1 Figs. 4.1 and 4.2 show a semi-circular glass block as rays of blue light are directed into the block at different angles. The rays are directed towards the centre C of the semi-circle so that no refraction occurs as the rays enter the block.

(a) At the angle shown in Fig. 4.1, no refracted ray emerges from the block at C.

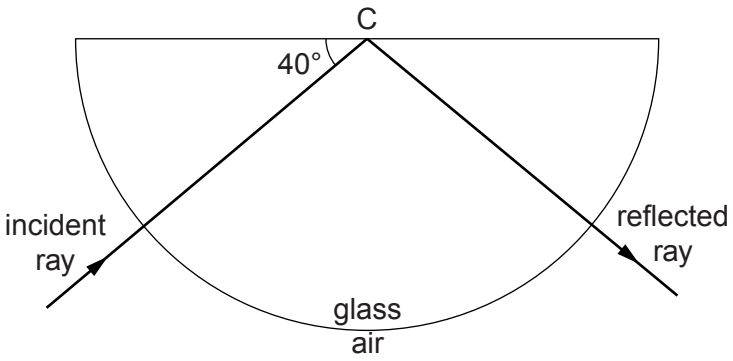

Fig. 4.1

(i) Determine the angle of reflection at C.

angle of reflection = ...

(ii) State the type of reflection occurring at C.

.....

[2]

(b)

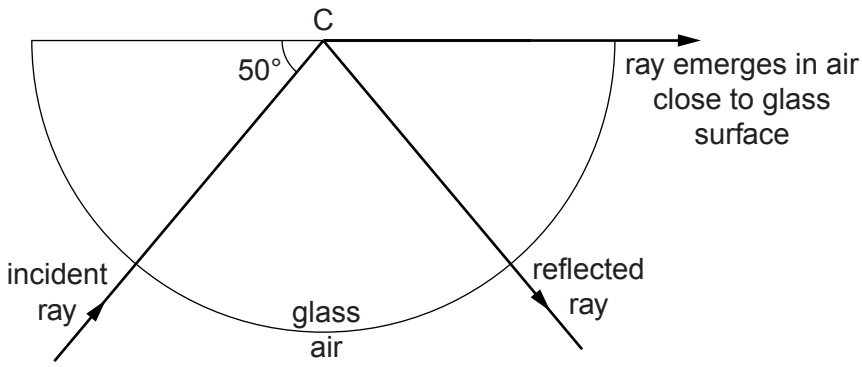

Fig. 4.2

Calculate the refractive index of the glass.

refractive index = ... [3]

(c) The experiment in **(b)** is now repeated with red light.

On Fig. 4.3, draw and label the paths of the reflected and refracted rays of red light. The dashed lines show the paths taken by the blue light in **(b)**.

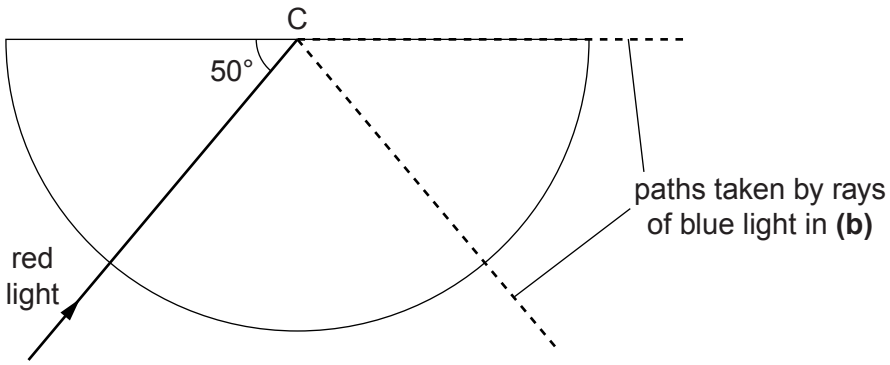

Fig. 4.3 [2]

(d) Fig. 4.4 shows a 45° – 45° – 90° prism used in an optical instrument. Part of the path of a ray of light passing through the instrument is also shown. Light leaves the instrument along path B.

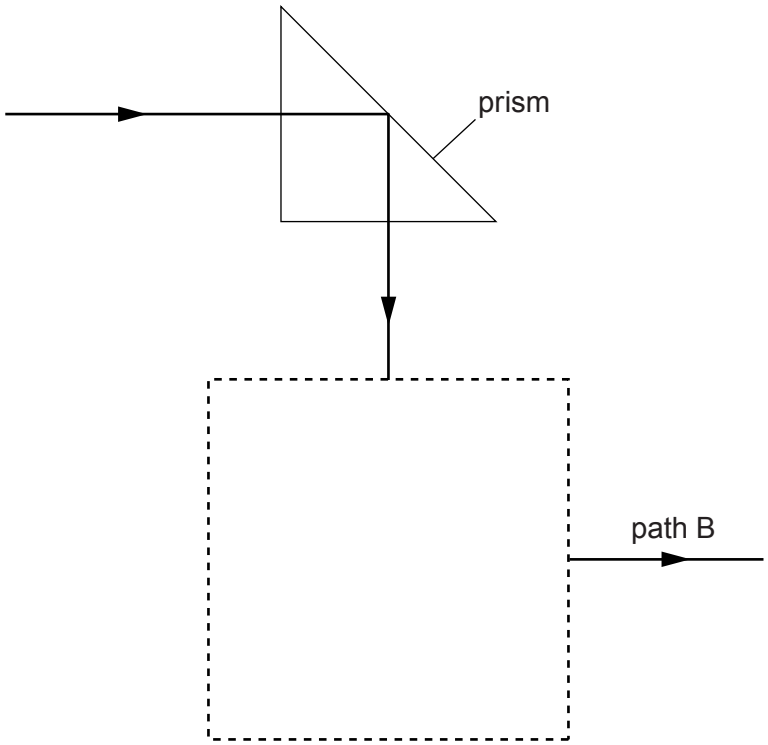

Fig. 4.4

In the dashed box, draw another 45° – 45° – 90° prism and complete the path of the light through this box. [2]

[Total: 9]

2 **(a)** A ray of light in air travels across a flat boundary into glass. The angle of incidence is 51°. The angle of refraction is 29°.

(i) In the space below, draw a labelled diagram to illustrate this information. [3]

(ii) Calculate the refractive index of the glass.

refractive index = ... [2]

(b) A ray of light in glass travels towards a flat boundary with air. The angle of incidence is 51°. This ray does not emerge into the air.

State and explain what happens to this ray.

.....

.....

.....

..... [2]

[Total: 7]

3 A small object is placed 3.0 cm from the centre of a convex lens of focal length 6.0 cm. An enlarged image is observed from the other side of the lens.

(a) On Fig. 7.1, draw a ray diagram to show the formation of this image.

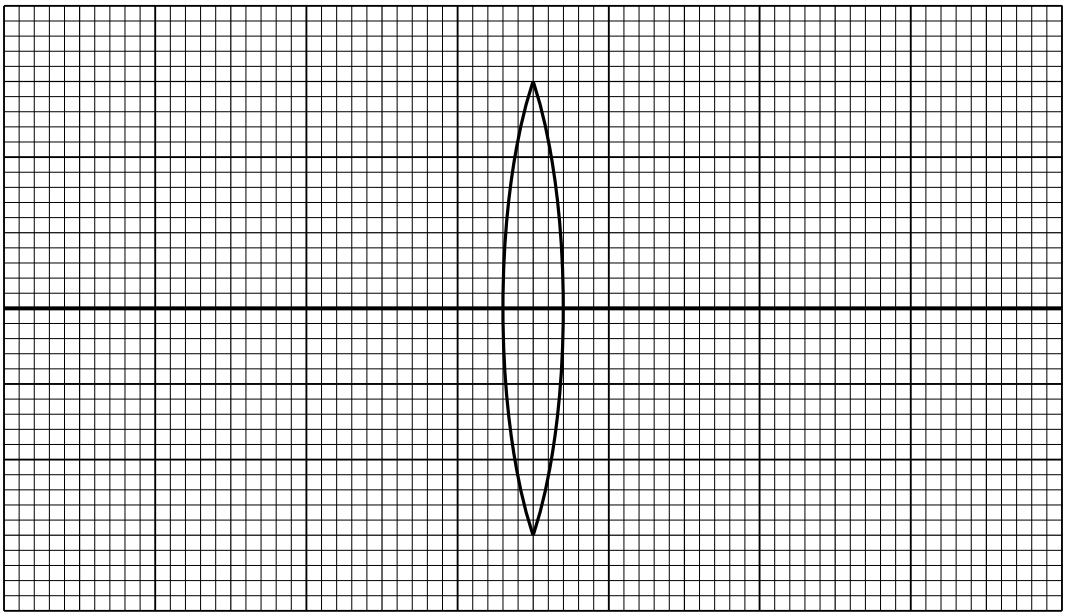

Fig. 7.1

[3]

(b) **(i)** State why this type of image is called *virtual*.

.....

..... [1]

(ii) State the common name given to a convex lens used in this manner.

..... [1]

[Total: 5]

4 A converging lens has a focal length of 7.0 cm. An object of height 2.0 cm is placed 3.0 cm from the centre of the lens. Fig. 7.1 is a full-scale grid that shows the arrangement of the object, the lens and the two principal foci (focal points).

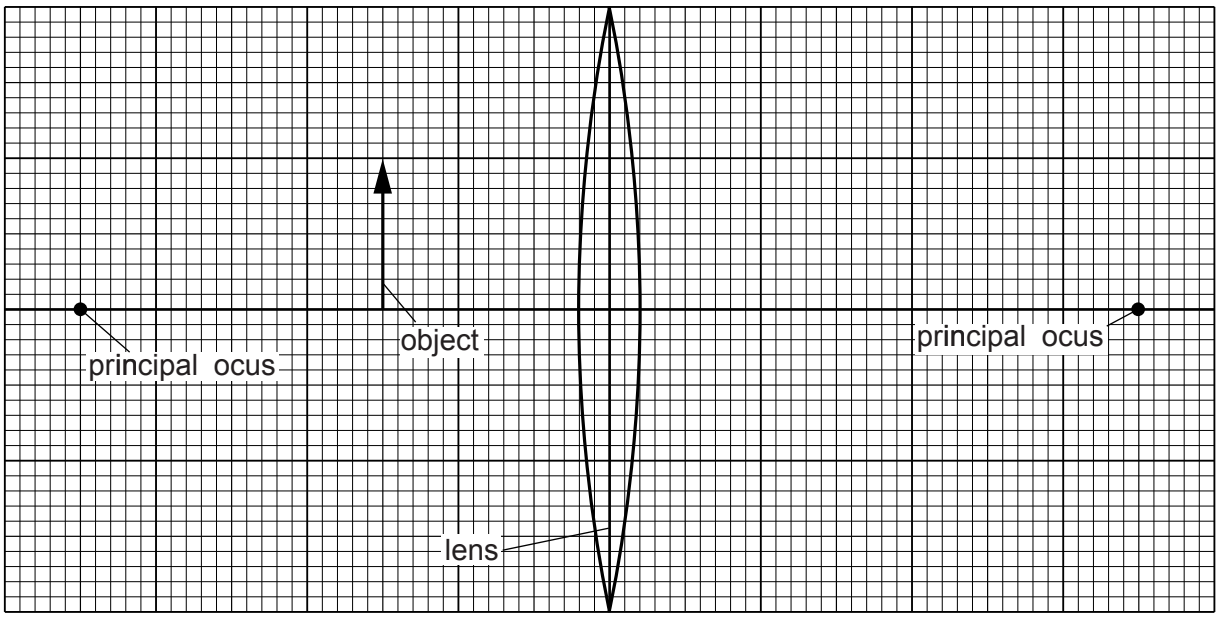

Fig. 7.1

(a) (i) By drawing on Fig. 7.1, show how the lens forms an image of the object. [3]

(ii) State **two** features of the image.

1. .....

2. .....
[2]

(b) (i) Determine the height of the image.

height = ... [1]

(ii) State the name of one device where a lens is used in the way shown in Fig. 7.1.

..... [1]

[Total: 7]

5 **(a)** Fig. 8.1 shows a section of an optical fibre. It consists of a fibre of denser transparent material, coated with a layer of a less dense transparent material.

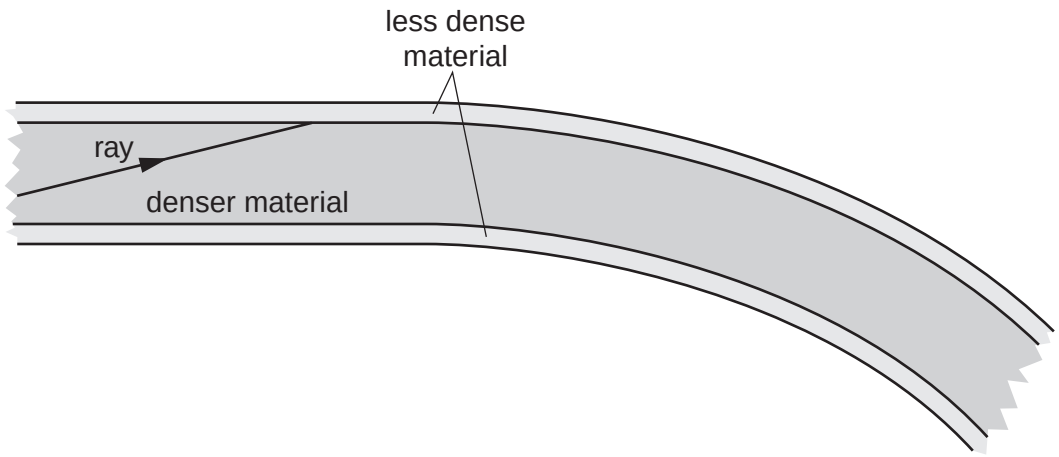

Fig. 8.1

One ray within the fibre has been started for you on Fig. 8.1.

(i) State and explain what happens to the ray already drawn, after it reaches the boundary between the materials.

.....

.....

.....[2]

(ii) On Fig. 8.1, carefully continue the ray until it reaches the end of the section of optical fibre. [1]

(b) Fibre-optic cables are sometimes used to carry out internal examinations on the human stomach.

(i) Suggest one reason why the cable is made of thousands of very thin optical fibres.

.....

.....

.....[1]

(ii) Describe briefly how the inside of the stomach is illuminated.

.....

.....

.....[1]

(iii) Describe briefly how the light from the stomach is transferred to the detecting equipment outside the body.

.....

.....

.....[1]

[Total: 6]

6 **(a)** What is meant by the *focal length* of a converging lens?

.....

.....[1]

(b) An object is placed in front of a converging lens. A real image is formed, as shown in Fig. 7.1. The converging lens is not shown.

Fig. 7.1

(i) Explain what is meant by a *real image*.

.....[1]

(ii) Rays of light from point A on the object form point B on the image.

On Fig. 6.1, draw

1. a ray to find the position of the converging lens, showing the lens as a vertical straight line in this position,

2. a ray to find the position of a principal focus of the lens, marking this position **F**,

3. a third possible ray from A to B. [3]

(iii) The distance between the object and the lens is increased. State any changes which take place in

1. the distance of the image from the lens,

.....

2. the size of the image.

.....[2]

[Total: 7]