Law of imagery and magnification of a concave mirror

Principle and equipment

Principle

Principle

Show that the equations $1/f = 1/g + 1/b$ and $B/G = b/g$ arevalid for concave mirrors.

Equipment

Position No.	Material	Order No.	Quantity
1	Demo Physics board with stand	02150-00	1
2	PHYWE Multitap transformer, DC: 2/4/6/8/10/12 V, 5 A / AC: 2/4/6/8/10/12/14 V, 5 A	13533-93	1
3	Lamp,halogen,mag.held,12V/50W	08270-20	1
4	Light box 12V/20W,w.magn.base	09804-00	1
5	Concave/convex mirror,magnet held	08270-12	1
Additional material:			
	Ruler		
	Circular template (see master) or a drawing compass		
	Water-soluble white board pen		

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Set-up and procedure

- Draw the optical axis.
- Using the circular template or a drawing compass, draw a circle with radius r = 200 mm on the magnetoptics board.
- Place the mirror on the circular arc.
- Mark the centre of curvature and the focal point (r = 200 mm; f = 100 mm).
- Draw an image arrow with g = 250 mm.
- Place the magnet-held lamp and the light box, each with a one-slit diaphragm, on the magnet optics panel so that a parallel and a focal point ray pass through the arrow head and are reflected by the mirror (Fig. 1). If necessary, readjust the mirror slightly.
- Draw the light beams as completely as you can.
- Remove the lamps and mirror.
- Draw the complete light paths. Mark the image arrow.
- Label g, b, f as well as Band G on the drawing (Fig. 1).
- Measure $g, b, f, B,$ and G.

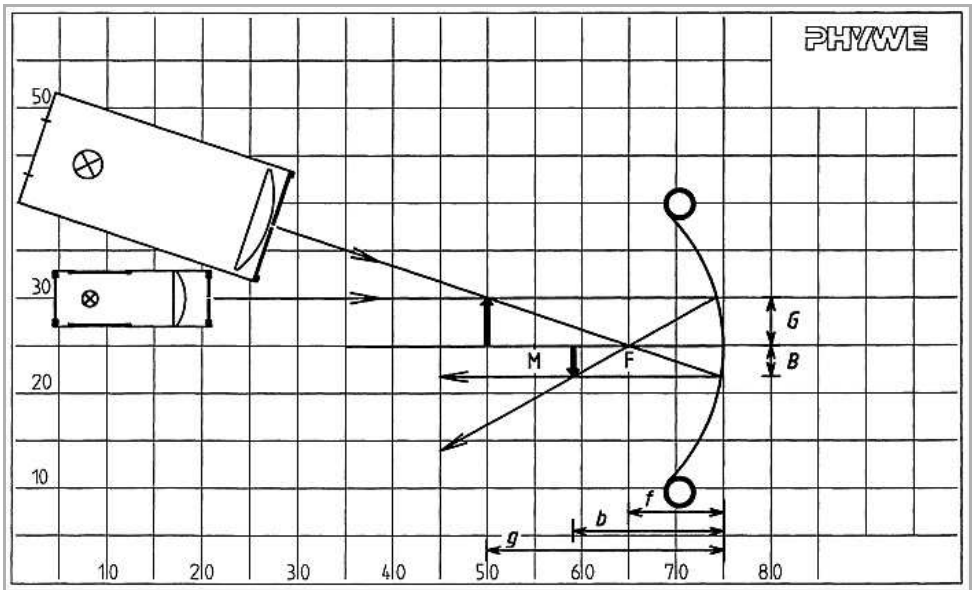

Fig. 1

Observation and evaluation

Observation

Results
g = 250 mm
b = 160 mm
f = 100 mm
G = 50 mm
B = 34 mm

Evaluation

$1/g$ = 0,0040 mm^{-1}
$1/b$ = 0,0063 mm^{-1}
$1/f$ = 0,0100 mm^{-1}

Therefore, as a good approximation, the equation $1/f = 1/g + 1/b$ is valid.

B/G = 34 mm / 50 mm = 0,68
b/g = 160 mm / 250 mm = 0,64

Therefore, as a good approximation, the equation $B/G = b/g$ is valid.

Remark
The deviation from the theoretically derived correlations can under certain conditions be fairly large. They are due to the mirror's relatively small radius of curvature.
It is recommended to repeat the measurements and calculations for different object arrows, the only restriction is that g >f. This is required in any case if one wants to derive the equations experimentally.
To make a circular template the master copy (see Fig. 1 in the Foreword) can be copied, pasted on thin cardboard and cut to size.

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