1 Light enters a glass fibre from air at an angle of incidence of 62°. The angle of refraction in the glass is 36°.

(a) The speed of light in air is 3.0×10^8 m/s.

Determine the speed of light in the glass fibre.

speed = ... [4]

(b) Describe how glass fibres are used in communications technology.

....

....

....

....[3]

[Total: 7]

2 Fig. 7.1 shows the principal axis PQ of a converging lens and the centre line XY of the lens.

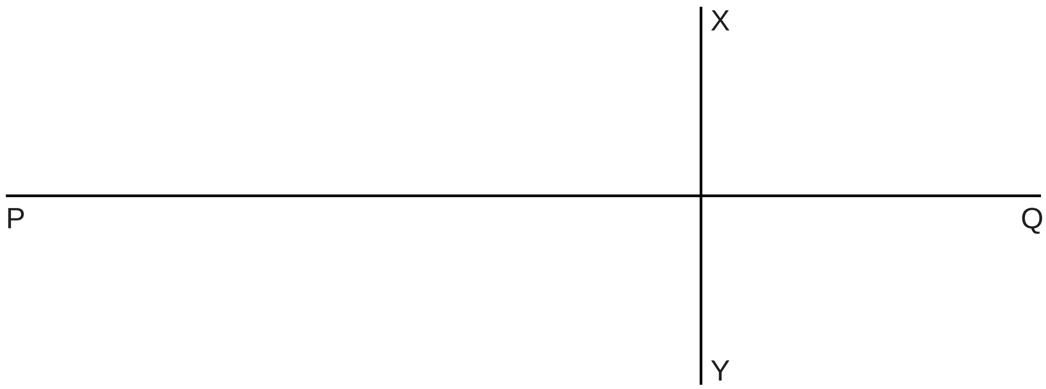

Fig. 7.1

An object 2.0 cm high is placed 2.0 cm to the left of the lens. The converging lens has a focal length of 3.0 cm.

(a) On Fig. 7.1, draw a full-scale diagram to find the distance of the image from the lens, and the height of the image.

distance of image from the lens = ...

height of image = ...
[5]

(b) State and explain whether the image in **(a)** is real or virtual.

....

....[1]

[Total: 6]

3 **(a)** Fig. 6.1 shows two rays from a point object P incident on a water surface.

An observer sees the image of P produced by reflection at the surface of the water.

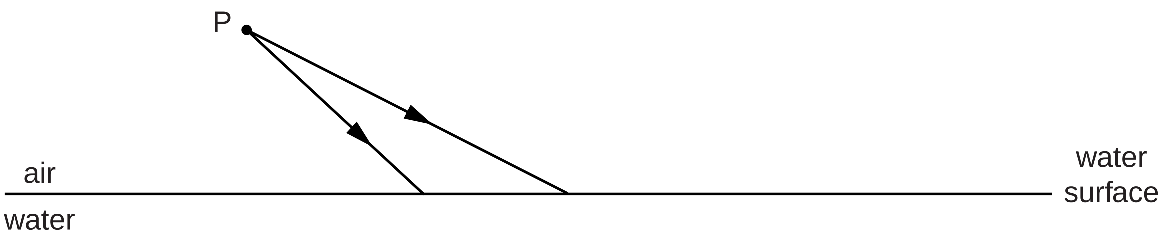

Fig. 6.1

On Fig. 6.1, draw the reflected rays and complete the diagram to locate the position of the image. Label the position of the image I. [2]

(b) Fig. 6.2 shows two rays from a point object Q incident on another water surface.

An observer sees the image of Q produced by refraction at the surface of the water.

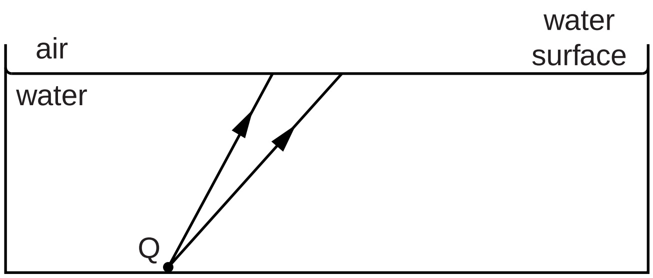

Fig. 6.2

On Fig. 6.2, draw possible refracted rays and complete the diagram to locate a possible position of the image. Label the position of the image J.
You do not need to calculate any angles. [2]

(c) The refractive index of water is 1.33.

Calculate the critical angle.

critical angle = ...[2]

(d) Describe, with a diagram, a medical use of optical fibres.

....

....

....

....

....[3]

[Total: 9]

4 The frequency of the monochromatic light produced by a laser is 4.7×10^{14} Hz.

A ray of light from the laser passes from a vacuum, where the speed of light is 3.0×10^{8} m/s, into a fibre-optic cable.

(a) State

(i) what is meant by *monochromatic*,

....

.... [1]

(ii) the frequency of light from the laser in the fibre-optic cable.

.... [1]

(b) The speed of light in the fibre-optic cable is 2.0×10^{8} m/s.

Calculate

(i) the refractive index of the material from which fibre-optic cable is made,

refractive index = ... [2]

(ii) the wavelength of light from the laser in the fibre-optic cable.

wavelength = ... [2]

[Total: 6]

5 **(a)** Fig. 7.1 shows a ray diagram of a converging lens forming the image I of the object O.

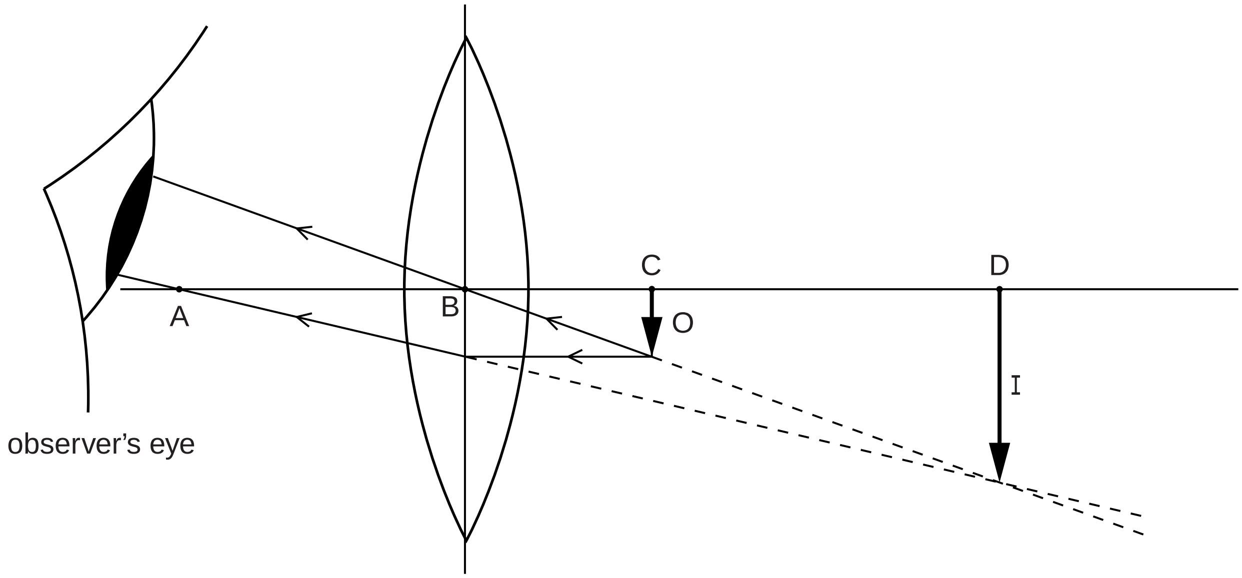

Fig. 7.1

(i) Put a tick in **two** boxes in the following list to describe the image formed by the lens in Fig. 7.1.

description	place **two** ticks in this column
real	
virtual	
magnified (enlarged)	
same size	
diminished (smaller)	

(ii) Which length, on Fig. 7.1, is the focal length of the lens?
Circle one of the lengths below.

AB BC BD CD

[3]

(b) In this question, you will apply the laws of reflection for a plane mirror to a curved mirror.

This mirror is shown in Fig. 7.2. The normal at any point on this mirror is the line from that point to the point C.

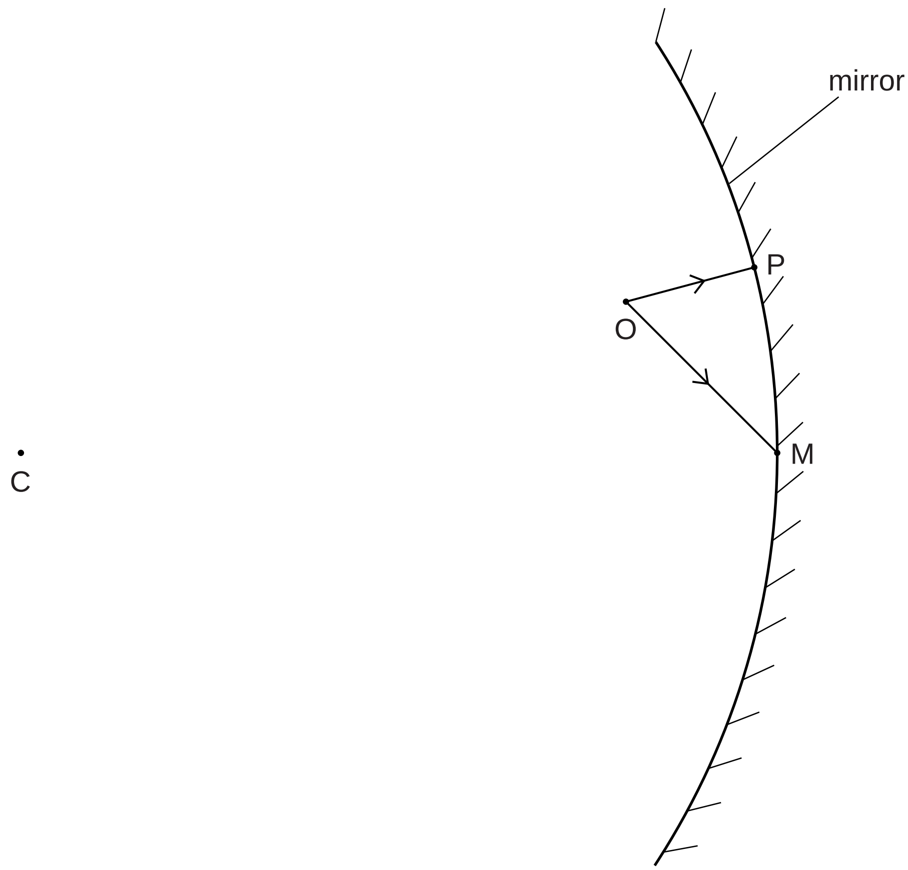

Fig. 7.2

Two rays have been drawn from the object O.

On Fig. 7.2,

(i) draw the normal to the mirror at M, [1]

(ii) draw the ray reflected from M, [1]

(iii) draw the ray reflected from P, [1]

(iv) extend the reflected rays back to the right of the mirror and locate the image. Label this image I. [2]

[Total: 8]

6 A ray of light from a laser passes from air into a clear, semi-circular, plastic block. Fig. 7.1 shows the ray entering the block.

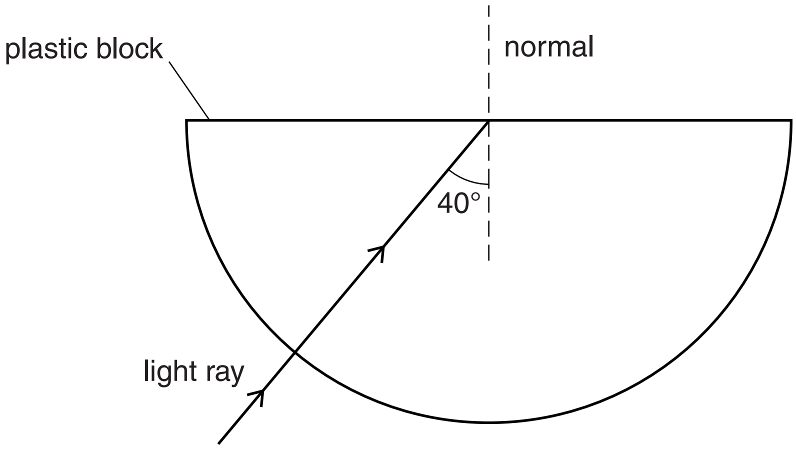

Fig. 7.1

The ray continues in the same direction and meets the middle of the opposite surface at an angle of 40° to the normal. The refractive index of the plastic is 1.5.

(a) The ray continues into the air.

Calculate the angle between the normal and the path taken by the light after it leaves the block.

angle = ... [3]

(b) The frequency of the light produced by this laser is 3.8×10^{14} Hz and its wavelength in the plastic block is 5.3×10^{-7} m (0.000 53 mm).

Calculate

(i) the speed of light in this plastic,

speed = ... [2]

(ii) the speed of light in air.

speed = ... [2]

(c) Explain why the ray does not change direction as it enters the plastic block.

....

....

....[2]

[Total: 9]