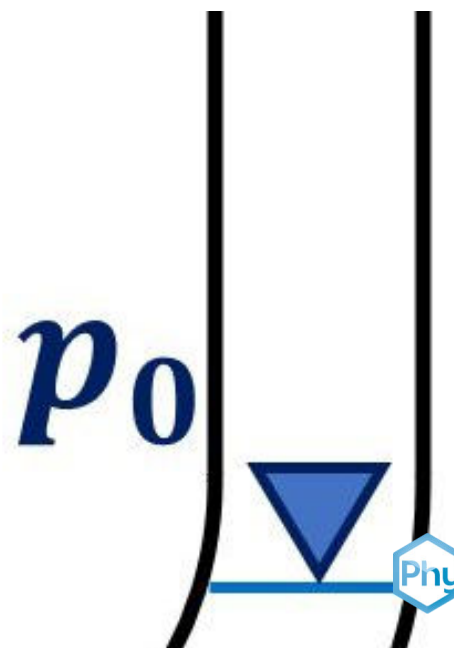
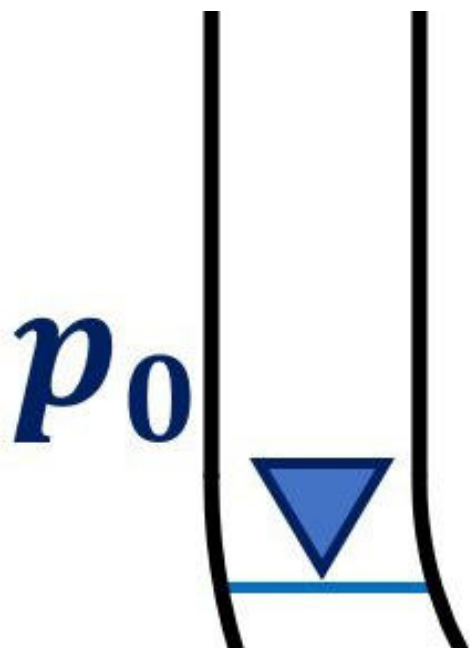


Joined vessels



Physics

Mechanics

Mechanics of liquids & gases



Difficulty level

medium



Group size

2



Preparation time

10 minutes



Execution time

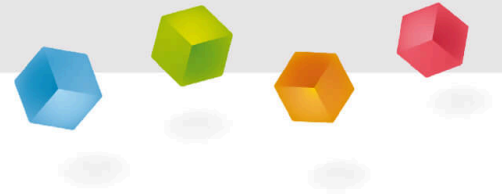
10 minutes

This content can also be found online at:

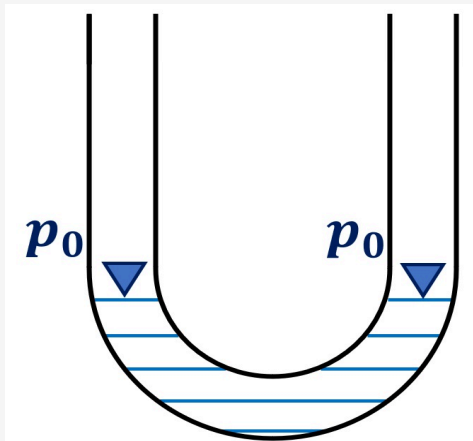
<http://localhost:1337/c/5fa96eca79804000390fa99>

PHYWE

Teacher information



Application



Schematic diagram of an unclosed U-tube filled with water

If a U-pipe - as shown in the figure - is filled with water, the water levels on both sides are always at the same level. However, this is only the case if the pressure on both sides is the same. In this case, it is an unsealed U-pipe on both sides of which only the ambient pressure p_0 works.

The ambient pressure can vary depending on the location and weather and is on average around the globe:

$$p_0 = 1013 \text{ hPa} \approx 1 \text{ bar}$$

$$1 \text{ bar} = 10^5 \text{ Pa} = 10^5 \frac{\text{N}}{\text{m}^2}$$

Other teacher information (1/2)

PHYWE

Prior



The students should already have developed a basic understanding of the effects and formation of pressures.

Scientific



If no additional pressure is applied to the fluid - in this case water - at either end of the U-pipe, the water levels are always in equilibrium. This phenomenon is independent of whether the position or course of the pipe is changed.

The unit of pressure is usually either bar (*bar*) or Pascal (*Pa*).

Other teacher information (2/2)

PHYWE

Learning



The students should learn that the height of the water level is completely independent of how the pipe is changed in its position or course.

Tasks



Using a flexible U-tube consisting of two glass bells and a piece of tubing, the students are to examine how the water level in the two legs of the U-tube behaves when they change their position relative to each other.

Furthermore, they should replace one of the two bells with a glass tube and repeat the experiment.

Safety instructions

PHYWE



The general instructions for safe experimentation in science lessons apply to this experiment.

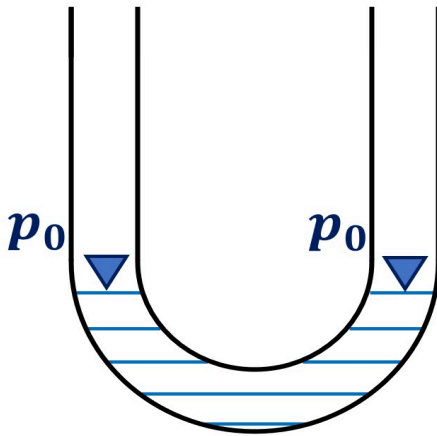
PHYWE

Student Information



Motivation

PHYWE



Schematic diagram of the U-tube manometer

A so-called U-tube manometer is a pressure measuring instrument that can be used to measure or display pressure differences. As a rule, different pressures prevail at the two ends of a U-shaped tube, which lead to a difference in the level of the liquid levels in the respective pipe sections.

If the pressures are the same on both sides (see left), the two liquid levels are also at the same level. By this principle, it is possible to find two points of equal height on a wall, if you don't have a spirit level at hand.

In this experiment you will deal with the water levels in a pipe.

Tasks

PHYWE



Investigate a so-called U-tube in this experiment.

Fill a U-shaped tube with water and observe the water levels in the two legs as you move them towards each other.

Using a flexible U-tube consisting of two glass bells and a piece of hose, investigate how the water level in the two legs of the U-tube behaves when they are changed in position relative to each other.

Repeat this experiment afterwards by replacing one of the two bells with a glass tube.

Equipment

Position	Material	Item No.	Quantity
1	Support base, variable	02001-00	1
2	Support rod, l = 600 mm, d = 10 mm, split in 2 rods with screw threads	02035-00	1
3	Beaker, 100 ml, plastic (PP)	36011-01	1
4	Glass bell with tube	03917-00	2
5	Glass tubes, l. 250 mm, pkg. of 10	36701-68	1
6	Glass tube holder with tape measure clamp	05961-00	1
7	PVC tubing, inner dia. = 7 mm, l = 1 m	03985-00	1

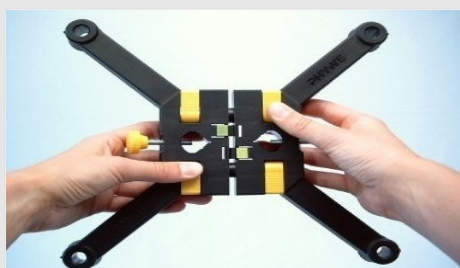
Set-up (1/3)

PHYWE

Plug the two halves of the tripod foot together.

Then screw together the divided stand rod to a long one.

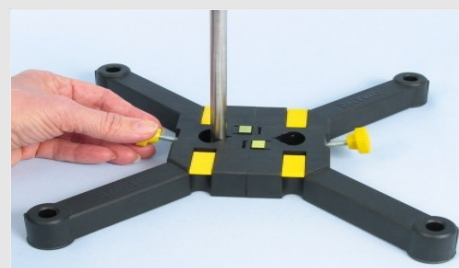
Fix the long stand rod vertically in the stand foot.



Assembling the tripod base



Screwing the stand rod



Assembling the tripod

Set-up (2/3)

PHYWE



Fasten the glass tube holder to the stand rod

Attach the glass tube holder to the stand rod.

Clamp the two glass bells to the glass tube holder

Connect them with a piece of hose about 50 cm long.



Connecting the glass bell by means of the hose

Set-up (3/3)

PHYWE



Filling the U-tube with water

Fill both glass bells halfway with water.

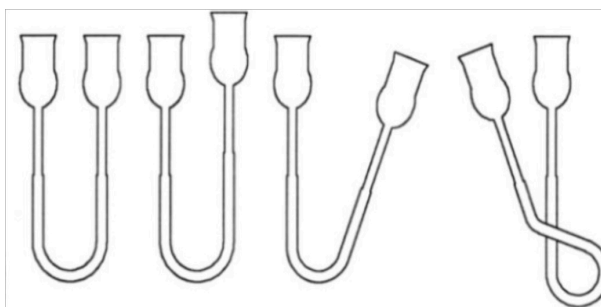
Procedure (1/5)

PHYWE



Test setup of the U-tube

- Hold the two glass bells one after another in four different positions. Orientate yourself by the sketch below and the pictures on the following page.
- Observe the water level in the two glass bells for all positions.



Procedure (2/5)

PHYWE



1st variation of the position of the right glass bell



2nd variation of the position of the right glass bell with inclination



3rd variation of the position of the right glass bell

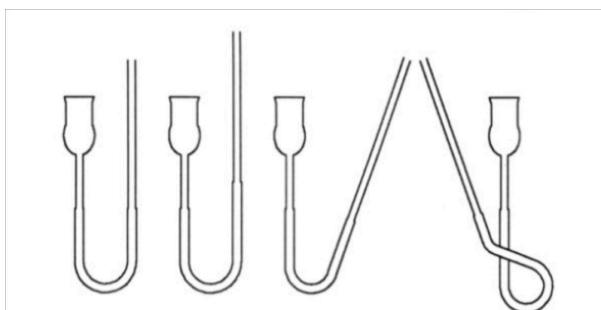
Procedure (3/5)

PHYWE



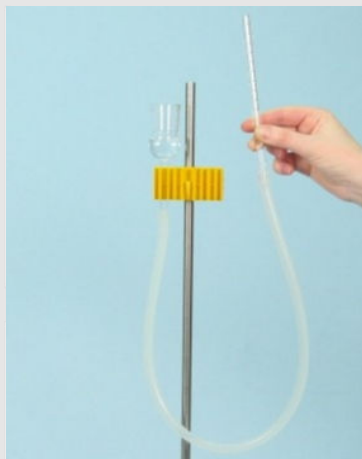
Replacing the glass bell with the glass tube

- Replace the right glass bell with the glass tube.
- Hold the glass tube in four different positions one after the other.
- Observe the water level in both vessels for all positions.

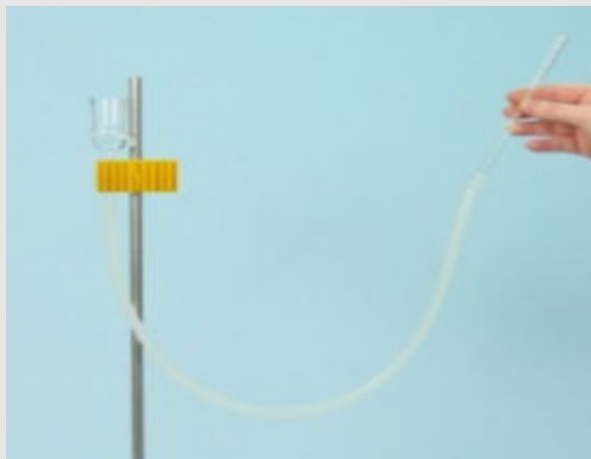


Procedure (4/5)

PHYWE



1st variation of the position of the glass tube



2nd variation of the position of the glass tube with inclination



3rd variation of the position of the glass tube

Procedure (5/5)

PHYWE

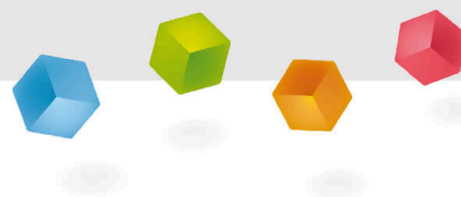


Disassembling the tripod base

- To disassemble the tripod base, press the buttons in the middle and pull both halves apart.

PHYWE

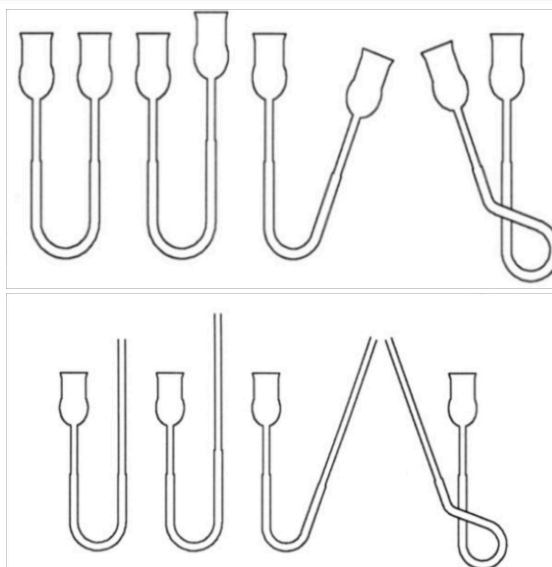
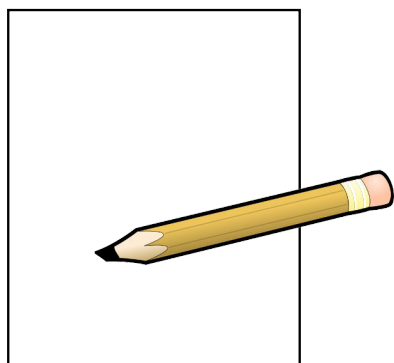
Report



Task 1

PHYWE

Take a pencil and a sheet of paper and make the sketches shown on the left. Draw on them the water levels you have observed.



Task 2

PHYWE



Comparison of the water levels of the experiment with the two glass bells

How do the water levels in both glass bells relate to each other?

- ☐ The right water level is higher than the left.
- ☐ The water levels are the same.
- ☐ The left water level is higher than the right.

✓ Check

Task 3

PHYWE



Comparison of the water levels of the experiment with the two glass bells

What happens when you raise or lower a bell jar?

- ☐ The water level of the right bell drops. Both levels remain at the same level.
- ☐ The water level of the right bell rises. The right level is now much higher than the left level.
- ☐ The water level of the right bell does not change. The right level is now slightly higher than the left level.

✓ Check

Task 4

PHYWE



Water level with inclination of the bell

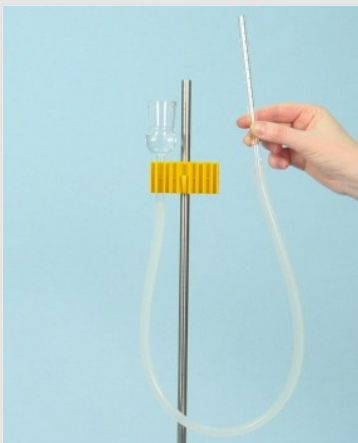
Does the water level also tilt when you tilt a bell jar?

- ☐ Both water levels are horizontally on the same level.
- ☐ The right water level always remains horizontal.
- ☐ The water level is also tilting.

✓ Check

Task 5

PHYWE



Test setup with glass tubes

How does the result change if you use the glass tube instead of the glass bell?

- ☐ With the glass tube the water level in it rises very strongly.
- ☐ The result is always the same.

✓ Check

Task 6

PHYWE

Drag the words to the right places.

If two or more are connected to each other, the
 in all vessels is always . The
 of the vessels has no on the levels.

Not necessary:

effect

equal

water level

different levels

inclination

vessels

 Check

Slide

Score/Total

Slide 20: Water level of the glass bells

0/1

Slide 21: Lifting a glass bell

0/1

Slide 22: Inclination of the bell

0/2

Slide 23: Test with glass tubes

0/1

Slide 24: Water level

0/6

Total amount

  0/11 Solutions Repeat