1 Fig. 7.1 and Fig. 7.2 show wavefronts of light approaching a plane mirror and a rectangular glass block, respectively.
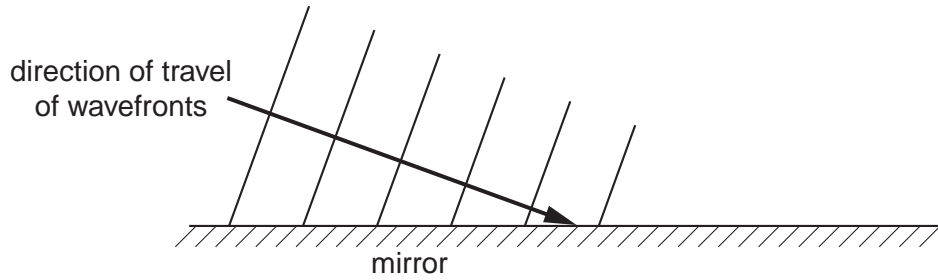
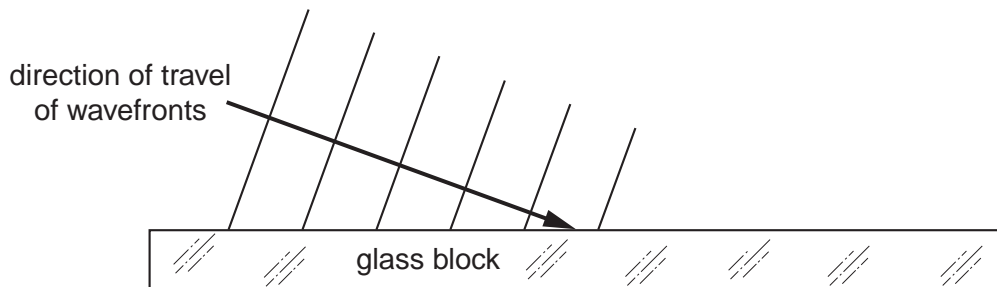direction of travel
of wavefronts

mirror

Fig. 7.1

direction of travel
of wavefronts

glass block

Fig. 7.2

(a) On Fig. 7.1 and on Fig. 7.2 draw wavefronts to show what happens after the waves strike the surface. [4]

(b) In Fig. 7.2, the waves approaching the block have a speed of 3.0×10^8 m/s and an angle of incidence of 70°. The refractive index of the glass of the block is 1.5.

    (i) Calculate the speed of light waves in the block.

                                speed = ... [2]

    (ii) Calculate the angle of refraction in the block.

                                  angle = ... [2]

[Total: 8]

2 Fig. 6.1 shows an object, the tip of which is labelled O, placed near a lens L.

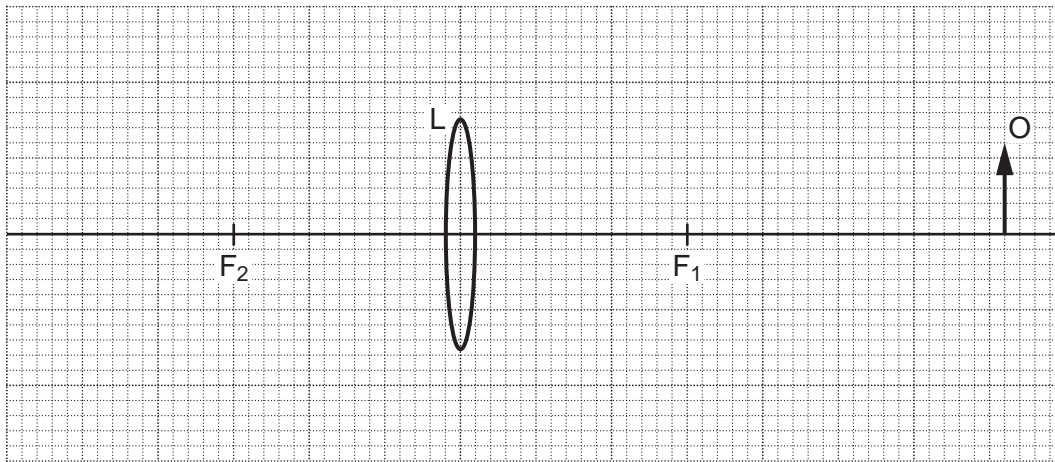The two principal foci of the lens are F_1 and F_2.

Fig. 6.1

(a) On Fig. 6.1, draw the paths of two rays from the tip of the object so that they pass through the lens and continue beyond.

Complete the diagram to locate the image of the tip of the object. Draw in the whole image and label it I. [2]

(b) State two changes to the image when the object is moved

(i) a small distance closer to the lens,

1. ....

2. .... [2]

(ii) to a position between F_1 and the lens.

1. ....

2. .... [2]

[Total: 6]

3 Fig. 6.1 shows two rays of monochromatic light, one entering the prism along the normal DE and the second one along PQ.
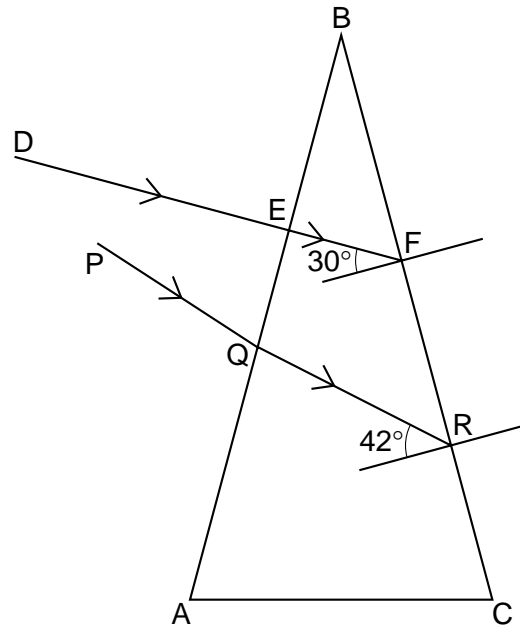

Fig. 6.1

(a) State what is meant by *monochromatic* light.

.... [1]

(b) The refractive index of the glass of the prism is 1.49. The ray EF is refracted at F. Use information from Fig. 6.1 to calculate the angle of refraction at F.

angle of refraction = ... [3]

(c) On Fig. 6.1, draw in the refracted ray, starting from F. [1]

(d) State how the refraction, starting at F, would be different if the monochromatic ray were replaced by a ray of white light.

.... [1]

(e) The critical angle for the glass of the prism is just over 42°. State the approximate angle of refraction for the ray striking BC at R.

.... [1]

(f) Another monochromatic ray, not shown in Fig. 6.1, passes through the prism and strikes BC at an angle of incidence of 50°. State what happens to this ray at the point where it strikes BC.

.... [1]

[Total: 8]

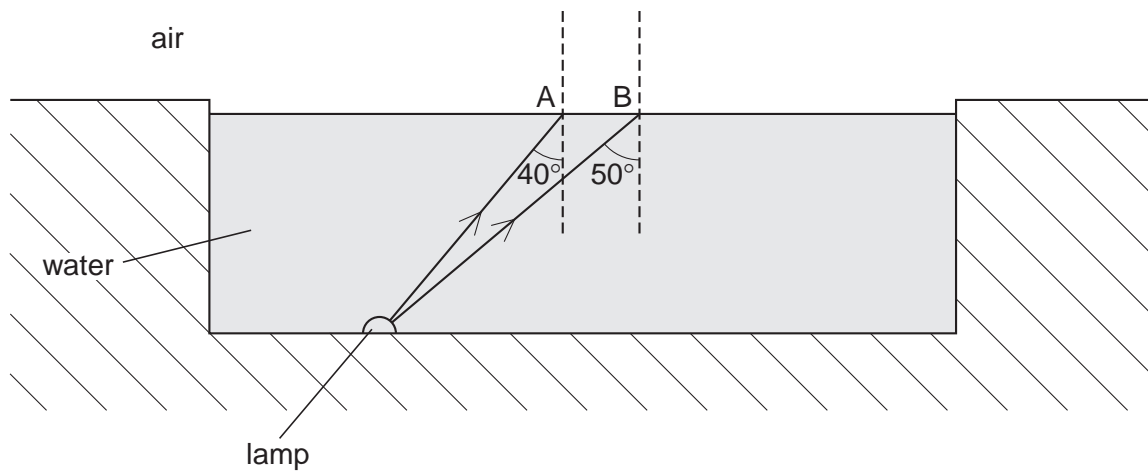**4**   Fig. 6.1 shows a cross-section through a swimming pool.

Fig. 6.1

(a) A ray of monochromatic light from a lamp at the bottom of the pool strikes the surface at A, as shown.

  (i) State what is meant by *monochromatic* light.

  .... [1]

  (ii) The water in the swimming pool has a refractive index of 1.33.

  Using information from Fig. 6.1, calculate the angle of refraction at A.

  angle of refraction = ... [3]

  (iii) On Fig. 6.1, draw the refracted ray.   [1]

(b) The critical angle for the water-air surface is 48.8°.

Another ray of monochromatic light from the lamp strikes the surface at B, as shown in Fig. 6.1.

(i) State and explain what happens to the ray after reaching B.

....

.... [2]

(ii) On Fig. 6.1, draw this ray. [1]

[Total: 8]

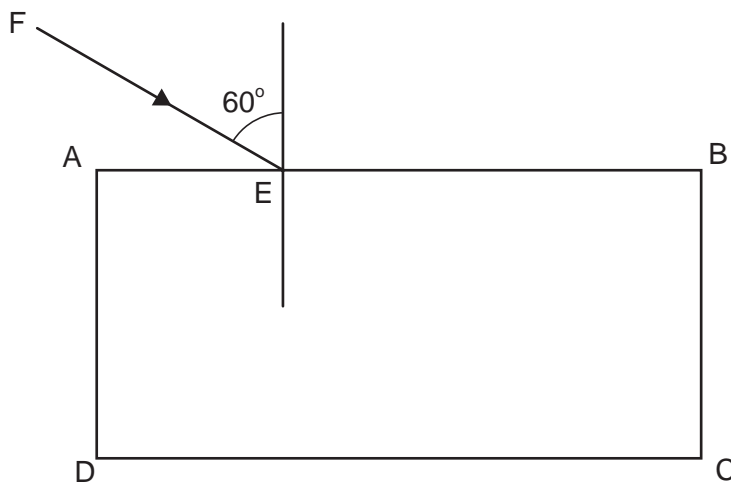**5** Fig. 6.1 shows a rectangular glass block ABCD.

Fig. 6.1

(a) The ray FE is partly reflected and partly refracted at E.

   (i) On Fig. 6.1, draw in the approximate path of the refracted ray, within and beyond the block. Label the ray *refracted ray*. [1]

   (ii) On Fig. 6.1, draw in the path of the reflected ray. Label the ray *reflected ray*. [1]

(b) A second ray, almost parallel to AE, strikes the block at E and is partly refracted at an angle of refraction of 43°.

   (i) State an approximate value for the angle of incidence at E.

        .... [1]

   (ii) State an approximate value for the critical angle for the light in the glass block.

        .... [1]

   (iii) Calculate an approximate value for the refractive index of the glass of the block.

        refractive index = ... [2]

(c) The speed of the light along ray FE is 3.0 x 10^8 m/s. Calculate the speed of the refracted light in the glass block.

speed = ... [2]

[Total: 8]