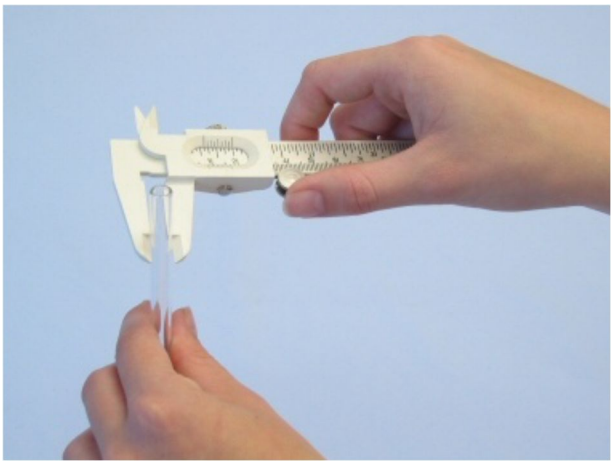
1.1 Measurement of length

Task

How does one measure length, diameter and hole depth?

It is often necessary to know the length of an object exactly. You can use different measuring devices, which differ in accuracy. In this experiment you will measure length, diameter, and hole depth of various objects. You will learn how to use a vernier caliper, and you will learn about the differences between a vernier caliper and a measuring tape.



Use the space below for your own notes.

Additional Information

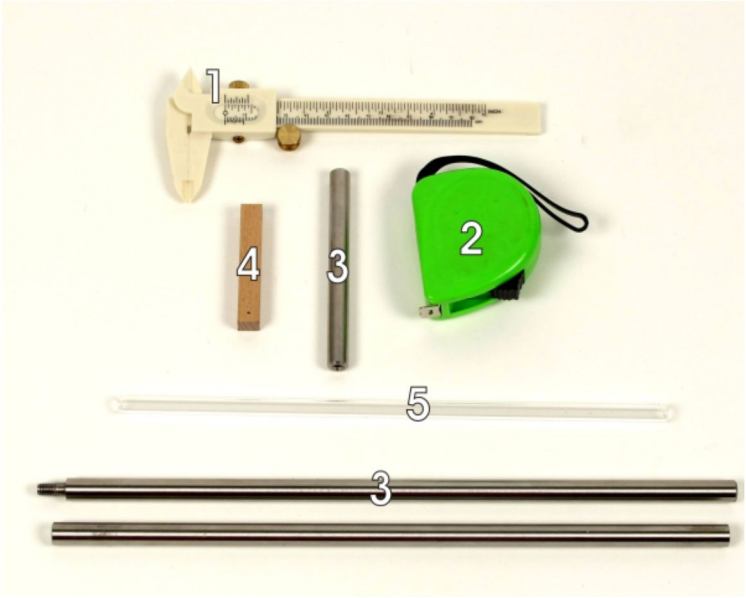
The students should measure length, diameter, and hole depth of various objects with a measuring tape and/or vernier caliper as possible. In doing this they should choose and use the more suitable measuring device. The results should be entered in the table as a numerical value and its unit. The symbol for the length (l) and the diameter (d) should also be used.
The average value (AV) of each set of 3 measurements should be determined.

Material

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

Position No.	Material	Order No.	Quantity
1	Vernier caliper, plastic	03011-00	1
2	Measuring tape, *l* = 2 m	09936-00	1
3	Support rod split in 2 rods, *l* = 600 mm	02035-00	1
3	Support rod with hole, stainless steel, 100 mm	02036-01	1
4	Wood column	05938-00	1
5	Glass tubes, *d* = 8 mm, *l* = 250 mm, 10 pieces	36701-68	1 piece

Material required for the experiment



Setup

The vernier caliper has a vernier which allows length to be read to 1⁄10 mm. To do this the vernier has 10 divisions in the 9 mm scale length. If the zero marks of both scales coincide (Fig. 1) the first division mark of the vernier scale diverges 1⁄10 mm from the main scale, the second 2⁄10 mm, the third 3⁄10 mm, etc. Watch out! Use only the cm-scale when measuring centimetres and only the inch-scale when measuring inches. Do not mix up the scales!

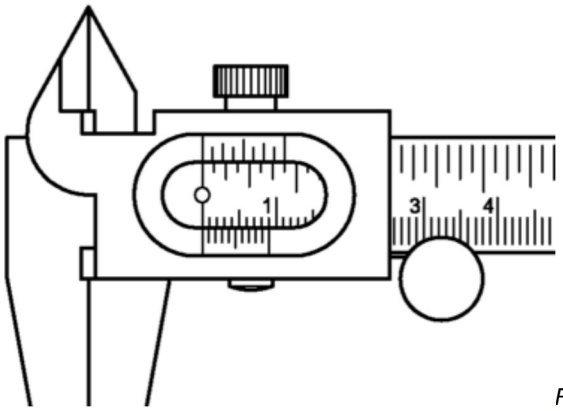


Fig. 1

If the vernier scale is shifted so that, e.g., its fourth division is over the fourth division of the measuring scale, this means that the two zero marks deviate by 4⁄10 mm, i.e. the measured value must be increased by 0.4 mm.

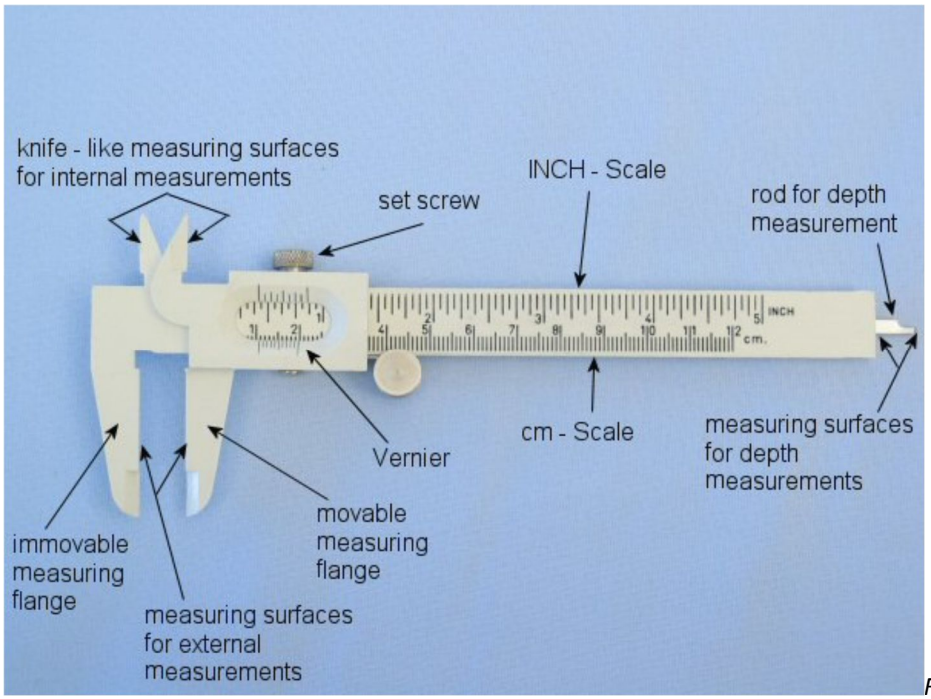


Fig. 2

Action

- First of all screw the two rods together (Fig.3).
- For the following experiment you should choose the most suitable measuring device (measuring tape or vernier caliper - both, if possible). You should perform each measurement 3 times.
- Measure the length of the two support rods, of the wood column and of the glass tube as exactly as possible using the measuring tape (Fig.4) and/or the vernier caliper (Fig.5).

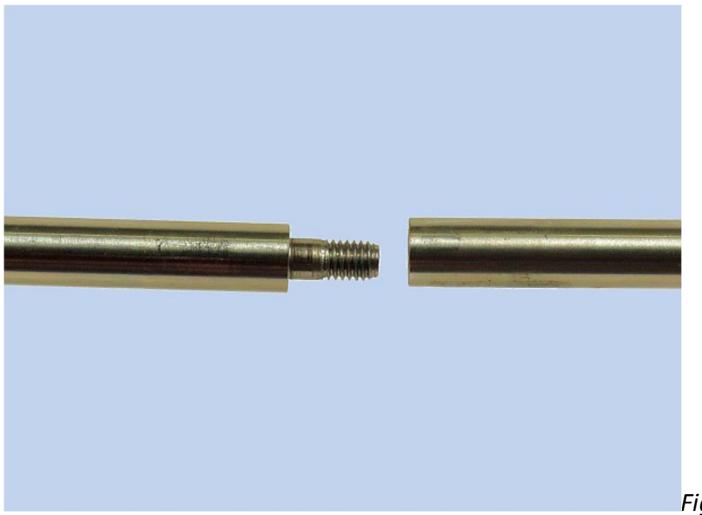


Fig. 3

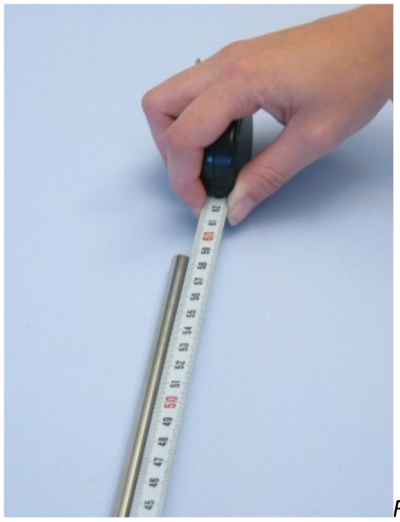


Fig. 4

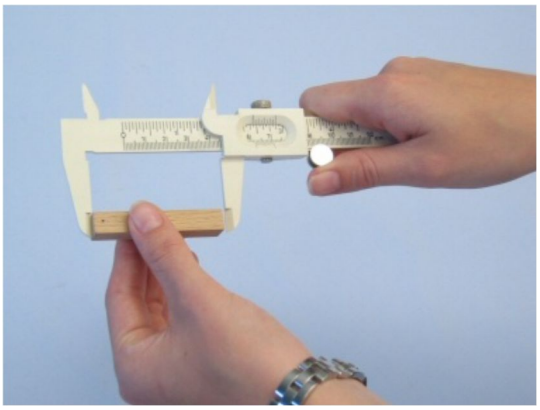


Fig. 5

Measure the inner and outer diameter of the glass tube (Fig. 6 and Fig. 7)

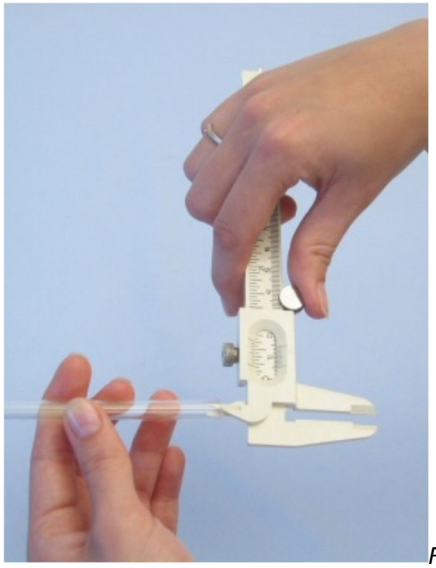


Fig. 6

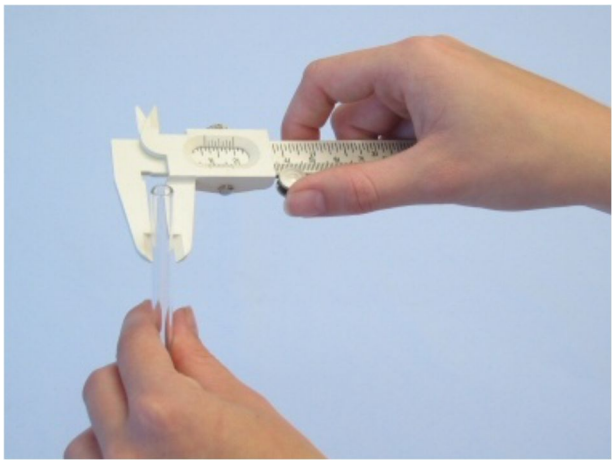


Fig. 7

Measure the depth of the blind hole in the short support rod (Fig. 8)

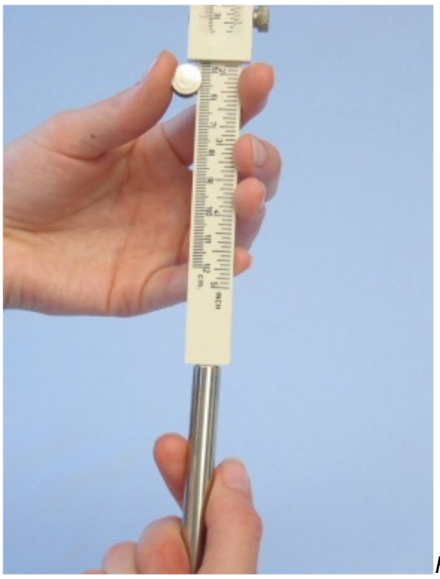


Fig. 8

Enter the measured values in Table 1 on the Results page giving the measuring device used in each case. Don't forget, every definitive statement of the length dimension consists of the numerical value and the measuring unit (here: m, cm or mm)!

Results

Table 1

Object		measuring device	measuring values value			Average (*AV*)
Support rod, long	length					
Support rod, Short	Length					
wood column	length					
glass tube	length					
glass tube	d_0					
glass tube	d_i					
blind hole	depth					

Evaluation

Question 1:

Calculate the average value and enter it in Table 1 on the Results page.

Question 2:

When does one use the measuring tape and when the vernier caliper?

Question 3:
How accurate can the values be determined with each measuring device?

Question 4:
Can the measuring tape be used to measure the internal diameter and hole depth?

Additional Tasks

Question 1:
Record the values shown in the caliper positions in Fig. 8 and Fig. 9.

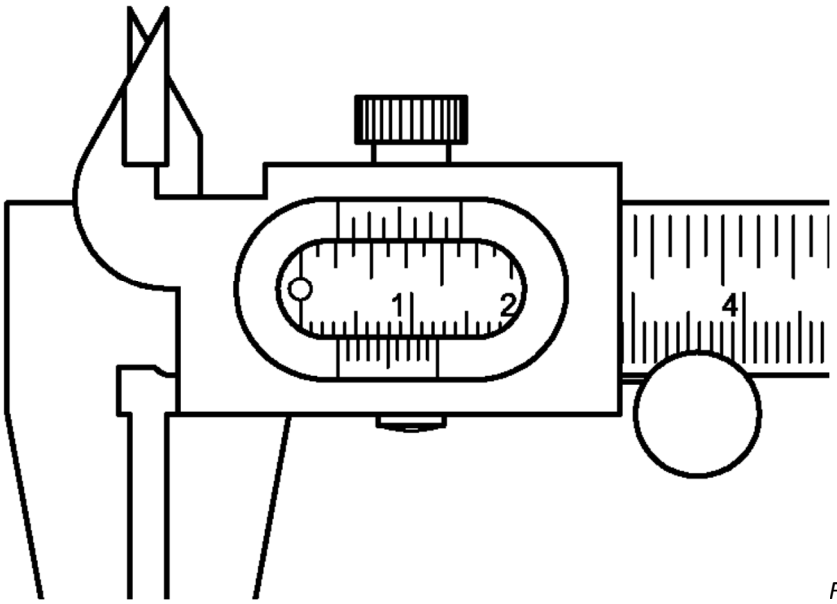


Fig. 8

Reading: _____ mm

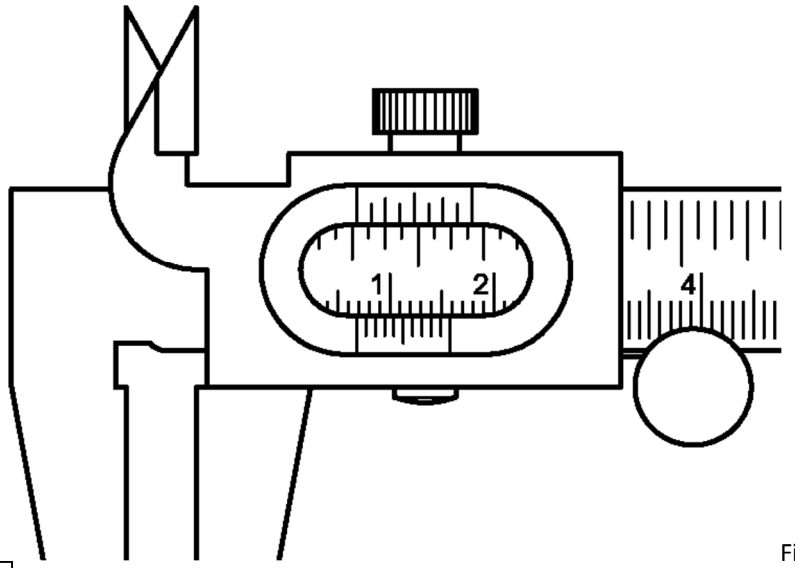


Fig. 9

Reading: ☐ mm

Question 2:

How accurate can lengths be determined with the vernier scale?

Up to ☐ mm.

Question 3:

Is it also possible to estimate intermediate values? How exact is this estimate?