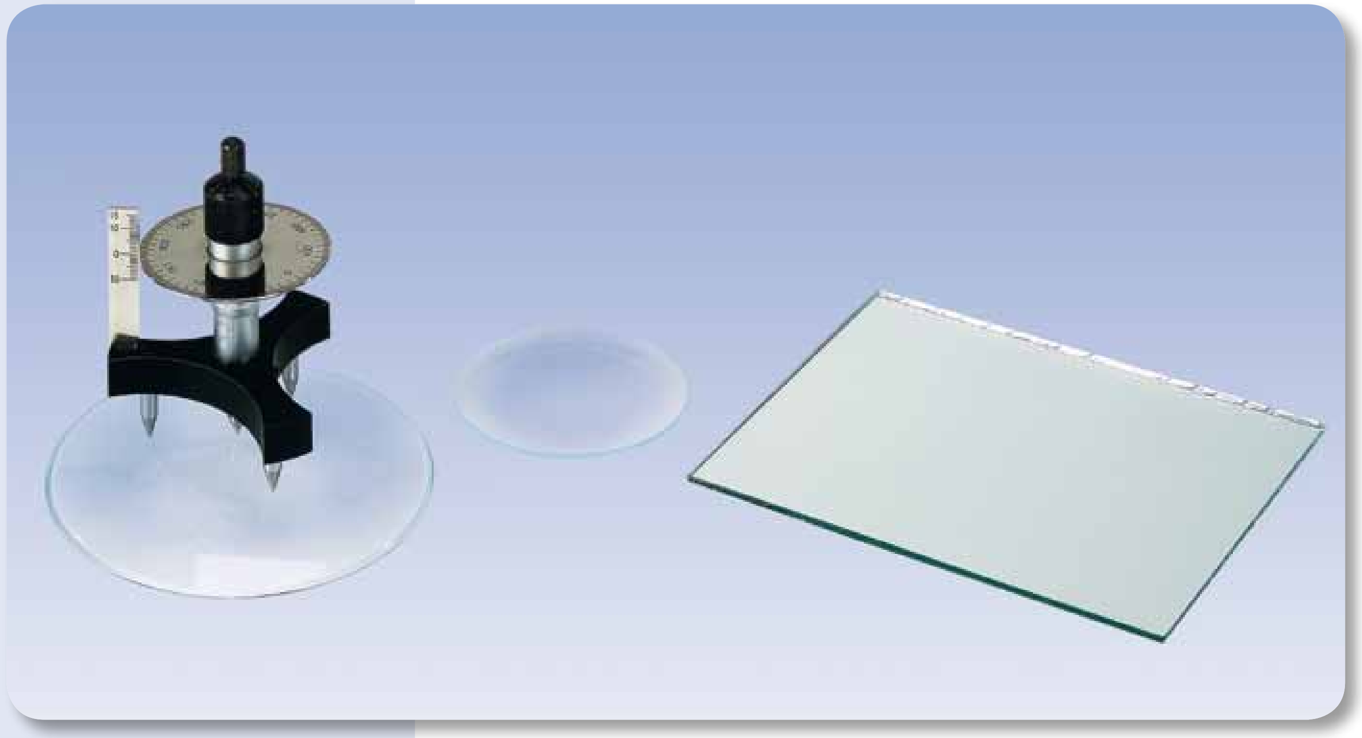
SPHEROMETER



EXPERIMENT PROCEDURE:

- **Measure the height of the curvature *h* for two watch glasses for a given distance *s* between the tips of the spherometer legs.**
- **Determine the radius of curvature *R* of both glasses.**
- **Compare the methods for both convex and concave surfaces.**

OBJECTIVE

Determine the radius of curvature of various watch glasses.

SUMMARY

From the height *h* of a spherical surface above a point on a plane defined by the corners of an equilateral triangle, the radius of curvature *R* of the spherical surface may be determined. This can be done for both convex and concave curvatures of the sphere.

REQUIRED APPARATUS

Quantity	Description	Number
1	Precision spherometer	1002947
1	Plane mirror	1003190
1	Set of 10 watch glass dishes, 80 mm	1002868
1	Set of 10 watch glass dishes, 125 mm	1002869

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BASIC PRINCIPLES

A spherometer consists of a tripod with the three legs tipped by steel points and forming an equilateral triangle with sides of 50 mm. A micrometer screw, the tip of which is the point to be measured, passes through the centre of the tripod. A vertical rule indicates the height *h* of the measured point above a plane defined by the tips of the three legs. The height of the measured point can be read off to an accuracy of 1 µm with the aid of a circular scale that rotates along with the micrometer screw.

The relationship between the distance *r* of all three legs from the centre of the spherometer, the radius of curvature *R* to be determined and the height *h* of the surface is given by the following equation:

(1) $$R^2 = r^2 + (R-h)^2$$

Rearranging for *R* gives:

(2) $$R = \frac{r^2 + h^2}{2 \cdot h}$$

The distance *r* can be calculated from the length *s* of the sides of the equilateral triangle formed by the legs:

(3) $$r = \frac{s}{\sqrt{3}}$$

Thus the relevant equation for *R* is as follows:

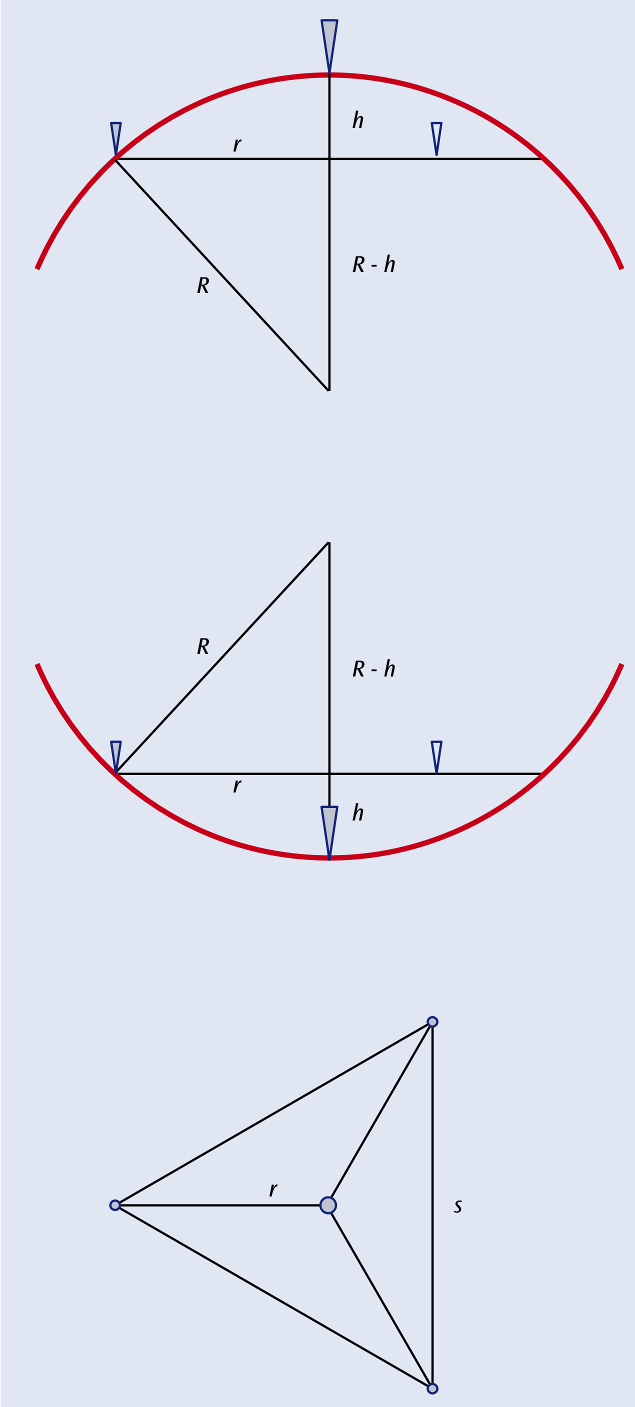
(4) $$R = \frac{s^2}{6 \cdot h} + \frac{h}{2}$$

EVALUATION

The separation *s* between the legs of the spherometer is in this case 50 mm. When the height *h* is small, equation (4) can be simplified to the following:

$$R = \frac{s^2}{6 \cdot h} = \frac{2500\text{mm}^2}{6 \cdot h} \approx \frac{420\text{mm}^2}{h}$$

The scale of the spherometer allows readings for heights between 10 mm and 1 µm to an accuracy of 1 µm, so that radii of curvature of about 40 mm to 400 m can be calculated.



Schematic for measurement of radius of curvature by means of a spherometer
Top: Vertical cross section for measuring an object with a convex surface
Middle: Vertical cross section for measuring an object with a concave surface
Bottom: View from above