

one ray, two laws: reflection turns it back, refraction bends it through

Object distance

u

always negative, object sits to the left of the pole

→ mirror equation

Mirror formula

$$\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$$

one equation, every spherical mirror

→ mirror equation

Image distance

v

sign alone tells real from virtual

$m = -v/u$ gives the magnification: negative m is inverted and real, positive m is erect and virtual

Concave vs convex mirror

Concave mirror

- converging, f is negative
- real and inverted, or virtual and magnified inside F
- torches, shaving mirrors, reflecting telescopes

Convex mirror

- diverging, f is positive
- image always virtual, erect, diminished
- vehicle side mirrors: a wider field of view

one mirror formula for both: only the sign of f changes

New Cartesian sign convention

- all distances from the pole, along the principal axis
- along the incident light (left to right): positive, against it: negative
- a real object sits left of the pole, so u is always negative
- heights above the axis positive, below it negative

Mirror formula and magnification *

mirror formula

$$\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$$

focal length from radius of curvature

$$f = \frac{R}{2}$$

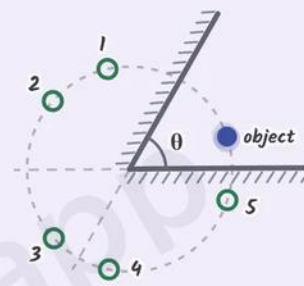
linear magnification

$$m = -\frac{v}{u} = \frac{f}{f-u}$$

R is always twice the magnitude of f , and carries the same sign as f in this convention

Two plane mirrors at an angle

- each mirror images the object, and each image again in the other mirror
- all the images lie on one circle through the object, centred where the mirrors meet
- let $n = \frac{360^\circ}{\theta}$
- n even: $N = n - 1$ images, wherever the object sits
- n odd: $N = n - 1$ on the bisector, $N = n$ off it



mirrors at 60° : $360^\circ/\theta$ is even, so $N = n - 1$, five images on one circle

