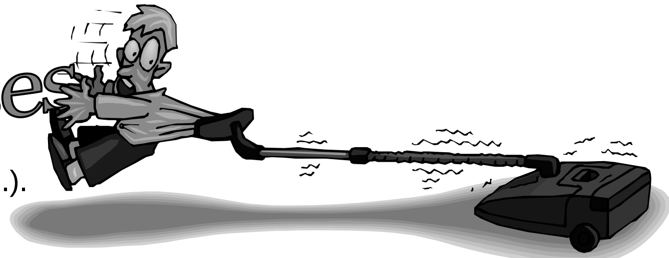
# Weighing Gases



**Prelab**: Video: "Gases and How They Combine" (17 min.).

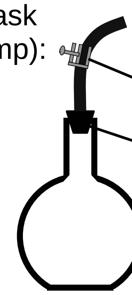
**Purpose**: To provide evidence of Avogadro's Theory.

**Materials**: Obtain the following: goggles, a plastic bag (taped around an eyedropper), and a 1 L flask (taped on the outside) with an attached rubber stopper, hose, and clamp (see below).

**Safety**: You will be creating a vacuum inside a glass flask. If the glass is cracked, the flask could implode, resulting in flying shards. Flasks are taped as a precaution. However, goggles must be worn during the lab. Note also that $H_2$ is a highly flammable gas; avoid sparks or open flames around $H_2$.

**Procedure**:

1. Put on goggles. Everyone in the room should be wearing goggles. Keep them on throughout the lab.
2. Evacuate the flask using the steps below (note: having two people help with this task will make it easier. One person can hold the flask while the other operates the pump):
    a. Loosen the clamp so that air can move freely into and out of the flask.
    b. Attach the open end of the hose to the vacuum pump. Turn on the pump.
    c. Allow approximately 30 seconds for the flask to be completely emptied.
    d. Tightly fasten the clamp to trap the vacuum inside the flask.
    e. Remove the hose from the vacuum pump. Turn the pump off.




3. Weigh the now empty flask. Record the mass in the chart below.
4. Fill a bag with $H_2$, by following these steps:
    a. Squeeze **all** air out of the bag. The bag should be squeezed into a tight ball in your hand.
    b. While the bag is compressed, attach the eyedropper to the hose leading from the gas tank.
    c. Slowly turn on the gas (using the black knob) to fill the bag. When the bag is almost full, turn off the gas, remove the bag & cover the tip of the eyedropper with your finger to trap the gas.
5. Attach the bag (via its eyedropper) to the hose of the evacuated flask. Unscrew the clamp. Some gas from the bag will be sucked into the flask. Do not squeeze the bag; you want the gas in the flask to be at atmospheric pressure. When the bag's volume stops changing, close the clamp to trap the gas inside the flask. Remove the bag from the flask. Weigh the flask with the gas and record.
6. Repeat steps 2 – 6 using $O_2$ (evacuate the flask, weigh it, fill it with $O_2$, weigh & record the mass).
7. Repeat steps 2 – 6 using $CO_2$ (evacuate the flask, weigh it, fill it with $CO_2$, weigh & record the mass).
8. Return all equipment. Get the accepted mass of each gas from your teacher. Complete the chart.

**Results**:

| Gas | Mass of flask (g) | Mass of flask with gas (g) | Mass of gas (g) | Accepted mass (g) | Density of Gas (g/L) | Molar mass (g/mol) | Moles of gas (mol) | # of molecules |
|---|---|---|---|---|---|---|---|---|
| $H_2$ | | | | | | | | |
| $O_2$ | | | | | | | | |
| $CO_2$ | | | | | | | | |
| | | | | | | | | |

Avogadro's theory is a critical contribution to science: it explains Gay-Lussac's law of combining gas volumes, it distinguishes between atoms & molecules, it provides a method of predicting the number of atoms in a molecule, it allows for the determination of relative mass, and it allows for the determination of molecular formulas.

**Questions**: (Read pages 466 – 467)

1. State the Law of Combining Gas Volumes. State Avogadro's theory.
2. Do your results from this lab support Avogadro's Theory? Explain.
3. If 1 L of $O_2$ has the same number of molecules as 1 L of $H_2$, why does it weigh 16 times more?
4. Avagodro's theory provides us with a way to predict the volumes of gases that will react in a chemical reaction. What information can be used to predict the volume ratios of reacting gases?
5. Fill in the last row of your chart for the gas $CH_4$ (methane). Predict values for all spaces.