2010 Sec 4 Physics Revision 8.1
08 Refraction of light

Name: _____ (   ) Class: 4/ ___   Date: _____

8.1 Introduction

- In **Figure 8.1.1**, label the angle of incidence *i*, angle of refraction *r* at the first air to glass boundary.
- The incident ray is _____ to the emergent ray.
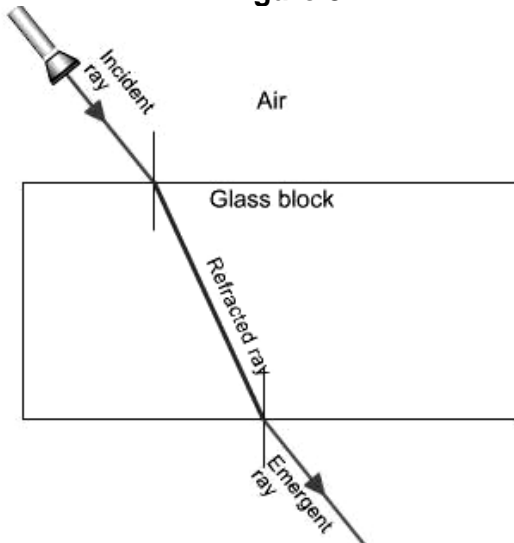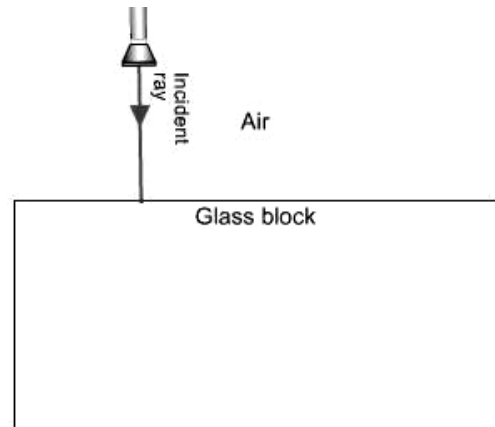- Complete the path of the light ray in **Figure 8.1.2**.

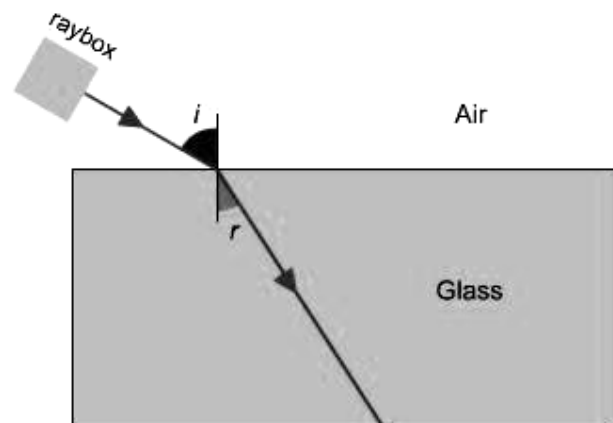**Figure 8.1.1**   **Figure 8.1.2**

8.2 Laws of refraction *(highlight or underline the key words!)*

- 1st law states that   _____

  _____

- 2nd law states that   _____

  _____

8.3 Optically less dense to denser medium

- When a light ray travels from an optically less dense medium to a denser medium, the angle of incidence is _____ than the angle of refraction.

When a light ray passes from an optically less dense medium to a denser medium, the ray is bent towards the normal.

The formula is, refractive index, n = sin *i* / sin *r*

raybox

Air
optically less
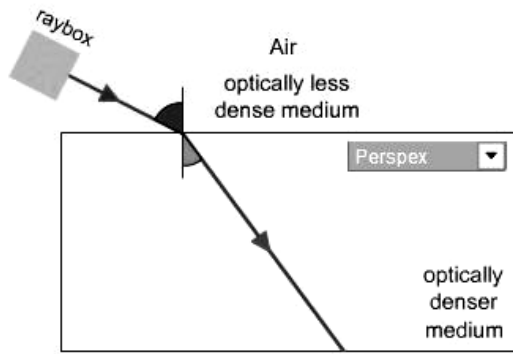dense medium

Perspex ▼

optically
denser
medium

Figure 8.3.1 shows a light ray travelling from air into perspex. The angle of incidence is 58° and the angle of refraction is 34.7°. Calculate the refractive index of perpex.

Quick check

1. When light travels, at an angle, from an optically less dense to a denser medium,

   A. it keeps to its original path.
   B. bends towards the normal.
   C. bends away from the normal.

2. The ratio sin i / sin r

   A. increases with the angle of incidence, i.
   B. decreases with the angle of incidence, i.
   C. remains constant for a particular medium.

8.4   Optically denser to less dense medium

- When a light ray travels from an optically denser medium to a less dense medium, and refraction occurs, the angle of incidence is _____ than the angle of refraction.

Air r

Glass   incident ray i

Air   Angle of
                       refraction is 90°

incident ray   Glass
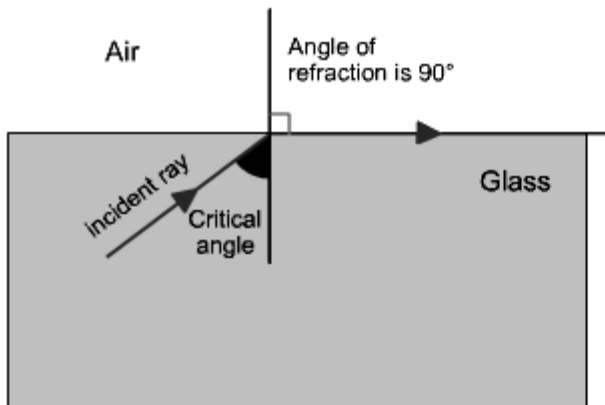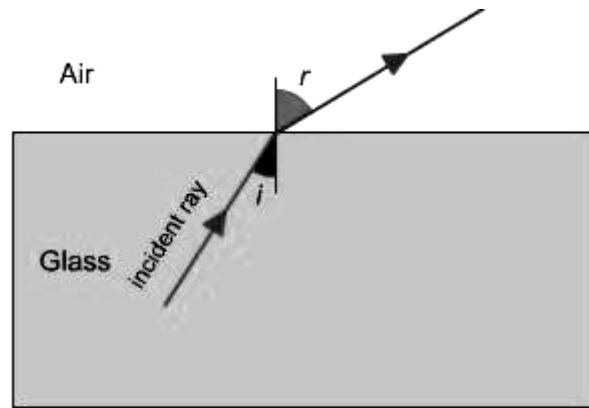
Critical
angle

When a light ray passes from an optically denser medium to a less dense medium, the ray is bent away from the normal.

The formula is, n = sin r / sin i

- The critical angle is defined as the angle of incidence in the optically denser medium for which the angle of refraction in the less dense medium is 90°.

- Total internal reflection occurs when
  1) the ray of light passes from a denser medium to a less dense medium.
  2) the angle of incidence in the denser medium is greater than the critical angle.
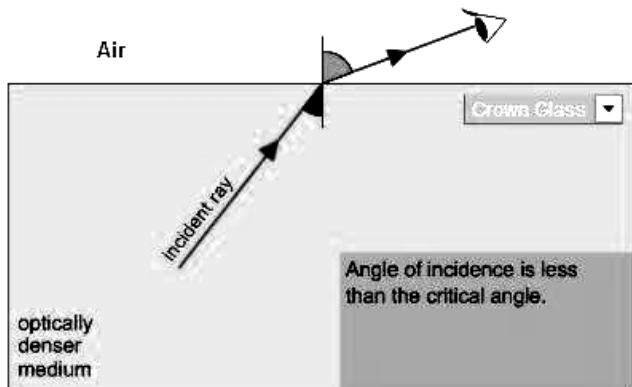
Figure 8.4.1 on the left shows a light ray travelling from crown glass into air. The angle between the incident ray and the normal is 38°. The angle of refraction is 69.4°.

(a) Calculate the refractive index of crown glass.

Air

Crown Glass ▼

Angle of incidence is less than the critical angle.

optically denser medium

incident ray

(b) Calculate the critical angle.

(c) If the angle of incidence is increased to 47°, complete the path of the light ray in **Figure 8.4.2** on the right.

Air

Crown Glass ▼

incident ray
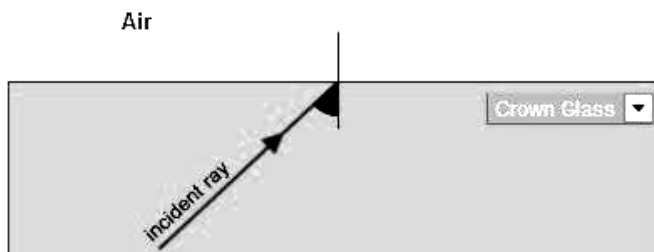
Quick check

1. When light travels, at an angle, from an optically dense to a less dense medium,

    A. it keeps to its original path.

    B. bends towards the normal.

    C. bends away from the normal.

2. A ray of light is passing from a glass block and out into the air, at an angle to the glass block.
What happens when the incident angle is equal to the critical angle?

    A. Total internal reflection occurs.

    B. The angle of refraction will be 90°.

    C. The angle of refraction is less than 90°.
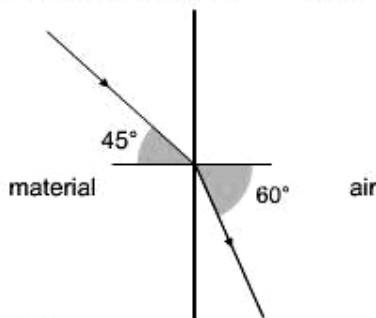
8.5   Quiz   (5 questions)

1. The diagram shows a light ray traveling in water and meets the water surface.
   Which one of the following labelled rays is most likely to be the resultant light ray?
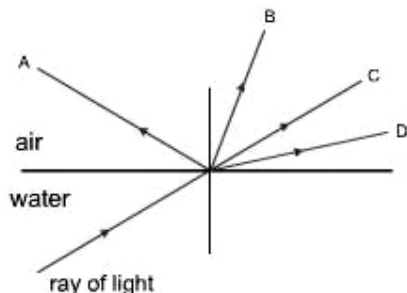
   A. Ray A
   B. Ray B
   C. Ray C
   D. Ray D

2. Total internal reflection of a ray of light is possible when the ray goes from
   A. a denser to less dense medium and the angle of incidence is greater than the critical angle.
   B. a denser to less dense medium and the angle of incidence is less than the critical angle.
   C. a less dense to denser medium and the angle of incidence is greater than the critical angle.
   D. a less dense to denser medium and the angle of incidence is less than the critical angle.

3. The diagram shows a medium placed on a table. A ray of light traveling from the air
   meets the medium at an angle of incidence of 40°, and its angle of refraction is 24°.
   What is the refractive index of the medium?
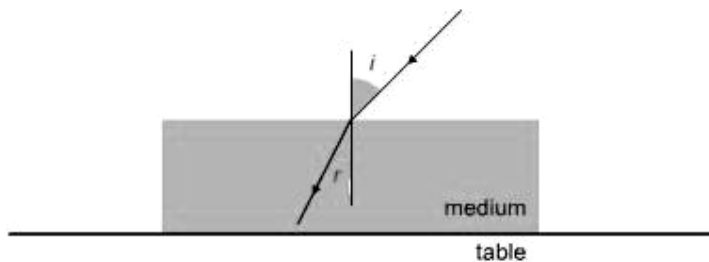
   A. 0.56
   B. 0.59
   C. 1.58
   D. 1.67

4. The refractive index of a glass material is 1.50.
   What is the critical angle of the material?

   A. 0.67°
   B. 41.8°
   C. 48.2°
   D. 90.0°

5. The diagram shows a ray of light moving from an unknown material to air.
   What is the refractive index of the material?

   A. 0.71
   B. 0.82
   C. 1.22
   D. 1.41