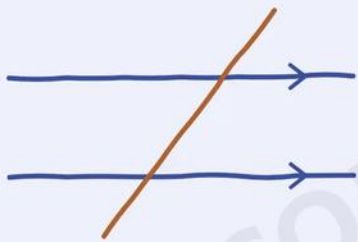


the two laws, the images that curved mirrors form, and the sign convention that predicts them

## The laws of reflection \*

- **first law**: the angle of incidence equals the angle of reflection,  $\angle i = \angle r$
- **second law**: the incident ray, the reflected ray and the normal all lie in one plane
- the **normal** is the perpendicular to the surface at the point where the ray strikes, and **every angle** is measured from it
- **regular reflection** from a smooth surface sends parallel rays off still parallel, which is what forms an image
- **diffuse reflection** from a rough surface scatters them in all directions, which is why we can see an ordinary wall from anywhere
- the laws hold in both cases. Diffuse reflection is not a failure of the laws, only a surface whose normals point every way



an incoming ray, the normal standing perpendicular to the surface, and the outgoing ray: the two angles measured from the normal are equal, and all three lines lie flat in the same plane

## The plane mirror

- the image is **virtual**, formed behind the mirror where no light actually reaches, so it cannot be caught on a screen
- it is **the same size** as the object and **as far behind the mirror** as the object is in front
- it is **upright**, and it is **laterally inverted**: left and right appear exchanged
- lateral inversion is why the word AMBULANCE is painted reversed on the front of the vehicle, so a driver ahead reads it correctly in the mirror
- **to see your whole body** you need a mirror only **half your height**, wherever you stand, which follows from the equal angles
- **two mirrors at an angle** form several images, and the number rises as the angle between them narrows

## Curved mirrors

- a **concave mirror** curves inward and **converges** parallel rays to a real focus in front of it
- a **convex mirror** curves outward and **diverges** them, so they only appear to come from a focus behind it
- the **pole** is the centre of the mirror, the **centre of curvature C** is the centre of the sphere it is part of, and **F** lies midway between them
- so the **focal length** is half the radius of curvature,  $f = R/2$
- a **concave mirror** can form both real and virtual images depending on where the object stands
- a **convex mirror** always forms a virtual, upright, diminished image, whatever the object distance

