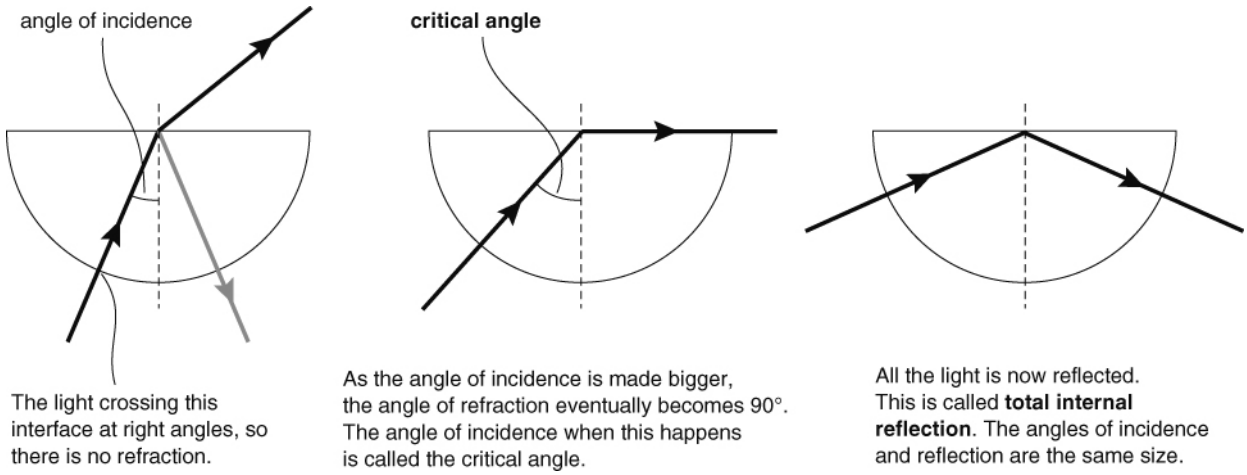
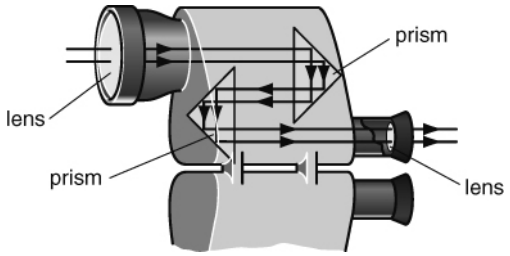
When light rays are transmitted through a glass block, they do not always pass right through the block and back into the air. Sometimes, some of the light is reflected and some of it is refracted.



Total internal reflection can happen whenever light goes from water or glass into air. It has many applications.

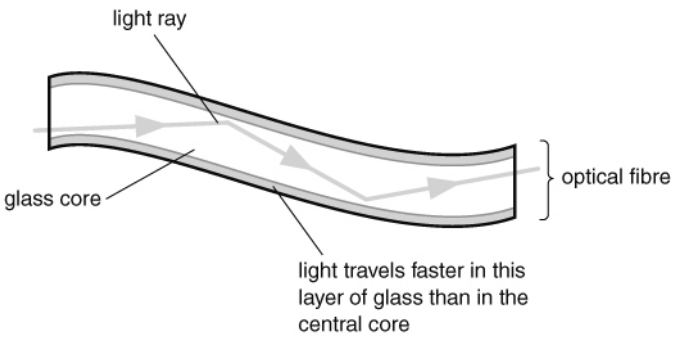
Telescopes and binoculars

Most telescopes use two lenses to make a larger image, but the image is upside down. Binoculars have two lenses and two prisms. The prisms send the light backwards and forwards twice so binoculars are shorter than a telescope of the same strength. The prisms also make the final image the right way up. Some telescopes have been specially designed for birdwatchers, and these telescopes have arrangements of prisms to turn the image the right way up. Although these telescopes give better magnification than binoculars, they are much heavier and more expensive.



Optical fibres

Doctors can use glass fibres to see into different parts of the body. Light is reflected from side to side along the glass fibre. When glass fibres are used like this they are called optical fibres.



1 **a** What does total internal reflection mean?

b Give *two* examples of where total internal reflection is used.

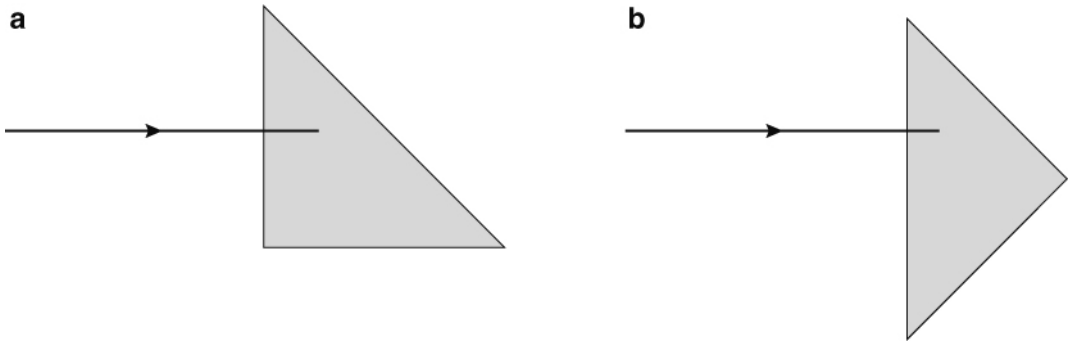
2 What is the difference between refraction and reflection?

3 **a** Why do bird watchers often use binoculars rather than telescopes?

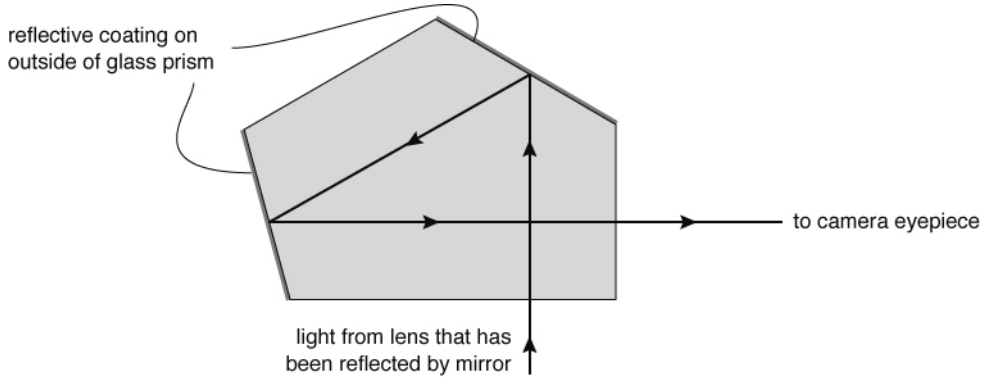
b Telescopes used for astronomy do not have prisms to make the image the right way up. Suggest why this is.

4 Periscopes can be used to see around corners or to see into inaccessible places. Suggest why optical fibres are better than periscopes for medical uses.

5 Copy these diagrams of prisms and finish drawing the light rays. The critical angle for glass is approximately 42°. Use a protractor to help you to draw the angles accurately.



6 This diagram shows a pentaprism used in most SLR cameras. It reflects the light from the mirror in the camera through 90° and produces an image in the viewfinder that is the right way up.



a Why is a reflective coating needed on the outside of the prism? (*Hint*: look carefully at the angles where the light is reflected.)

b Suggest why the camera doesn't just have a single triangular prism, as shown in the diagram in question 5a. It may help you to draw two separate rays of light on the diagram for 5a, and on a copy of the diagram of the pentaprism.

c Suggest why the camera does not have two prisms, as used in binoculars.

I can…

- explain what total internal reflection is
- describe some applications of total internal reflection.