## EXPERIMENT PROCEDURE

- **Point-by-point measurement of the pressure *p* of the enclosed air as a function of the temperature *T*.**
- **Plotting the measured values in a *p*-*T* diagram.**
- **Verification of Amontons' law.**

You can find technical information about the equipment at 3bscientific.com

## OBJECTIVE

**Verify the linear relationship between the pressure and temperature of an ideal gas**

## SUMMARY

The validity of Amontons' law for ideal gases is demonstrated using normal air. To demonstrate this, a volume of enclosed air located in a hollow metallic sphere is heated with the aid of a water bath while the temperature and pressure are being measured at the same time.

## REQUIRED APPARATUS

| Quantity | Description | Number |
|---|---|---|
| 1 | Jolly's Bulb and Gauge | **1012870** |
| 1 | Magnetic Stirrer with Heater (230 V, 50/60 Hz) | **1002807 or** |
| | Magnetic Stirrer with Heater (115 V, 50/60 Hz) | **1002806** |
| 1 | Digital Quick Response Pocket Thermometer | **1002803** |
| 1 | K-Type NiCr-Ni Immersion Sensor, -65°C – 550°C | **1002804** |
| 1 | Set of 10 Beakers, Low Form | **1002872** |
| 1 | Tripod Stand 150 mm | **1002835** |
| 1 | Stainless Steel Rod 250 mm | **1002933** |
| 1 | Bosshead | **1002827** |
| 1 | Universal Jaw Clamp | **1002833** |





## BASIC PRINCIPLES

**The volume of a quantity of gas depends on the pressure the gas is under and on its temperature. When the volume and the gas quantity remain constant, the quotient comprising the pressure and the temperature remains constant. The law discovered by *Guillaume Amontons* applies for gases in the ideal state, i.e. when the temperature of the gas is far in excess of its so-called critical temperature.**

The law discovered by Amontons

(1) $$\frac{p}{T} = \text{const.}$$

is a special case of the universal gas law valid for all ideal gases, which describes the relationship between the pressure $p$, the volume $V$, temperature $T$ relative to absolute zero and the mass $n$ of a gas:

(2) $$p \cdot V = n \cdot R \cdot T$$

$$R = 8{,}314 \frac{\text{J}}{\text{mol} \cdot \text{K}}\text{: universal gas constant}$$

Based on the generally applicable Equation (2) the special case (1) can be derived under the precondition that the volume $V$ and the mass of the enclosed gas $n$ do not change.
In the experiment the validity of Amontons' law is demonstrated using air as the ideal gas. To do this the enclosed volume of air located in a hollow metal sphere is heated up with the aid of a water bath. At the same time the temperature $\vartheta$ is measured in °C using a digital thermometer and the pressure $p$ is measured using a manometer attached to the hollow sphere.

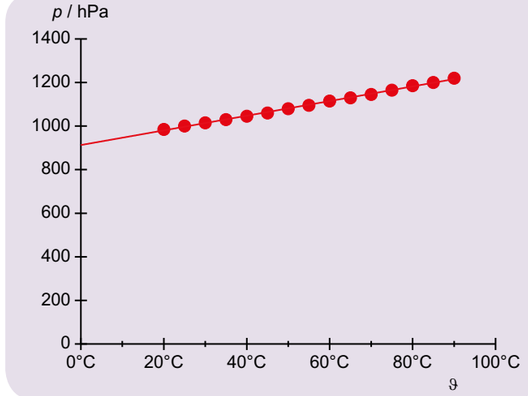


Fig. 1: Pressure-temperature diagram of air at constant volume and constant mass.

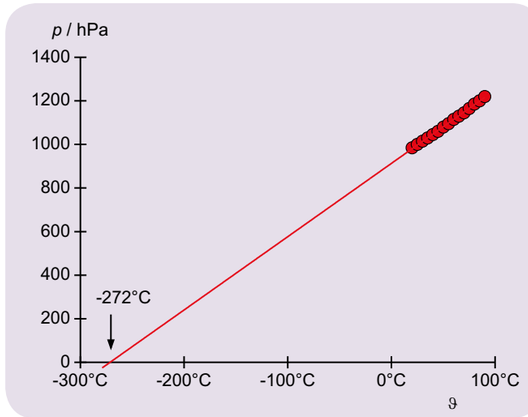


Fig. 2: Extrapolation of the pressure to a value of $p$ = 0.

## EVALUATION

The linear relationship between pressure and temperature is confirmed by fitting a straight line

(3) $$p = a \cdot \vartheta + b$$

to the measurement points. By extrapolating the pressure $p$ up to a value of 0, the absolute zero temperature can be determined:

(4) $$\vartheta_0 = -\frac{b}{a}\ [°\text{C}]$$