Communicating vessels (Item No.: P1296900)

Curricular Relevance

Area of Expertise: Physics
Education Level: Age 14-16
Topic: Mechanics
Subtopic: Mechanics of liquids
Experiment: Communicating vessels

Difficulty	Preparation Time	Execution Time	Recommended Group Size
Intermediate	10 Minutes	20 Minutes	1 Student

Additional Requirements:

- Set-square

Experiment Variations:

Keywords:

Prinicple and Equipment

Principle

It is to be proved, that the heights of a (homogenous) liquid in vessels which are connected to each other are the same.

The principle of the water-level will then be demonstrated.

Equipment

Position No.	Material	Order No.	Quantity
1	Demo Physics board with stand	02150-00	1
2	Pointers f. Demonst.Board, 4 pcs	02154-01	1
3	Rod on fixing magnet	02151-02	1
4	Track holder on fixing magnet	02151-05	2
5	Clamping holder, 0-13 mm, fixing magnet	02151-07	2
6	Overflow vessel on fixing magnet	02158-00	1
7	Immersion probe	02632-00	1
8	Cart for measurements and experiments	11060-00	1
9	Track, l 900 mm	11606-00	1
10	Glass beaker DURAN®, tall, 600 ml	36006-00	1
11	Silicone tubing i.d. 7mm, 1 m	39296-00	2
12	Beaker, low form, plastic, 100 ml	36011-01	1
13	Microspoon, steel	33393-00	1
14	Patent Blue V (sodium salt), 25 g	48376-04	1
15	Marker, black	46402-01	1
Additional Material:			
16	Set-square		

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Set-up and procedure

Set-up 1

- Connect an approximately 110 cm length of silicone tubing to the efflux vessel, then position the vessel at the top left of the demo-board.
- Position the clamp with the immersion probe top right, then connect the free end of the tubing to the immersionprobe (Fig. 1).
- Fill about 500 ml of water into the beaker, colour the water and pour it into the efflux vessel.
- Remove entrapped air by repeated squeezing of the tubing.
- Use the set-square to help pen mark the positions of the liquid leveis, and clearly demonstrate these positions with pointers.

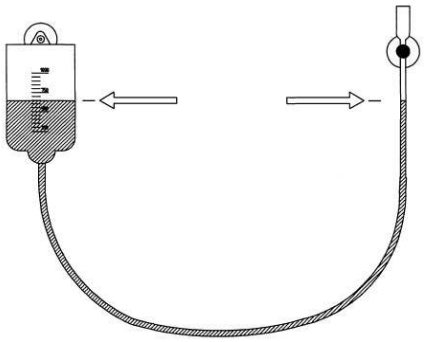

Fig. 1

Set-up 2

- Use the track holders to position the track on the demo-board.
- Prepare a water-level: Slip one end of an approximately 11 0 cm length of silicone tubing to the tube onto the immersion probe and the other onto the glass nozzle from the efflux vessel.
- Clamp the water-level at the ends of the track (Fig. 2).

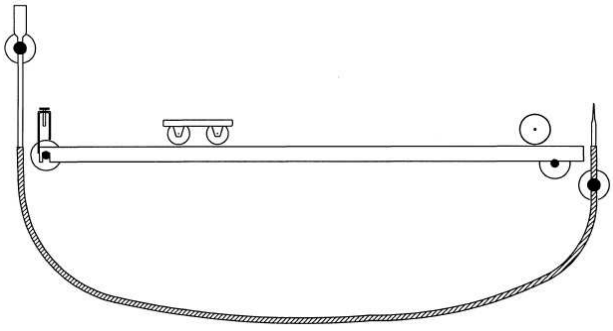

Fig. 2

Procedure 1

- Incline the immersion probe at various angles and observe the water level. Note your Observations (1).
- Remove the immersion probe and the efflux vessel and empty them.
- Position the track at the marks drawn for the height of the liquid leveis and fix it in position with the track holders.
- Fix the metal angle which is supplied with the track on the left end of the track, and the shaft with magnetic base on the board at the other end of the track, as stop for the car.
- Place the car on the track. After that, tilt the track a little to the right or to the left.
- Note your Observations (2).

Procedure 2

- Carefully pour coloured water from the beaker into the immersion probe. Remove any entrapped air bubbles by squeezing the tubing.
- Change the position of the track, until the top edge is at the same height as the water levels.
- Place the car on the track and so check if the track is held horizontally.

Observations and evaluation

Observations

Observation 1

1. The position of the liquid leveis remains unchanged, whether the glass tube is held vertically or inclined.
2. The car stands still on the track. When the track is tilted, the car performs an (accelerated) movement.

Observation 2

The track is held horizontally, when the track ends are at the same heights as the levels of the water columns in the water-level.

Evaluation

Evalution 1

A liquid stands at the same height everywhere in connected (communicating) vessels. The liquid levels are on the same horizontal plane in all of them.

The reason for this is the pressure exerted by the weight. This is the same in all directions at the lowest point of a system of communicating vessels, and is dependent on the height of the liquid column, but not on the shape of the vessels.

Evaluation 2

A water-level enables two points which are at a great distance from one another to be adjusted to the same height. They then lie in the same horizontal plane.

Remarks

We recommend that you draw a line between the points marked for the height of the liquid columns before positioning the track on the demo-board, as this increases the clarity of this part of the experiment. The liquid levels all lie in the same plane, when the liquid has the same density throughout, i.e. is homogenous. If you wish to bring out this fact, then you can extend the experiment by pouring, for example, a little methylated spirits in the immersion probe. The result of this is that, because $\rho_{\mathrm{water}} > \rho_{\mathrm{spirit}}$ the liquid level in the immersion probe tube is higher than that in the efflux vessel.

The water-level, also known as channel-level, is used in practice (building, landscaping etc.) for levelling over large distances. For this, distant points above the two levels of liquid are sighted on and their difference in height to the horizontal plane of the water-level determined with a graduated measuring rod.

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