



Class: 2nd stage

Subject: Physical Chemistry



**Ministry of Higher Education and Scientific Research
Al-Mustaqbal University College**

**Chemical engineering and petroleum industries
(Physical Chemistry lab)**

Experiment No.4

**(Determination of the molecular weight of volatile
liquids by Dumas method)**

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Determination of the molecular weight of volatile liquids by Dumas method

In the early 19th century, Jean-Baptiste Dumas, a distinguished French chemist, created a relatively simple method for determining the molecular weight of a volatile substance. The Dumas method is appropriate to determine the molecular weights of volatile organic substances that are liquids at room temperature.

When a precisely known amount of the volatile liquid is transferred from the liquid state to the gas phase, it follows the ideal gas law.

$$PV = nRT$$

$$PV = \frac{w}{M} RT$$

P: vapor pressure

V: volume of the vapor

W: weight of the vapor

M: molecular weight of the volatile liquid

R: gas constant

T: the temperature of the vapor in kelvin

Aim of the experiment:

To find the Molecular weight of the volatile liquid (acetone)



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Equipment:

Acetone, balance, beaker, flask, graduated cylinder, heater, aluminum foil, thermometer, small pin.

Procedure:

1. Weigh the empty flask that is covered with the aluminum foil and let it be (w_1).
2. Put 3 ml of the acetone in the flask then cover it with the aluminum foil and make a small hole with the pin.
3. Put the flask in the water bath and raise the temperature to the boiling point to make sure that it is constant , then wait until all the liquid acetone vaporize and turns to vapor, its pressure will be the same as the atmospheric pressure.
4. Move the flask from the water bath and cool it to condense the vapor of the acetone.
5. Weigh the flask that contains the condensed acetone after drying it , let it be (w_2).
6. Measure the volume of the flask by filling it with water then pour the water in a graduated cylinder and read the volume, this will be the volume of the vapor (V)



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Calculations:

Put the information you got from the experiment in the following equation:

$$PV = nRT$$

$$PV = \frac{w}{M} RT$$

$$PV = \frac{(w_2 - w_1)}{M} RT$$

$$M = \frac{(w_2 - w_1)RT}{PV}$$

$$M = \frac{(w_2 - w_1)0.082 * T}{1 * V}$$

Discussion:

1. Drive the equation of the molecular weight.
2. State two liquids that can be used in this experiment instead of acetone.
3. Why it is important to drill the aluminum cover?