Experiment 7

The Gas Constant

Purpose and Goals

- To determine the gas constant R, by collecting H_2 produced when a known amount of Mg reacts with acid.

Principles

- According to the ideal gas law,

  $PV=n\,RT$ (1)

- Rearrange the equation,

  $R=PV/\,n\,T$ (2)

if P, V, n, T are known, we can calculate R by equation (2).

In this experiment

- P : pressure of H_2, $P_{H2}=P_{bar}- P_{H2O}$
- V: volume of H_2 collected
- n: moles of H_2
- T: absolute temperature (K)

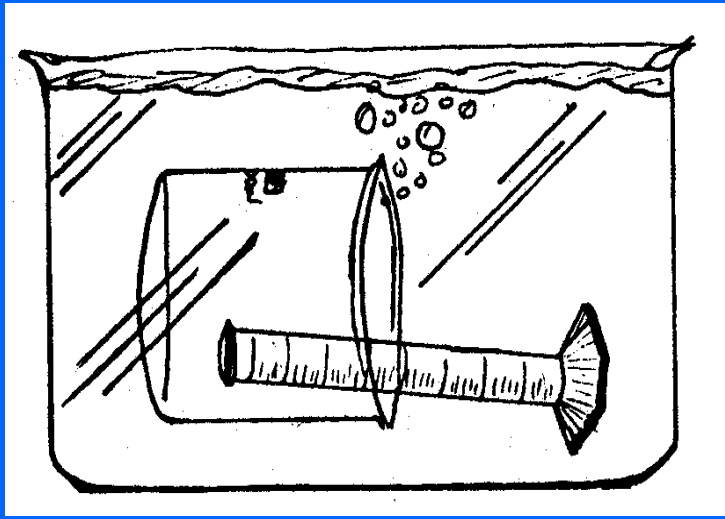
Procedure

Prepare the solutions:

- Solution 1: 50 ml H_2O + 10ml 6M HCl
  (used for reaction)

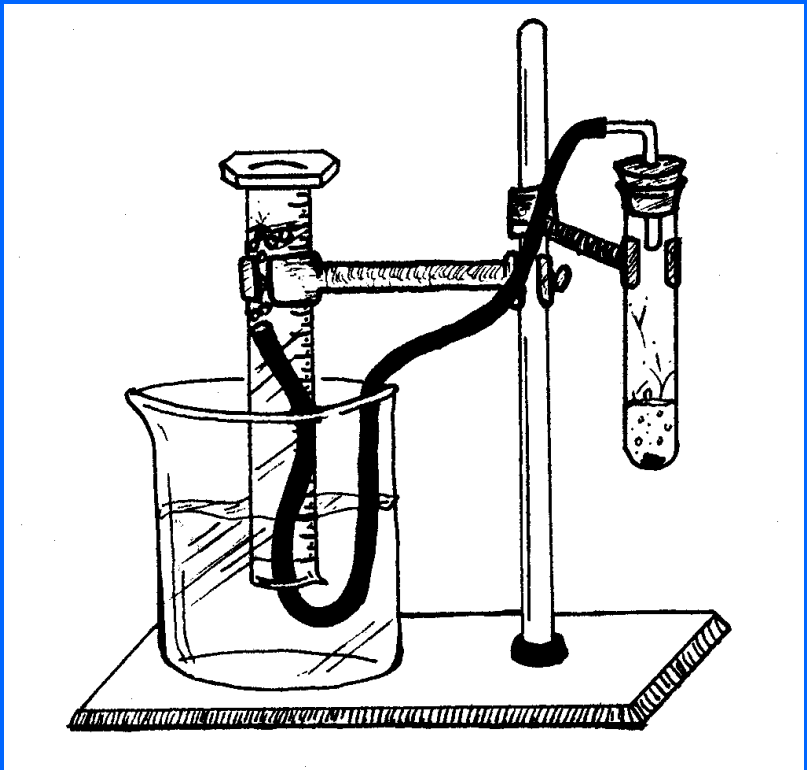
- Solution 2: 90 ml H_2O + 10 ml solution1
  (used for cleaning of Mg ribbon)

Procedure (cont.)



- Submerse a 100 ml cylinder and a 1000 ml beaker in the sink. Make sure that there are no bubbles in the top of the cylinder. Keep the cylinder inverted when they are removed from the water

Procedure (cont.)



Put the rubber hose inside the cylinder.

Procedure(cont.)

- Clean the Mg ribbon with *solution 2*
- Take the metal out, rinse and dry it
- Weigh out about 0.070g~0.075g of Mg, record the mass

Procedure(cont.)

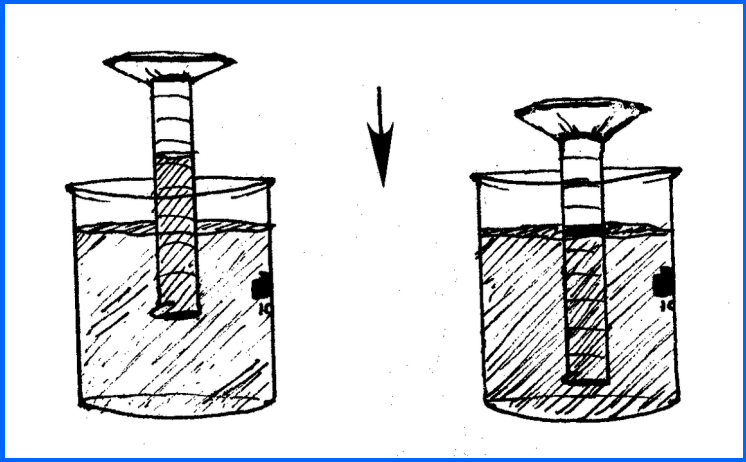
- Place 12 ml solution 1 into the test tube, then the weighed Mg ribbon

Do not let Mg react with acid. tilt the test tube at an angle, put in the metal,insert the rubber stopper, then turn the test tube upright

- When all the Mg disappears, record the volume in ml.

- After you finish experiment, record the barometric pressure and room temperature

Reminders



- Water level inside and outside cylinder are even.

- Always wear the safety goggles

Calculations

R=PV/nT

(1) P_{H2} (torr) =P_{bar}- P_{H2O}

P_{bar} : given on board in torr

P_{H2O}: given on page7- 4 in torr.

P_{H2}(atm)=P torr / 760 (torr/atm)

(2) V_{H2}(L), change milliliter to liter dividing by 1000 ml/L

Calculations(Con.)

(3) n moles of H_2

$Mg + 2HCl \rightarrow MgCl_2 + H_2$

1 1

mass/24 n

(4) T absolute temperature

T (K) = t ° (centigrade) + 273

The unit of R is atm.L/ mole.K

Calculations(Con.)

(5)Average value of R = (R1 + R2 + R3)/3

$$\% \text{ Error} = \frac{(\text{average R} - 0.0821)\times 100\%}{0.0821}$$

Accepted R is 0.0821 atm. L/mole .K