured)	m_{air}	in g
Volume of conical flask	v	in dm³
Room Temperature	ϑ	in C
and hence	T	in K
Air pressure	p	in mbar

Under the experimental conditions, the gas density is $\rho_{gas} = \frac{m_{gas}}{V} = \frac{\Delta m + m_{air}}{V}$

and under standard conditions $\rho_{o\,gas} = \frac{\Delta m}{V} \cdot \frac{1013\ \text{mbar}}{p} \cdot \frac{T}{273.1\text{K}} + \rho_{o\,air}$

where $\rho_{o\,air} = 1.293\ \text{g/dm}^3$

The conical flask must be completely dry.
The gas cylinders should be at room temperature.
Gases which are lighter than air (e.g. hydrogen) can be passed into the inverted conical flask from below.