Hydrostatic pressure (Item No.: P1001800)

Task and equipment

Information for teachers

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Task and equipment

Task

What kind of pressure exists in water?

First, you will investigate whether pressure in water depends on the direction.
Then you will determine the hydrostatic pressure p in water as a function of the depth h.

Equipment

Position No.	Material	Order No.	Quantity
1	Support base, variable	02001-00	1
2	Support rod, l = 600 mm, d = 10 mm, split in 2 rods with	02035-00	1
2	Support rod with hole, stainless steel, 10 cm	02036-01	1
3	Boss head	02043-00	2
4	Glass tubes,l.250 mm, pkg.of 10	36701-68	2 pieces
5	Glass tube holder with tape measure clamp	05961-00	1
6	Measuring tape, l = 2 m	09936-00	1
7	Probes for hydrostatic pressure	02634-00	3 pieces
8	Glass beaker DURAN®, short form, 600 ml	36015-00	1
8	Syringe 20ml, Luer, 10 pcs	02591-03	1 piece
9	PVC tubing, i.d. 7mm	03985-00	1
	Glycerol, 250 ml	30084-25	250 ml
Additional material			
	Scissors		1

Set-up and procedure

Set-up

Set up a stand with the support base (Fig. 1) and the 600 mm support rod (Fig. 2-3).

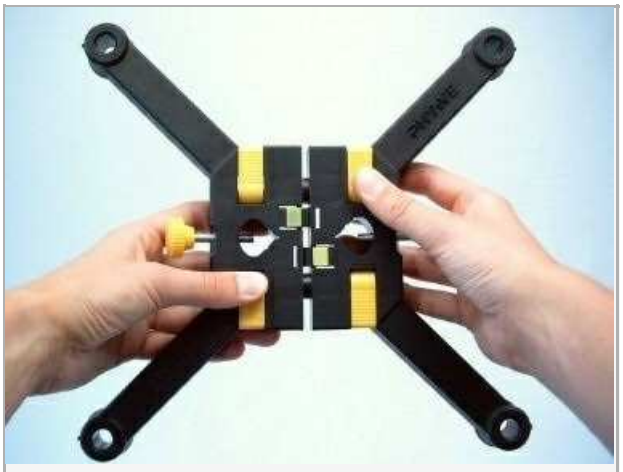


Fig. 1

Fig. 2

Fig. 3

Fix the glass tube holder to the support rod (Fig. 4), and clamp a bosshead below the glass tube holder (Fig. 5).

Fig. 4

Fig. 5

Clamp the short support rod into the bosshead and fix another bosshead on its other end (Fig. 6).
Fix the measuring tape to the glass tube holder (Fig. 7).

Fig. 6

Fig. 7

Fix the two glass tubes to the glass tube holder; these are the manometer tubes. Connect their lower ends with approx. 40 cm of silicone tubing. Attach a 60 cm length of silicone tubing to the upper end of the right tube (Fig. 8).

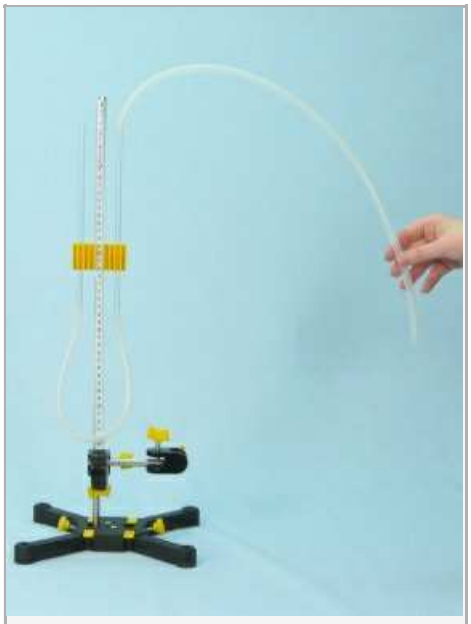


Fig. 8

Attach a pressure probe to the silicone tubing and mount it in the bosshead (Fig. 9).

Fig. 9

Use the syringe as funnel and fill the manometer with water (Fig. 10) until both glass tubes are half-full.

Place the beaker underneath the pressure probe and fill it with water (Fig. 11).

Fig. 10

Fig. 11

Procedure

Directional dependence of hydrostatic pressure

To measure the bottom pressure use the hook-shaped bent probe (Fig. 12). To measure the lateral pressure use the probe bent at right angle (Fig. 13). Measurement of the top pressure is performed with the straight probe (Fig. 14).

- For each measurement, immerse the probe (position of opening!) 5 cm in the water and force the water out which has entered the probe by moving the manometer tubes.
- Make sure that the water-air interface is not curved.
- When measuring lateral pressure, water may only extend about halfway up the straight side of the manometer.

Repeat each measurement three times and record the value Δl determined for the difference in the water levels of the two manometer tubes, which is an indicator of the pressure p. Enter the values in Table 1 in the report.

Fig. 12

Fig. 13

Fig. 14

Dependence of the hydrostatic pressure on the immersion depth

- Use the straight probe.
- Sink the probe a centimeter at a time from 1 to 10 cm in the water.
- At each depth, force the water which has seeped into the probe out - by raising one of the manometer tubes - insofar as that the water-air interface in the probe's opening is as flat as possible.
- Record the immersion depth *h* of the probe and the corresponding difference in the water levels Δ*l* on both sides of the manometer in Table 2 in the report.

Fig. 15

In order to disassemble the support base, press the yellow buttons (Fig. 16).

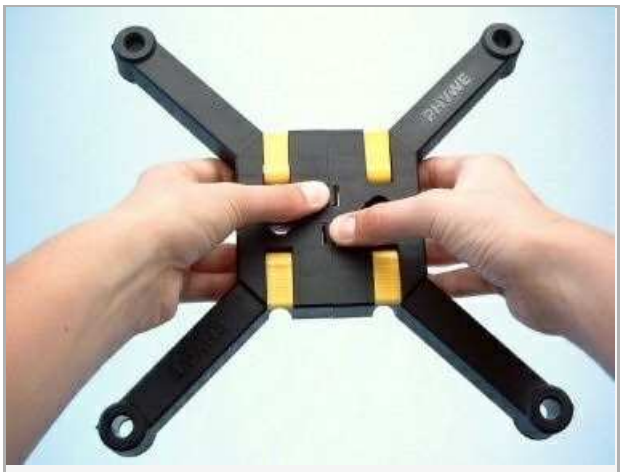


Fig. 16

Report: Hydrostatic pressure

Result – Table 1

Note down the measured values of the first part of the experiment at the immersion depth h = 5 cm.

Calculate the average value from the measured values for Δl.

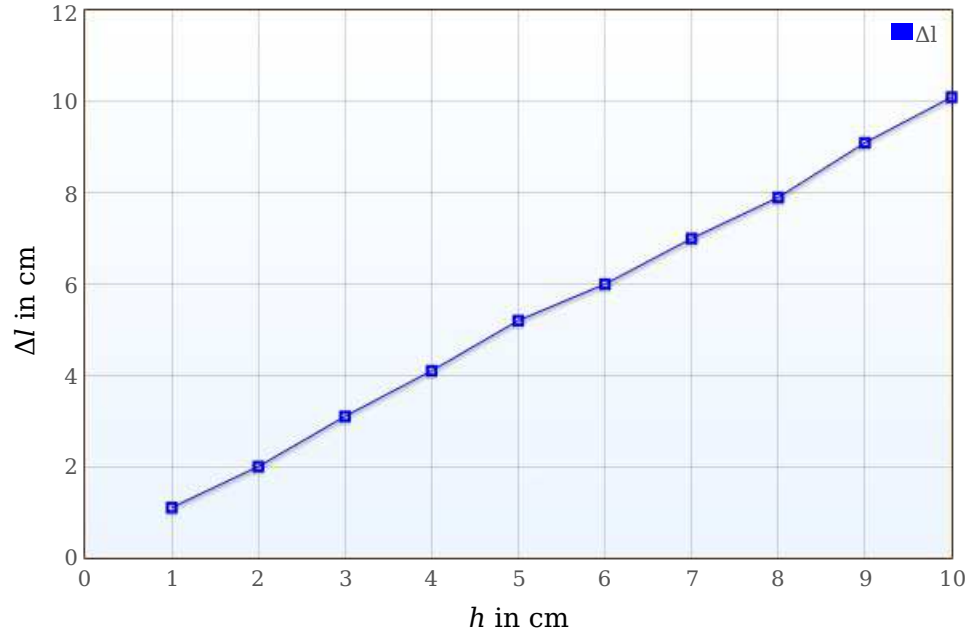
Manometer	Δl in cm			average values in cm
Bottom pressure	0 ±0	0 ±0	0 ±0	0 ±0
Top pressure	0 ±0	0 ±0	0 ±0	0 ±0
Lateral pressure	0 ±0	0 ±0	0 ±0	0 ±0

Result – Table 2

Record all the measured values of the second experiment.

h in cm	Δ*l* in cm
1	1,1
2	2,0
3	3,1
4	4,1
5	5,2
6	6,0
7	7,0
8	7,9
9	9,1
10	10,1

Number1



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Evaluation – Question 1

Explain why the difference in height Δl of the water levels in the manometer is a measure of the hydrostatic pressure p.

Evaluation – Question 2

Do top, bottom and lateral pressure differ at the same immersion depth?

Evaluation – Question 3

Look at the graph generated from Table 2. What correlation exists between immersion depth *h* and hydrostatic pressure *p*?

Evaluation – Question 4

What can you say about hydrostatic pressure now that the measurements have been made?