



Molecular physics and thermodynamics

2.2 Hydrostatic pressure

THEORETICAL PREPARATION

Hydrostatic pressure can be calculated according to the following formula $p_h = h \cdot \rho \cdot g$,

h depth,

ρ fluid density,

g gravitational acceleration.

EQUIPMENT

dual pressure sensor, USB link, notebook with a DataStudio program, 2 measuring cylinders of 500ml, aquarium, water, ethanol, stick, Scotch tape, marker, length measure

PROCEDURE

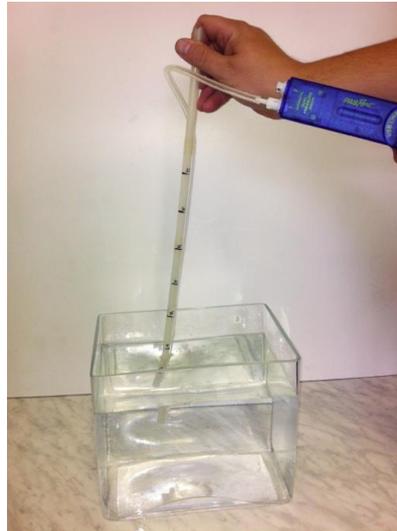
A) Quantitative relationship of hydrostatic pressure and depth of water in an aquarium

1) Mark the 5 cm sections on the stick. Use the tape to fasten the sensor hose to the stick.



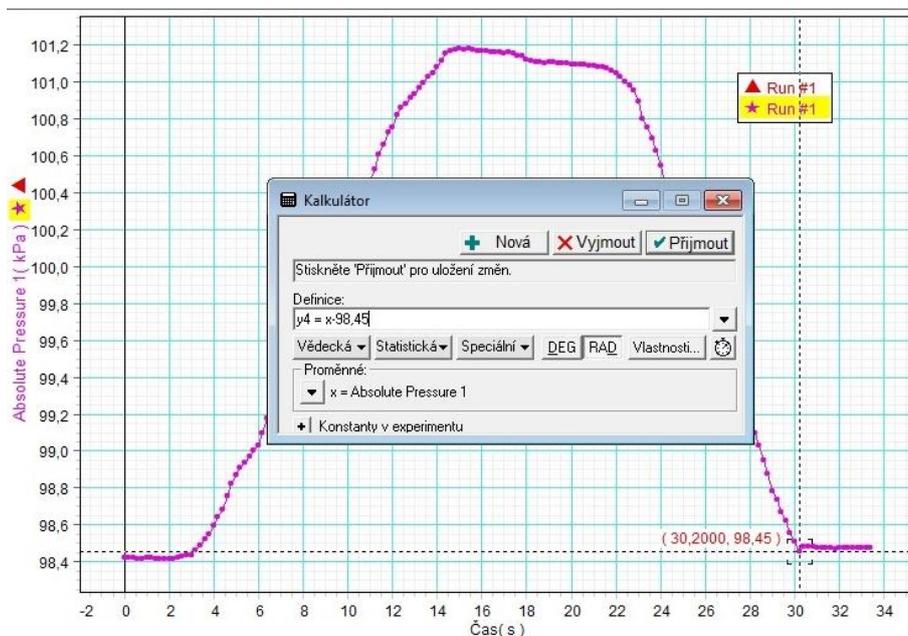
2) Pour water into the aquarium, connect the pressure sensor to the USB link and to the notebook.

3) Initiate the measurement by pushing the button START and slowly move the stick under the water. Try to incline or move the stick from side to side in certain depth. Take out the hose fluently and end the measurement.



4) Create pressure (from the input, to which was the hose connected) - time graph.

5) The sensor measures absolute pressure, i.e. atmospheric and hydrostatic together, therefore we have to move the graph (of value of the atmospheric pressure), so it shows only hydrostatic pressure. Read the value of the atmospheric pressure from the graph and use the button calculation to move the graph.

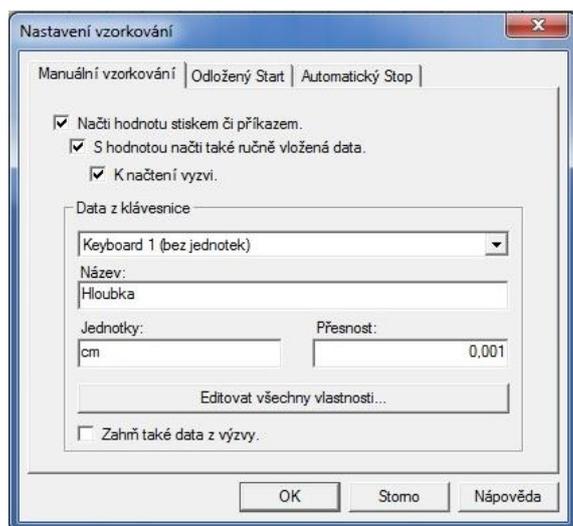


6) Write a summary.

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B) Measurement of hydrostatic pressure in various depths in water and ethanol

- 1) Pour water (coloured) in one of the measuring cylinders and ethanol into the other. Measure each of the fluids separately.
- 2) Use the button Take to set the depth manually (we need to do this when measuring depth, because we can experience problems when doing it automatically). At first, you need to set manual sampling of the value in Experiment – Sampling setting – Manual sampling (according to the picture).



- 3) Measure in the depth from 0 to 30cm. Always in 5cm sections, as they are marked on the stick. Enter the value of the depth manually (in cm) after pushing the button Take.



- 4) Visualize both measurements in one graph of hydrostatic pressure-depth relationship.

Move the graphs of the value of atmospheric pressure (see above).

- 5) Use the feature Fitting – Linear fitting to inset lines in both graphs. It is obvious that hydrostatic pressure is getting bigger with rising density of the fluid and it is also visible from the graph that the hydrostatic pressure is proportional to depth.
- 6) Fill in the chart with measured and calculated values of hydrostatic pressure for water and ethanol in various depths.

$$\text{Water density: } 1000 \frac{\text{kg}}{\text{m}^3}$$

$$\text{Ethanol density: } 789 \frac{\text{kg}}{\text{m}^3}$$

$$g = 9,81 \text{ m.s}^{-2}$$

- 7) Write a summary.