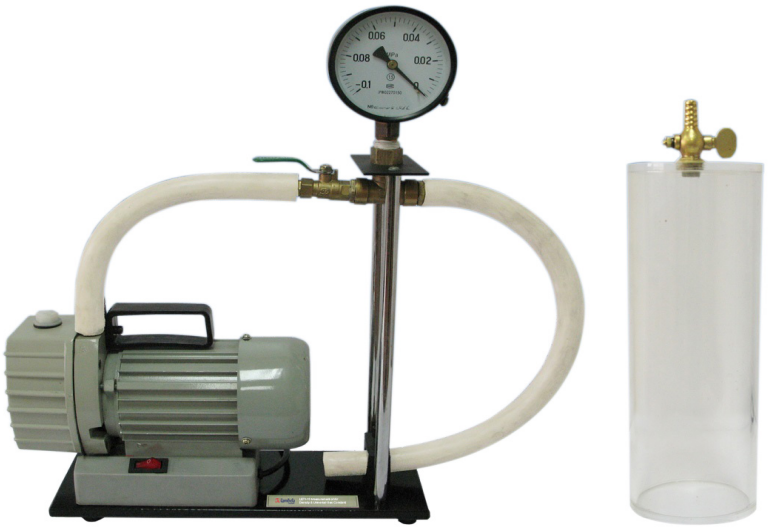
Construct, Conduct & Comprehend Physics Experiments

LETI-15 Measurement of Air Density & Universal Gas Constant

- High performance
- Simple structure, stable and reliable
- Affordable



The universal gas constant is an important constant in thermodynamics, and gas density is an important physical quantity in molecular physics. The two quantities can be easily measured using this apparatus through vacuuming method. This apparatus has the features of small size, convenient operation and durable structure. The experimental data are stable and reliable (errors of air density and universal gas constant are 1% and 3% respectively). This apparatus is designed with following innovations:

1. Relatively large volume of gravity bottle (1 liter) is used that makes the experimental phenomenon more obvious. Its volume can be calculated directly from the measurements of its outer diameter, height and wall thickness using a caliper.
2. Directly read out the vacuum degree with a high-precision vacuum meter, do not need to use an expensive thermal coupling vacuum gauge.
3. Use the phenomenon of naturally slow air leakage at the junctions to change inside pressure, no vacuum needle valve is needed, so that the requirement of air tightness at each junction is not very strict.
4. Use a physical electronic balance to measure the change of gas mass. The operation is convenient and the accuracy meets the requirements for a basic physics experiment. The cost is lower than an electronic analysis balance.

LETI-12 Apparatus of Measuring Air Density and Universal Air Constant mainly consists of a rotary vacuum pump, a vacuum gauge, a vacuum valve, a gravity bottle, an electronic balance, a mercury thermometer, and vacuum tubes. Using this apparatus, the following experiments can be performed:

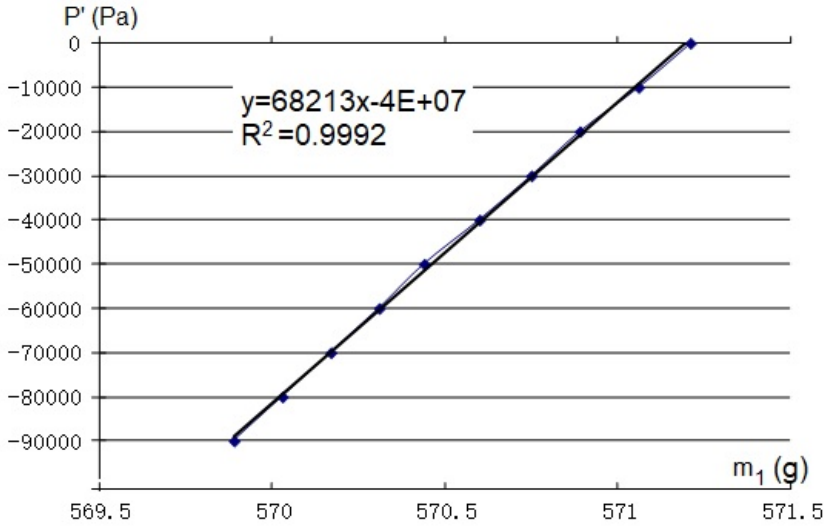
1. Measure the density of ambient air by vacuuming method, convert it to the standard value of dry air under standard state (0 °C, one standard atmospheric pressure), and compare it with the theoretical value of the standard state.
2. From the ideal gas state equation, derive the expression of universal gas constant under variable pressure. Measure the data of total mass m_1 (air plus container) at gas pressure P' by the method of reducing pressure step-by-step and plot their relationship curve. Acquire the universal gas constant R by curve fitting, and compare it with theoretical value.

Specification

Description	Specifications
Rotary vacuum pump	1 Liter/Sec, max vacuum 6 Pa, speed 1400 rpm, power 180 W
Vacuum gauge	Range - 0.1 to 0 Mpa, minimum scale 0.002 Mpa
Electronic balance	Capacity: 0 - 1000 g, Readability: 0.01 g
Mercury thermometer	Range 0 - 50 °C, a minimum scale 0.1 °C

Parts

Description	Qty
Vacuum pump	1
Vacuum gauge	1
Vacuum valve	1
Gravity bottle	1
Vacuum tubes	2
Tee & connectors	1 set
Base & support	1
Electronic balance	1 (optional)
Mercury thermometer	1 (optional)
Manual	1



Plot of total mass m_1 and gas pressure P' with curve fitting

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