

Core 1

At night, the light beam from a torch is shone into a swimming pool along the line TSA. Instead of striking the bottom of the pool at A, the beam travels to B, as shown on Fig. 1.

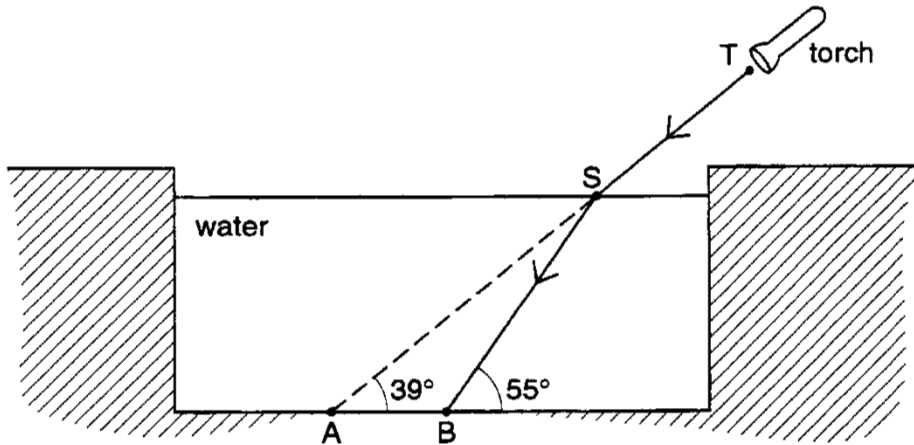


Fig. 1

- (a) At S, the direction of the beam changes. State the name we use to describe this change.
[1]
- (b) (i) On Fig. 1, draw the normal to the surface at S.
 (ii) Clearly mark and label the angle of incidence. [2]
- (c) Fig. 2 shows the same pool and the same points A, B, S and T. The critical angle for the water is 50° .

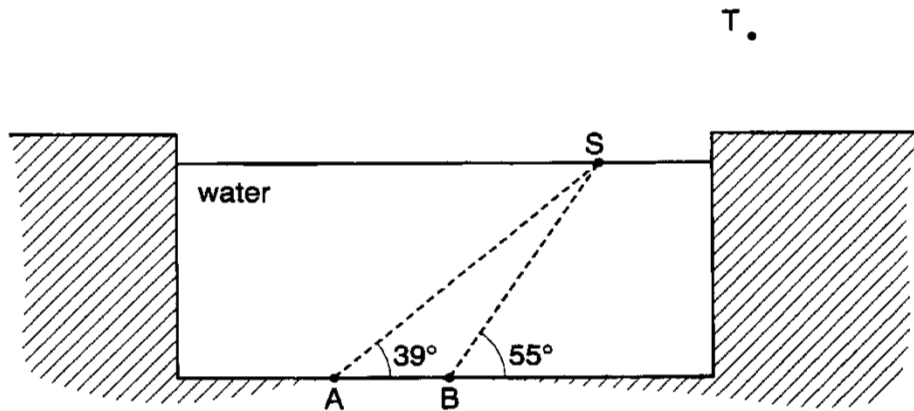


Fig. 1

- (i) A beam of light is directed up from B to S. On Fig. 2, carefully draw the path of the ray from B to S and then out into the air.
- (ii) 1. A beam of light is directed up from A to S. Describe what happens to the beam at S.

- 2. Explain why this happens.

[4]

Core 2

(a) A ray of red light passes through a glass prism, as shown in Fig 3.

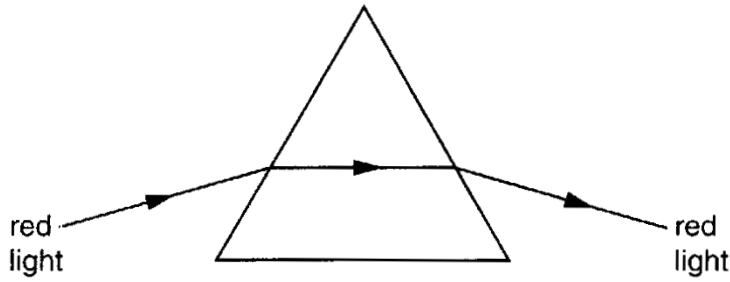


Fig. 3

What name do we use for the change of direction of the ray as it enters the glass?

.....[1]

(b) Fig. 4 shows the same prism, with white light passing through it. The path of red light is shown.

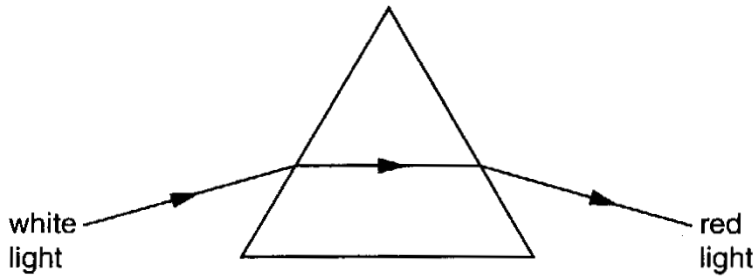


Fig. 4

(i) On Fig. 4, draw a possible path for blue light.

(ii) Something else is happening to the white light, in addition to what is shown in Fig. 3.

What name do we use for this? [5]

(c) Light from the Sun is now passed through the prism. The path of red light is shown in Fig. 5.

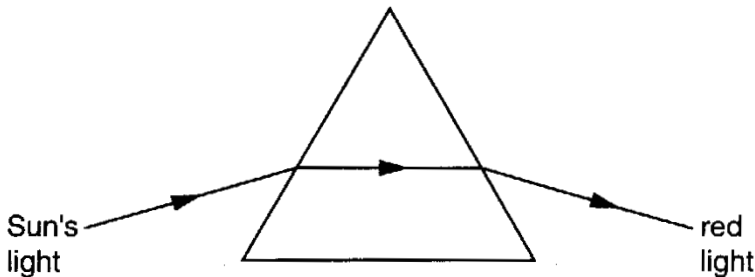


Fig. 5

We can detect infra-red rays using a thermocouple. On Fig. 5, mark with the letter T a position where the thermocouple could detect the infra-red rays after they have passed through the prism. [1]

Core 3

Fig. 6 shows a view from above of a vertical mirror. A small lamp is placed at the point marked L.

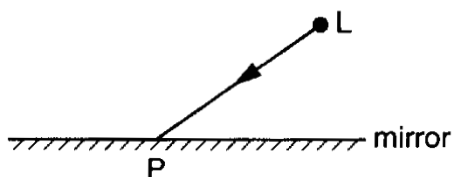


Fig. 6

- (a) One ray, LP, from the lamp has been drawn.
 - (i) At P, draw and label the normal to the mirror.
 - (ii) At P, draw and label the reflected ray.
 - (iii) Mark, using an X for each, two angles which are equal. [3]
- (b) Carefully mark, using a clear dot, the position of the image of the lamp. [1]
- (c) If you were looking into the mirror from point L, you might see something like Fig. 7 "looking back at you". (Apologies if you are better-looking than this!)



Fig. 7

- (i) Mark clearly with the letter R, the image of your right ear.
- (ii) Your nose is 30 cm from the mirror.
How far from your nose is its image? [2]

Alternative to Practical 1

Fig. 8 represents the apparatus an IGCSE class is using for an optics experiment, in which a glass beaker filled with water acts like a lens.

The glass beaker filled with water is placed with C, the centre of its base, on a line labelled LL'. An optics pin is placed at the point labelled O, so that the pin is touching the side of the beaker.

Two points A and A' are on the surface of the beaker at equal distances from the line LL'. The pin at point O acts as an optical object. The ray emerging from A is located by using two pins placed at two points labelled P₁ and P₂.

- (a) Draw a neat, thin and accurate line to show the path of the ray from O to A in the water. Complete the path, in air, of the emerging ray along AP₁P₂. [3]
- (b) Produce the line P₂P₁A backwards so as to cut the line LL'. Label, with the letter I, the point where the two lines cross. Point I is the position of the image of the pin O when it is touching the side of the beaker. [2]
- (c) Draw the line OA' to represent a ray in water from O passing through A'. Using the information you gained in (b), draw a line to show the path of the ray in air after it passes through the point A'. Mark your diagram in such a way as to show how you found the direction of the ray in air. [1]
- (d) Take measurements to calculate the following ratio.

$$IR : OC = \dots : 1$$

Record your measurements and show your working.

$$IR : OC = \dots : 1$$

[2]

Alternative to Practical 1

glass beaker filled with water

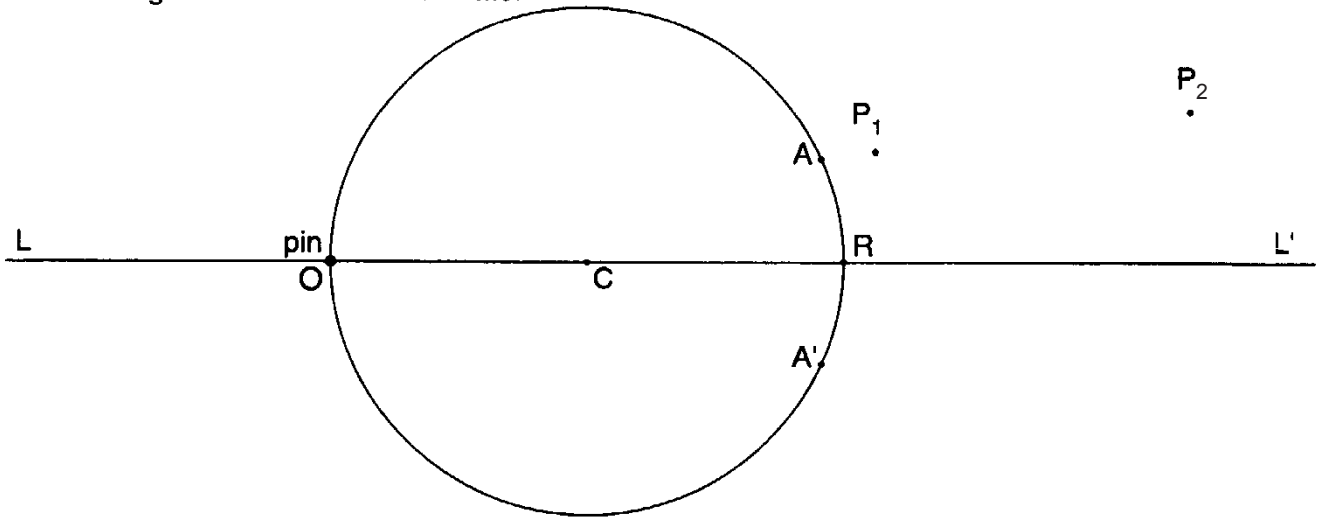


Fig. 8

Extension 1

Fig. 9 shows an object placed 2.0 cm from a thin lens, which is to be used as a magnifying glass.

The focal length of the lens is 3.0 cm. The diagram is drawn to full scale.

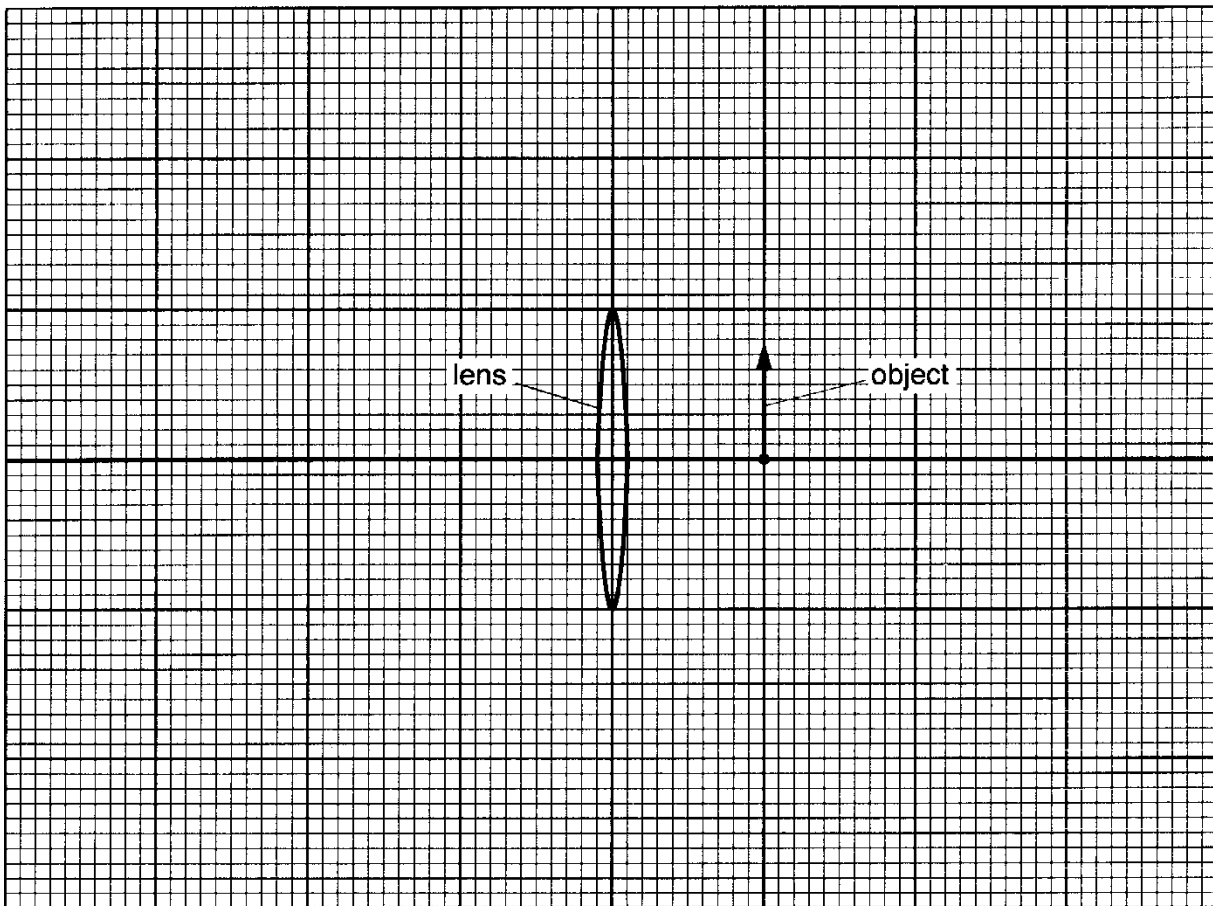


Fig. 9

- (a) On Fig. 9, draw any two rays from the tip of the object which enable you to locate the tip of the image. Draw in the image and label it I. [3]
- (b) On Fig. 9, draw in an eye position which would enable image I to be seen. [1]
- (c) By taking measurements from Fig. 9, work out how many times bigger the image is than the object.

The image is times bigger than the object. [2]

Extension 2

Fig. 10 shows how a right-angled prism may be used to change the direction of a ray of light.

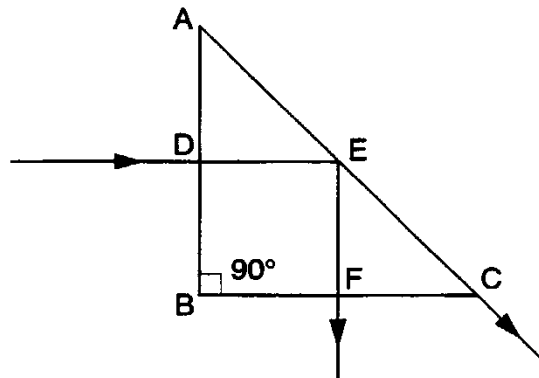


Fig. 10

(a) Explain why the ray of light does not change direction at D and at F.
[1]

(b) State **one** property of the light which does change at D and at F. At each point say whether it increases or decreases.

[2]

(c) At E the light splits, with one ray along the surface of the prism and one ray along EF. Draw the normal at E. Label the critical angle with the letter X and state its value.
 critical angle = [2]

(d) The refractive index of this glass may be calculated using the formula

$$\text{refractive index of glass} = 1/\sin c,$$
 where *c* is the critical angle.
 Use your value of the critical angle of this glass to calculate its refractive index.
 refractive index = [2]

Core 1

- a refraction
- b(i) the normal should be drawn at right angles to the surface of the water at S
- (ii) the angle of incidence should be shown between the normal and the incident ray
- c(i) the beam should be refracted away from the normal along ST
- (ii) 1 total internal reflection
- 2 the angle in the water is greater than the critical angle

Core 2

- a refraction or deviation
- b(i) the blue path should show 2 downward refractions (i.e. below the path for red), one at each face
- (ii) dispersion
- c T should be shown just above the emergent red ray

Core 3

- a(i) the normal should be shown at right angles to the mirror at P
- (ii) the reflected ray should be shown at the same angle to the normal as the incident ray by eye
- (ii) either angles i and r or the angles between the rays and the mirror
- b the dot should be shown on the reflected ray as far from the mirror as L is
- c(i) the ear on the right should be identified
- (ii) 60 cm

Alternative to Practical 1

- a three marks are gained by
 - a neat thin line OA
 - a neat, thin line AP_1P_2
 - an arrow from O

- b two marks are gained by
 - a neat line extended to LL'labelled I

- c the line should be a continuation of IA'

- d IR /OC should lie between 2.9 and 3.1 or to scale of diagram reproduced

Extension 1

- a two of these
 - through either focus
 - through centre of curvature
 - ray produced back to form an image
- b the eye should be in a sensible position to the left of the lens
- c the image length should be 4.5 ± 0.2 , approximately 3 times bigger than the object
or according to the scale of the diagram

Extension 2

- a the ray hits at right angles to the surface
or angle $i = 0^\circ$
it travels along the normal
- b the velocity / speed / wavelength
increases at F
decreases at D
- c the value 45° should be stated or shown on the diagram
- d the refractive index = $1 / \sin 45^\circ$
 $= 1.4$