Molecular physics and thermodynamics

2.10 Isothermal process

THEORETICAL PREPARATION

For two different states of an ideal gas determined by values *p*, *T* and *V* applies the equation of state:

$$\frac{p_1 V_1}{T_1} = \frac{p_2 V_2}{T_2}$$

If the temperature remains constant during change of phase of the gas, we can talk of an isothermal process, for which applies equation in the form of:

$$p_1 V_1 = p_2 V_2$$

$$pV = \text{constant}$$

The *pV* – diagram deals with equation of reciprocal proportion and the pressure - volume graph is an arm of a hyperbola.

EQUIPMENT

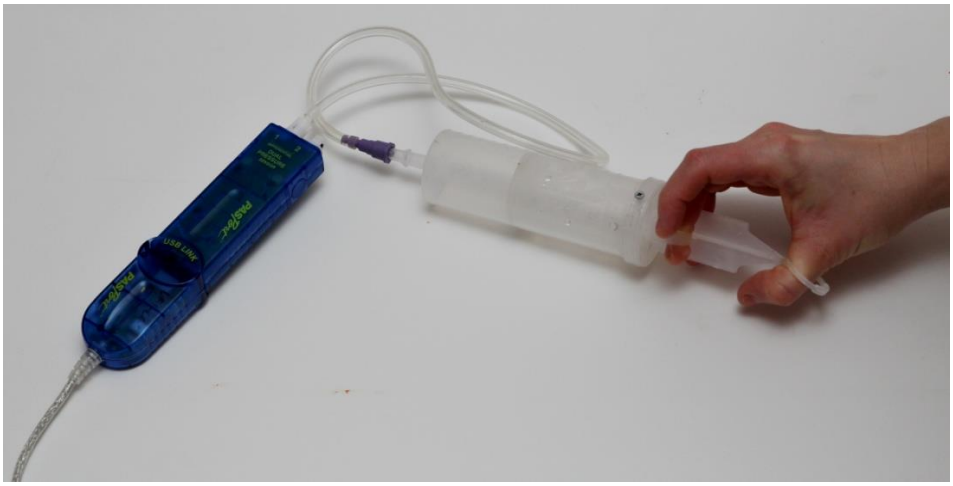
dual pressure sensor, USB link, notebook equipped with the program DataStudio, syringe e.g. 150 ml, warm water, thermometer, heat bath

PROCEDURE

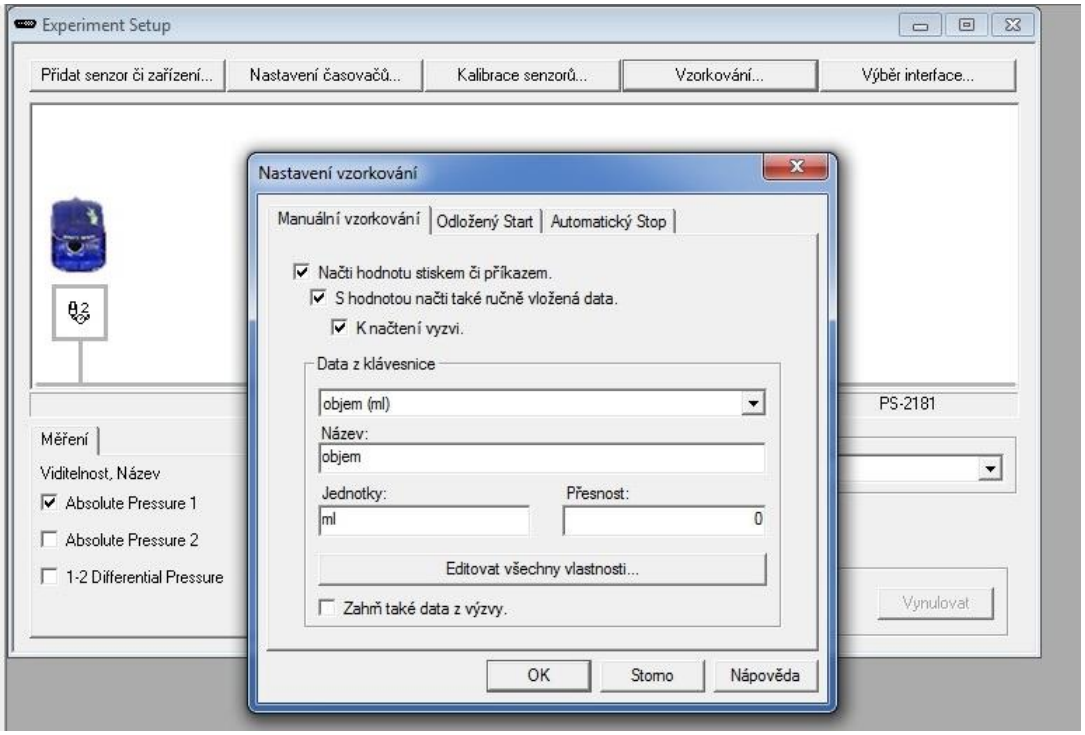
1) Set the syringe volume to 80 ml and connect it to the dual pressure sensor. Then connect the USB link to the notebook.

CZ.1.07/1.1.26/02.0094

INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ



2) Because there may occur some problems with measuring the volume of air in the syringe, we will always use the button Take when setting the volume. At first, we need to set the values in Experiment-Setting sampling-Manual sampling, according to the picture.



3) Use the thermometer to measure the room air temperature.

4) Start the measuring in the DataStudio program and execute the measurement through the use of the button Take. Note down the values of air volume in mililitres. Measure by the volumes of 50ml, 60 ml, 70ml (by the hand-pressed plunger), 80 ml (without any activity of the hand)

90ml, 100ml, 110ml, 120ml, 130ml, 140ml, 150ml (when pulling the plunger out). The volume changes occur slowly enough to allow the system to continually adjust the temperature of air in the syringe with air in the room. Push the button with a red symbol of a square to end the measurement.

5) Plot the pressure-volume graph.

6) Create a chart using all the measurements (through the File-Export data), in which you calculate the product of air volume and pressure in the syringe.

7) Calculate the constant in isothermal process equation from the state equation of an ideal gas.

8) Execute the same measurement but set higher temperature of water approximately 35°C , in which we sink the syringe.

9) In one graph mark the relation of air volume and pressure in the syringe by the two different temperatures (in the air and the warm water).

10) Write a summary.