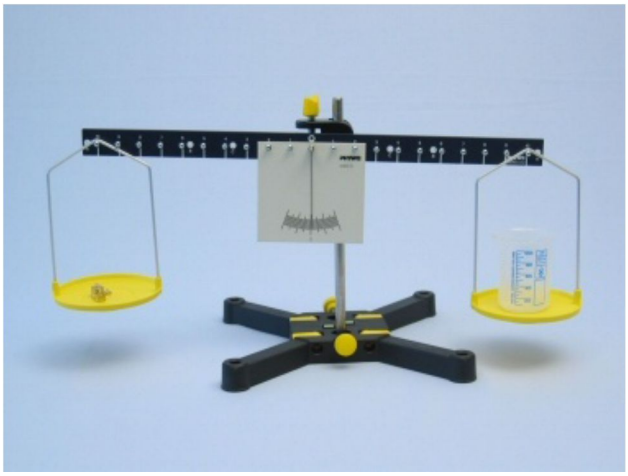
1.6 Determination of the density of liquids

Task

Can liquids have different densities?

The density ρ can be determined from a mass and a volume measurement. The unit of density is kg/dm^3 or g/cm^3 or g/ml. In this experiment the density of water and of a salt solution are determined.



Use the space below for your own notes.

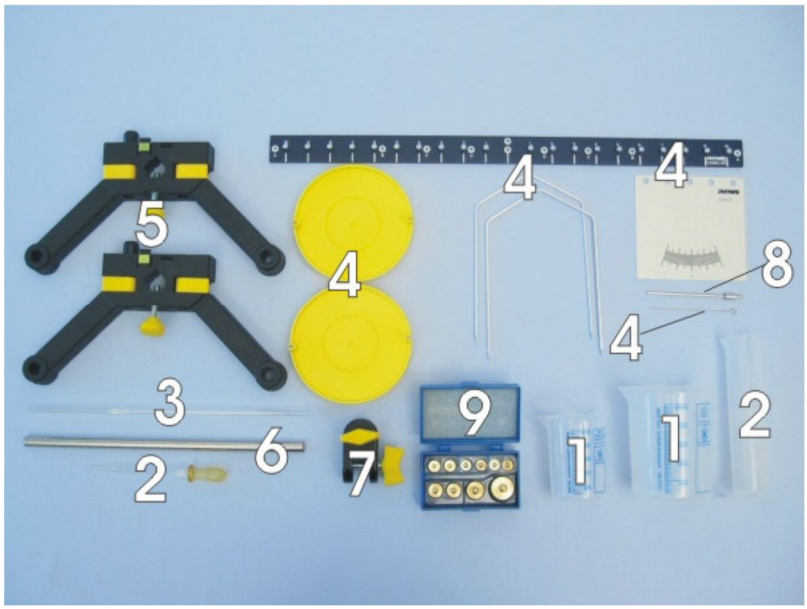
Material

Material from "TESS advanced Physics Set Mechanics 1, ME-1" (Order No. 15271-88)

Position No.	Material	Order No.	Quantity
1	Beaker, plastic, short form, 250 ml	36013-01	1
1	Beaker, plastic, short form, 100 ml	36011-01	1
2	Graduated cylinder, 50 ml, plastic	36628-01	1
2	Pipette, with rubber bulb	64701-00	1
3	Glass tubes, d = 8 mm, l = 250 mm, 10 pieces	36701-68	1 piece
4	Balance pan, plastic	03951-00	2
4	Plate with scale	03962-00	1
4	Lever	03960-00	1
4	Pointer for lever	03961-00	1
5	Support base, variable	02001-00	1
6	Support rod, stainless steel 18/8, l = 250 mm, d = 10 mm	02031-00	1
7	Bosshead	02043-00	1
8	Holding pin	03949-00	1
9	Set of precision weights, 1g…50g, in case	44017-00	1

Additional Material			
	Sodium chloride, purest, 250 g	30155-25	10 g

Material required for the experiment



Setup

Set up a stand with the support base and the support rod as you can see in Fig. 1 and Fig. 2.

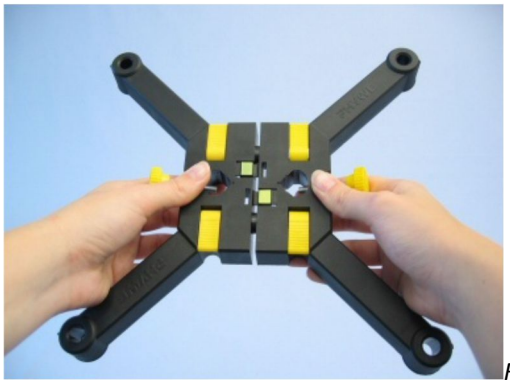


Fig. 1

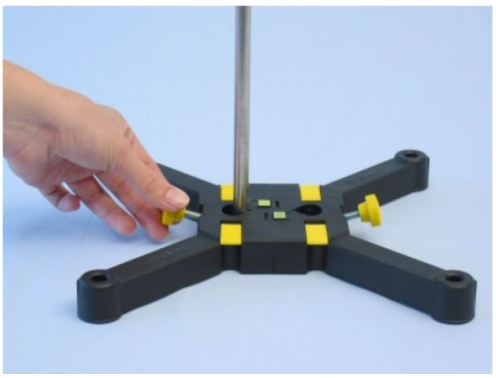


Fig. 2

Put the plate with scale in the middle of the lever, then, put the holding pin in the hole of the pointer and in the hole of the lever (Fig. 3). Fix the holding pin in the bosshead (Fig. 4).

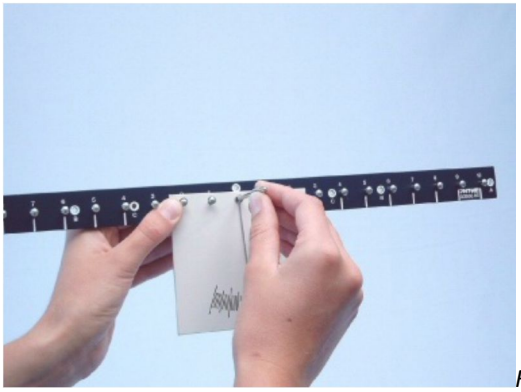


Fig. 3

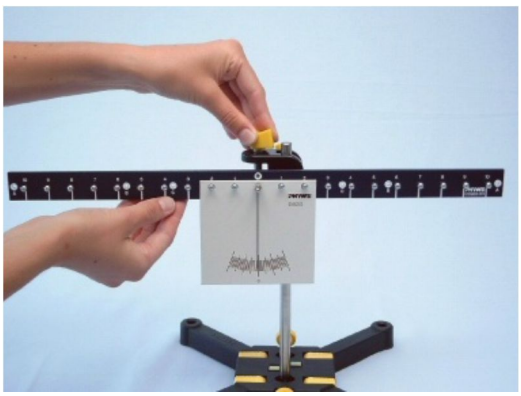


Fig. 4

Assemble the balance pan (Fig. 5) and hang each of them up at the end of the lever (Fig. 6).

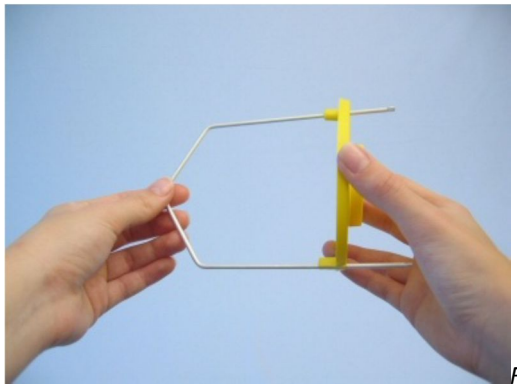


Fig. 5

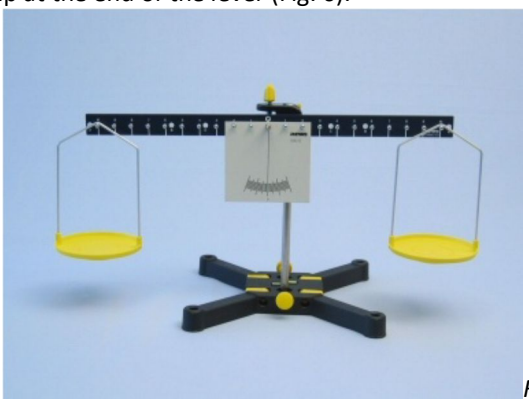


Fig. 6

Place the pointer in such a way, that it points exactly to the zero mark (Fig. 7).

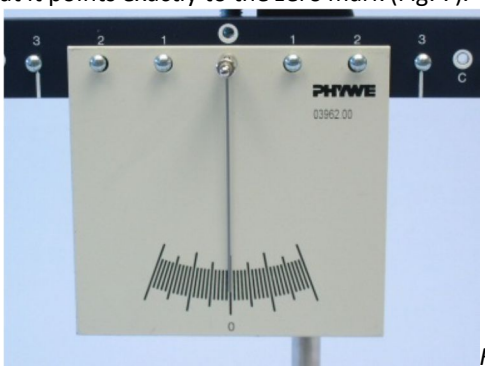


Fig. 7

Action

- Fill exactly 50 ml of water into the graduated cylinder.
- Read the exact Volume *V* on the graduated cylinder; take the meniscus into consideration!
- Determine the mass m_0 of the small beaker with the beam balance (Fig. 8), note the result in Table 1 on the Results page and fill the contents of the graduated cylinder into the small beaker. Be sure to pour all of the water into it.
- Determine the mass m_1 of beaker and water, and note the new value in Table 1.
- Add 10 g of NaCl (table salt) to the graduated cylinder and fill it up with 40 ml of water.
- Stir the solution vigorously with the glass tube until all the table salt is dissolved; then fill the cylinder exactly to the 50 ml mark with the pipette.
- Pour the solution into the small beaker, determine the mass m_2 of the solution in the beaker and record the new value in Table 1.

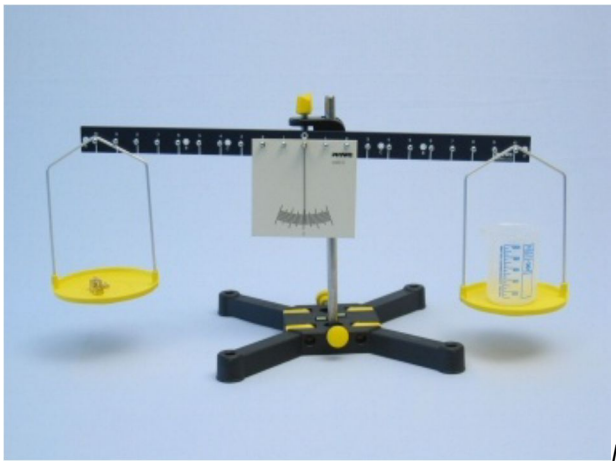


Fig. 8

In order to disassemble the support base you should press the yellow buttons (Fig. 9).

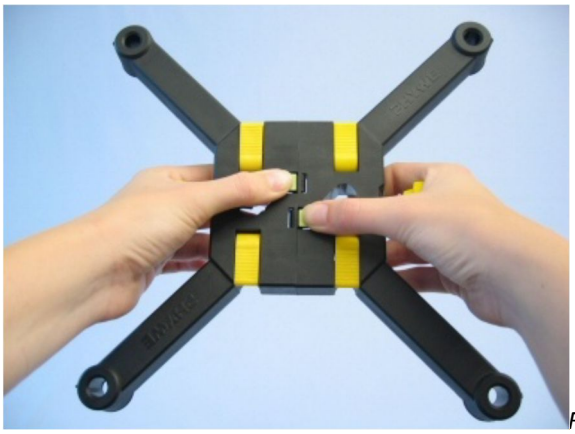


Fig. 9

Results

Table 1

mass of the small beaker:		
empty	**m_0 in g**	
with 50 ml of water	**m_1 in g**	
with 50 ml of solution (10% Salt)	**m_2 in g**	

Evaluation

Question 1:

Using V = 50 ml and $m = m_1 - m_0$ and $m = m_2 - m_0$ respectively to calculate the density of the water and the salt solution according to the formula: $\rho = m/V$

Material	m in g	V in cm^3	ρ in g/cm^3
water			
salt solution			

Question 2:

Which liquid has the higher density?

Question 3:

How would you explain this difference?

Question 4:

Do you know any liquids with a density less than water?

Additional Task

What happens when you carefully pour oil or alcohol onto water? Can you explain your answer?