Measurement of length (Item No.: P0998100)

Curricular Relevance

| Area of Expertise: Physics | Education Level: Age 14-16 | Topic: Mechanics | Subtopic: Substance and material properties | Experiment: Measurement of length |
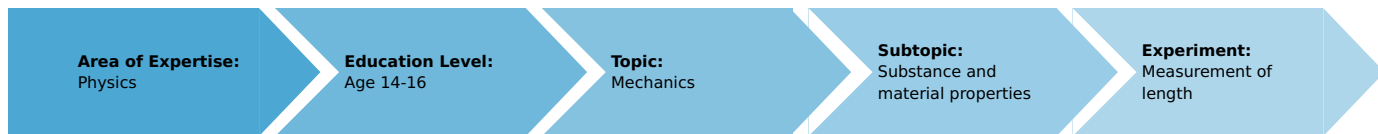
Difficulty

Easy

Preparation Time

10 Minutes

Execution Time

10 Minutes

Recommended Group Size

2 Students

Additional Requirements:

Experiment Variations:

Keywords:

Task and equipment

Information for teachers

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.

Remark

The metre, or meter, (SI unit symbol: m), is the fundamental unit of length (SI dimension symbol: L) in the International System of Units (SI). The eleventh CGPM defined the metre in the new International System of Units (SI) as equal to 1,650,763.73 wavelengths of the orange-red emission line in the electromagnetic spectrum of the krypton-86 atom in a vacuum.
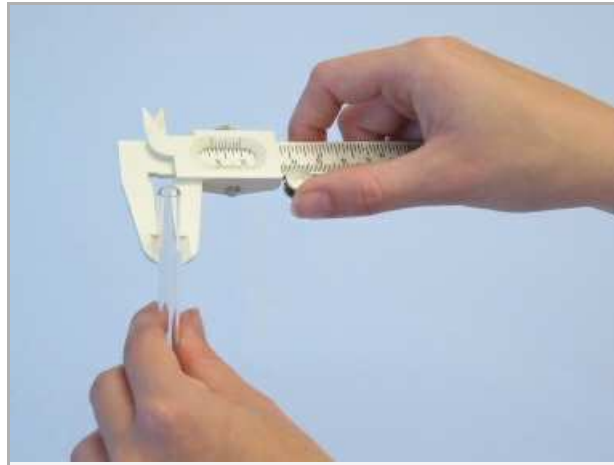
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Robert-Bosch-Breite 10
D - 37079 Göttingen

Tel: +49 551 604 - 0
Fax: +49 551 604 - 107

info@phywe.de
www.phywe.com

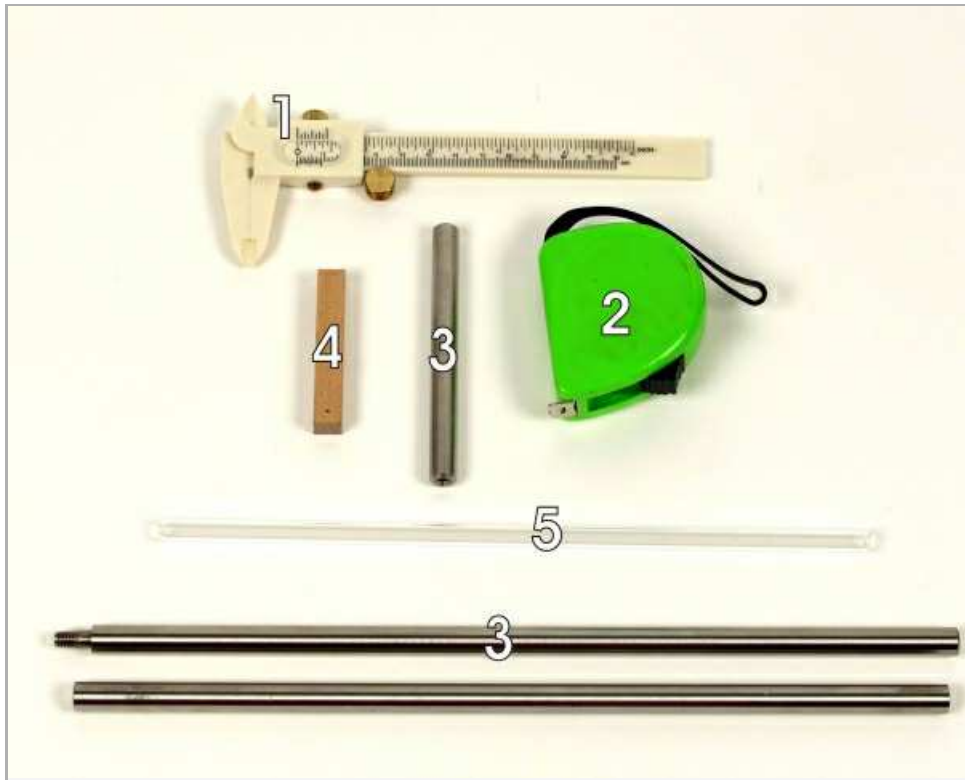# Measurement of length (Item No.: P0998100)

Task and equipment

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.

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Equipment

Position No.	Material	Order No.	Quantity
1	Vernier calliper, plastic	03011-00	1
2	Measuring tape, l = 2 m	09936-00	1
3	Support rod, stainless steel, l = 600 mm, d = 10 mm	02037-00	1
3	Support rod with hole, stainless steel, 10 cm	02036-01	1
4	Wood column	05938-00	1
5	Glass tubes,l.250 mm, pkg.of 10	36701-68	1

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Set-up and procedure

Set-up

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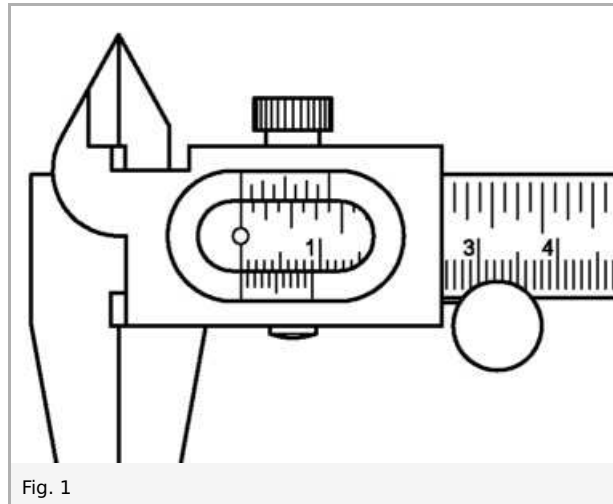
If the vernier scale is shifted so that, e.g., its fourth division is over the fourth division of the measuring scale, this means that the two zero marks deviate by 4/10 mm, i.e. the measured value must be increased by 0.4 mm.

Fig. 2
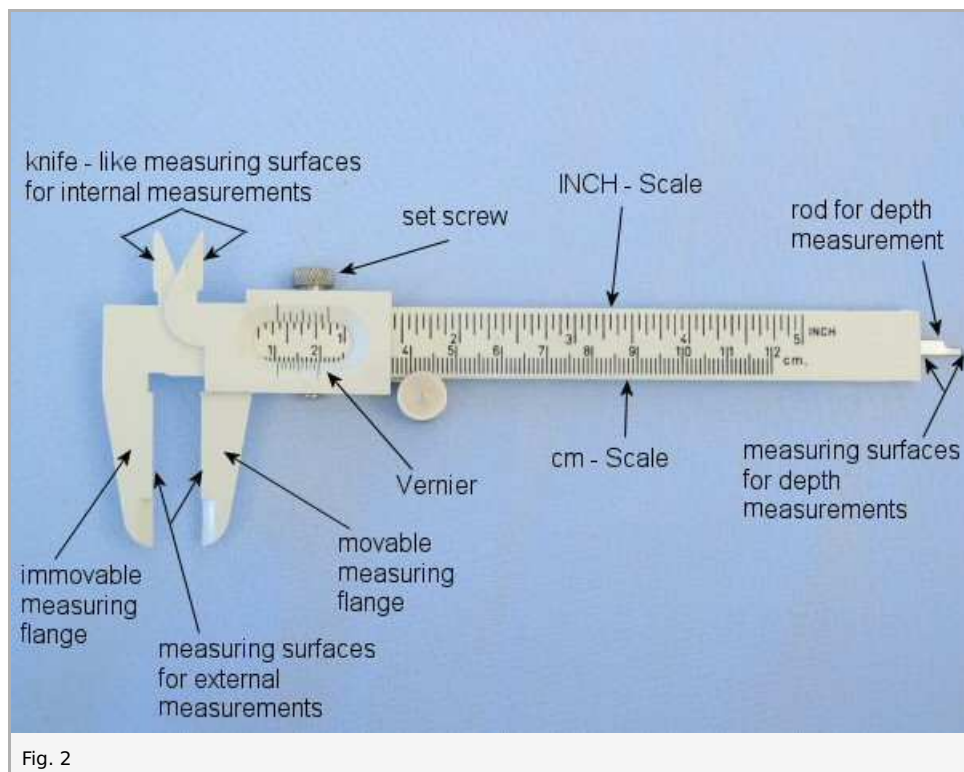
Procedure

- 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).

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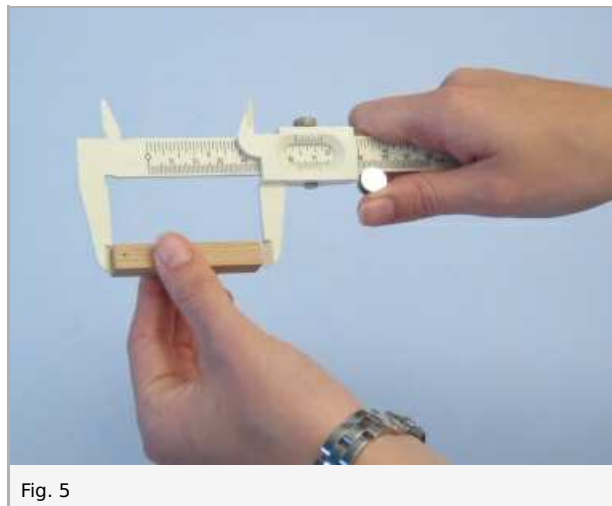www.phywe.com

Fig. 3

Fig. 4

Fig. 5

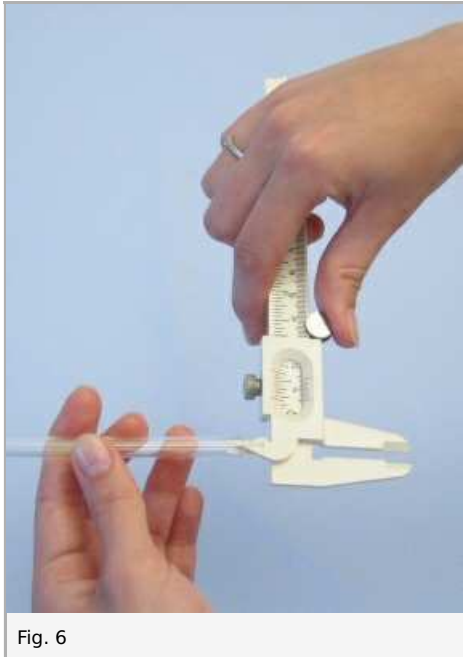Measure the inner and outer diameter of the glass tube (Fig. 6 and Fig. 7)

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 in the report 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)!

Report: Measurement of length

Results - Table 1 (26 points)

Enter the measured values in the Table 1, calculate average values (AV).

Object	measuring device		measuring values			average value (AV)	
support rod, long, l	measuring tape	1	0 ±0	0 ±0	0 ±0	60.0	1 ±0.5
support rod, short, l	measuring tape	1	0 ±0	0 ±0	0 ±0	10.0	1 ±0.3
	vernier caliper	1 ±0	0 ±0	0 ±0	0 ±0	10.0	10 ±0.3
wood column, l	measuring tape	1	0 ±0	0 ±0	0 ±0	60.0	1 ±0.3
	vernier caliper	0	0 ±0	0 ±0	0 ±0	60.0	1 ±0.3
glass tube, l	measuring tape	1	0 ±0	0 ±0	0 ±0	25.0	1 ±0.3
glass tube, d_o	vernier caliper	1	0 ±0	0 ±0	0 ±0	8.0	1 ±0.15
glass tube, d_i	vernier caliper	1	0 ±0	0 ±0	0 ±0	5.8	1 ±0.07
blind hole, l	vernier caliper	1 ±0	0 ±0	0 ±0	0 ±0	21.0	1 ±0.5

Evaluation - Question 1 (10 points)

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

For lengths over 120 mm it is necessary to use the measuring tape; for length less than 120 mm one can use both measuring devices.

Evaluation - Question 2 (10 points)

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

The measuring accuracy of the measuring tape is 1 mm, 0.5 mm can be estimated. The vernier caliper's reading accuracy is approx. 0.5 mm without vernier and approx. 0.1 mm with vernier.

Evaluation - Question 3 (10 points)

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

Internal diameter and hole depth can only be exactly determined with the vernier caliper.

Evaluation - Additional Task 1 (1 point)

Record the value shown in the caliper positions in Fig. 1.

Reading: ____3.4____ mm

Evaluation - Additional Task 2 (1 point)

Record the values shown in the caliper positions in Fig. 2.

Reading: ____6.8____ mm

Evaluation -Additional Task 3 (1 point)

How accurate can lengths be determined with the vernier scale?

Until ____0.1____ mm.

Evaluation - Additional Task 4 (10 points)

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

Intermediate values can be estimated to within 5/100 mm.

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