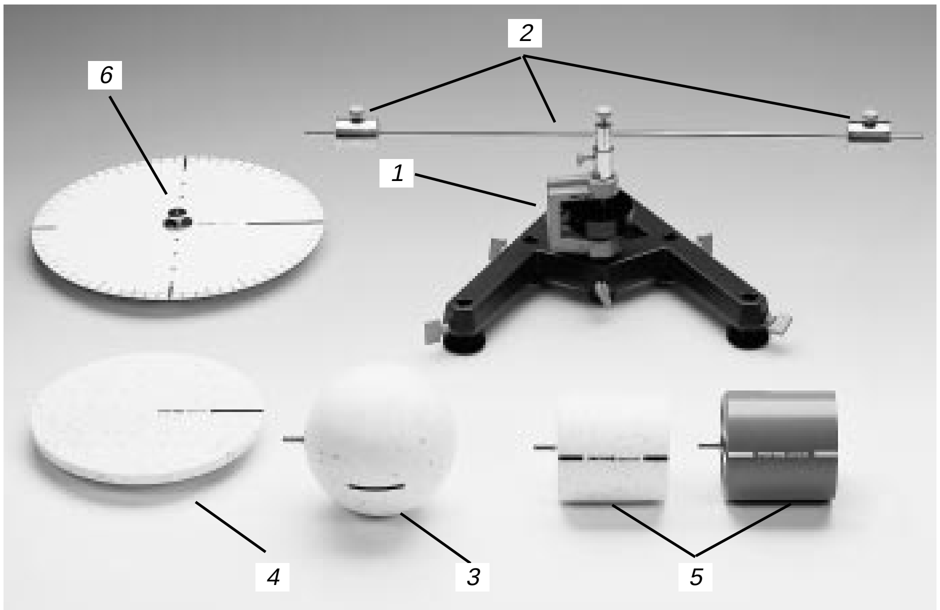
Angular oscillation apparatus

02415.88

Operating Instructions



1 PURPOSE

The angular oscillation apparatus allows the relationship between mass distribution and moment of inertia to be examined, and also the moments of inertia of various model bodies set in angular oscillation on a rotation axis to be quantitatively determined from the duration of oscillation of the bodies. Steiner's principle can be verified using bodies whose centre of gravity does not lie on the rotation axis.

2 DESCRIPTION AND MODE OF ACTION

Figure 1 shows the individual parts of the angular oscillation apparatus. Descriptions of them are given below. The various bodies have either a fixed pin or a pin which can be held at different positions for attaching them to the rotation axle. Markings on the symmetrical round bodies simplifies the observation of the rotating oscillation.

1 *Rotation axle*
The axle is held in a pivot in a U-shaped frame and is fixed to the frame by a spiral spring. On one side, the axle protrudes out of the frame and has a flange with a tensioning screw. The rigid shaft on the opposite side of the frame serves to hold the rotation axle.

When the rotation axle (or a body which is firmly connected to it) is displaced from its position of rest by an angle φ , the spiral spring will oppose the displacement and generate a torsional moment M, the size of which increases with the angle of displacement. The torsional moment is proportional to the displacement angle for displacements of up to 180°. The quotient of $M/\varphi = D^*$ is called the angular coefficient.

2 *Rod with movable masses*
The rod (60 cm long) is fitted through the transverse hole in the bolt supplied, and attached to the rotation axle with the pin of this bolt. The two equal masses on the rod can be moved apart as required and be fixed in position with fastening screws.

3 *Sphere*
Styrofoam body with uniform mass distribution, diameter approx. 14 cm, mass approx. 760 g.

4 *Disk*
Styrofoam body with uniform mass distribution, diameter approx. 22 cm, mass approx. 300 g.

5 *Hollow and solid cylinders*
Cylindrical bodies which have the same mass (approx. 380 g) and the same outer dimensions (diameter and height each 10 cm), but different mass distributions. The solid (styrofoam) cylinder has a uniform mass distribution but that of the hollow cylinder is non-uniform, the mass being practically only in the 4 mm thick walls (the front part with the attachment pin has a relatively small mass and inertia).

6 *Disk with diametrical holes*
Metal disk (diameter 30 cm). The attachment pin can be fitted into any one of the diametrical holes (which are 3 cm apart), so that the disk can be either centrally or eccentrally attached to the rotation axle., i.e. the rotation axle can be displaced from the centre of gravity.

3 HANDLING

3.1 General usage

To set up the rotation axis, fit it with its rod firmly held in a tripod or support base PASS (with an exactly vertical rotation axis there is no disturbing influence of the force of gravity on bodies whose centre of gravity is eccentric to the rotation axis).

Fit the body to be used in the experiment firmly onto the rotation axis and mark its position of rest with a support rod in a barrel base.

The angular coefficient for the spiral spring need not be known for qualitative or comparative experiments, but must be known when moments of inertia are to be determined.

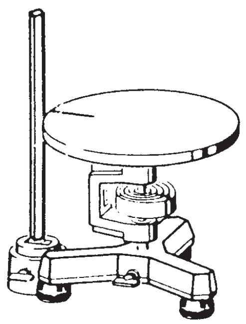


Fig. 2

3.2 Determination of the angular coefficient *D**

Fit the rod *2* (without the two masses) to the rotation axis at its centre of gravity. Fit a spring balance 1 N to the rod at a distance r from the rotation axis and displace the rod at an angle φ from its position of rest. Measure the force F which is acting tangentially to the rod (see Fig. 3). The torsional moment M is proportional to the displacement angle φ for displacements of up to 180°, and the following is valid:

$$D^* = \frac{M}{\varphi} = \frac{F \cdot r}{\varphi} \; .$$

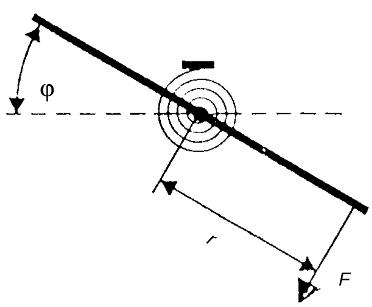


Fig. 3

Measurement example:

Displacement angle	$\varphi = 180\,° = \pi$ rad
Force	$F = 0.40$ N
Radius	$r = 20$ cm

From this we can calculate the angular coefficient

$$D^* = \frac{F \cdot r}{\varphi} = \frac{0{,}40\ \mathrm{N} \cdot 20\ \mathrm{cm}}{\varpi\ \mathrm{rad}} = 2{,}55\ \frac{\mathrm{N} \cdot \mathrm{cm}}{\mathrm{rad}} \; .$$

We recommend that you mark the value you determine on the rotation axis.

4 LITERATURE

Information on request
Versuchseinheiten Physik

Drehbewegungen	16000.31

5 LIST OF EQUIPMENT

Angular oscillation apparatus	02415.88
consisting of:	
Rotation axle	02415.01
Sphere	02415.02
Disk	02415.03
Hollow cylinder	02415.04
Solid cylinder	02415.05
Rod with movable masses	02415.06
Disk with diametrical holes	02415.07

Recommended accessories

Stop cock, mechanical	03074.00
PHYWE spring balance 1N	03060.01
Circular level	02122.00
Support base -PASS-	02005.55
or	
Tripod base -PASS-	02002.55
Barrel base -PASS-	02006.55
Support rod -PASS-, square, 250 mm	02025.55