

PHY2208-3

- focal point and focal length
- magnification by the spherical mirror
- graphical ray tracing.

Y & F p.1091-1093 and sec 35-4.

Object-image relationship:-

$$\boxed{\frac{1}{s} + \frac{1}{s'} = \frac{2}{R}}$$

clearly as $s \rightarrow \infty$ $s' \rightarrow R/2$

in this geometry, the mirror brings parallel (“collimated”) rays from a distant source to a focus.

The point F (distance $R/2$ from V) is the **focal point** of the mirror.

Defn. the distance $R/2$ is the **focal length** of the mirror, symbol ‘ f ’.

Hence :-

$$\boxed{\frac{1}{s} + \frac{1}{s'} = \frac{1}{f}}$$

“Gaussian mirror equation”.

(also applies to lenses - see later)

Consider an extended object of height y . We can use a graphical technique to determine y' (the image height).

To do this, we locate the image of the tip of the object by finding the intersection of any two rays emanating from it which are reflected from the mirror.

4 rays are especially easy to draw :-

1. The ray which passes through C will be reflected back through C
2. The ray that strikes V is reflected symmetrically about the optic axis.

Previous ray diagram illustrated that

3. any ray entering the mirror parallel to the optic axis is reflected so as to pass through F
4. any ray entering the mirror via F is reflected so as to emerge travelling parallel to the optic axis

In the graphical ray-tracing method we locate the image of an object by drawing at least two of these rays and finding the intersection point.

NB we may need to extrapolate ray paths to a point beyond the mirror to find an intersection point. This is a virtual image (recall the plane mirror)

e.g. the following construction uses rays 1 & 2 to locate the image :-

clearly $\triangle PQV$ and $\triangle P'Q'V$ are similar ,
hence :-

$$m = \frac{y'}{y} = -\frac{s'}{s}$$

image magnification formula for the spherical mirror

NB -ve sign because image is inverted. Also real and minified ($|m| < 1$)

example Y & F 35-4 (distances $\div 2$) :

“ a concave mirror has radius of curvature 10cm. Find graphically the image of an object in the form of an arrow perpendicular to the axis of the mirror at each of the following object distances a) 15cm, b) 10cm, c) 5cm and d) 2.5cm. “

For next time ...

1) go over your notes

2) use the Gaussian mirror equation and the image magnification formula to check our graphical calculations.