# DENSITY OF AIR, DEMO - QUANTITATIVELY

**MED 01.15a**



***Material:***

| Item-no. | Qty. | Description |
|---|---|---|
| DM503-2A | 1 | Vacuum pump, electric 12, two stages |
| C1520-1M | 1 | Vacuum hose, plastics, D=6 mm, L=100 cm |
| DM520-2G | 1 | Bell jar 7 l |
| DE722-2B | 1 | Barometer „inno" |
| DM125-3E | 1 | Digital balance, 6000/1 g |

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**Purpose:**

Determination of the mass of air and thus its weight force.

**Preparation:**

The barometer is switched on and placed in the bell jar.
The vessel is closed with the lid. The tap on the lid must be open.
We connect the recipient (the bell jar) to the vacuum pump with the hose.
Make sure that the hose is firmly inserted into the connections.

**Experiment 1:**

The barometer shows the air pressure in the bell jar, which is initially equal to the air pressure in the surroundings.

The vacuum pump is switched on.
We watch the barometer reading.


**Explanation:**

The vacuum pump sucks the air out of the interior of the bell jar.

As there are fewer and fewer air particles in the vessel, the air pressure also drops, which we can see on the display of the barometer.

When the pressure no longer changes, the valve on the lid is closed and the pump is switched off.

## Attention:

When the pump is switched off, the valve on the lid of the bell jar must be closed immediately, otherwise the oil from the pump will be sucked into the bell jar!

**Hints:**

The pump does not manage to completely suck out the bell jar!
Depending on the performance of the pump, a value below 30 hPa should be achieved.
If one assumes that the normal ambient air pressure is around 1000 hPa, then with a residual pressure of 30 hPa, 97% of the air has been sucked off.

If you are working with a large vacuum vessel (in this case 7 liters volume), we strongly recommend using a two-stage electric vacuum pump.

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**Experiment 2:**

Now a digital balance with a weighing range of at least 2500 g and a resolution of at least 1 g is required.
The vacuum hose is pulled off the lid of the bell jar.
The balance is switched on and tared if necessary.

The bell jar (including the barometer) is placed on the digital balance.

The total mass of the almost empty bell jar is noted in the chart below.
The air pressure in the almost vacuum chamber is also noted in the chart below.


| | Total mass (in g) | Air pressure in the bell jar (in hPa) |
|---|---|---|
| Bell jar without air | | |
| Bell jar with air | | |
| Difference | | |

**Experiment 3:**

Remove the bell jar from the digital balance.
The tap or inlet valve is opened very slowly so that air can flow into the bell jar.
Observe the display of the barometer.

As soon as the barometer shows an air pressure of around 1000 hPa, the ambient air pressure has been reached.

The inside of the bell jar is now completely filled with air again.

To prove this, the cover can be removed briefly.

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We place the bell jar (including the barometer) on the digital balance again.

The total mass of the air-filled bell jar is noted in the chart below.

The air pressure of the air-filled bell jar vacuum chamber is also noted in the chart below.

The difference between the masses and the air pressure is calculated and the results are entered in the table.

Using the difference in air pressure, we can calculate out how much air we sucked out of the bell jar.

To simplify the calculation, we can assume that the normal ambient air pressure is around 1000 hPa.

The difference in air pressure from the ambient air pressure is ……. %.

The interior of the bell jar is 7000 ml.

The percentage of the sucked out air, converted to 7 liters, results in a

a) sucked volume of …… litres.

b) the mass difference determined is ……. G.

According to the experiment 1 $dm^3$ (litre) of air has a mass of ……. g.

**Note**
The density of air is 1,20 $g/dm^3$ at a temperature of approximately 20 °C