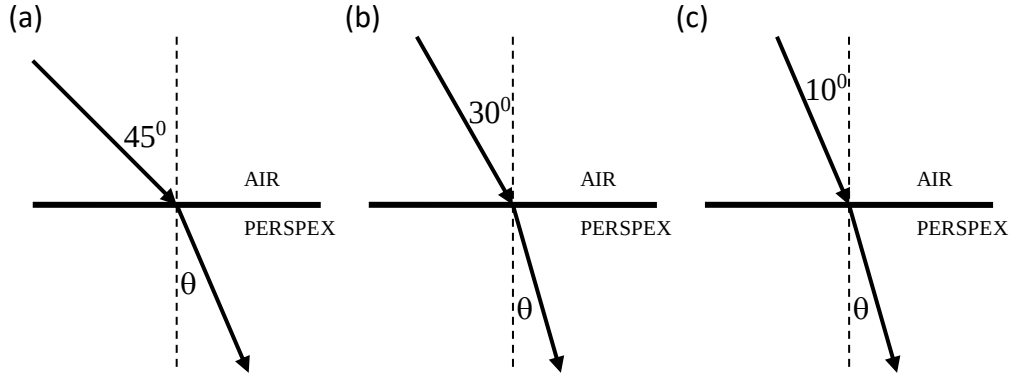
Higher Grade Physics

Unit 2 : PARTICLES & WAVES

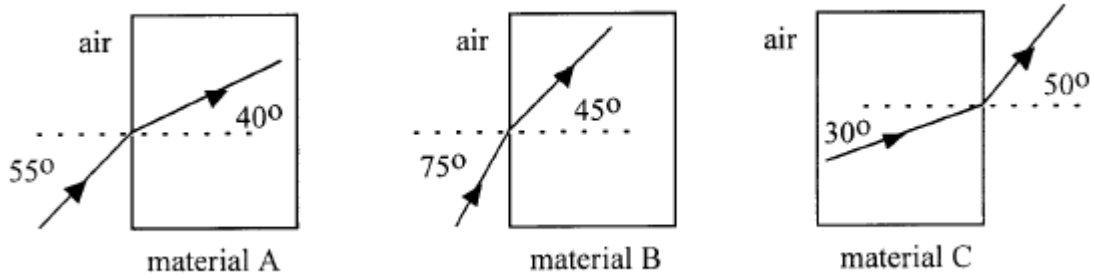
Refraction of Light

Refraction

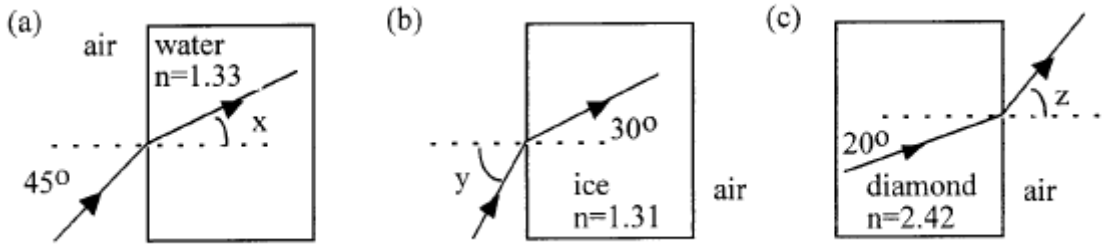
1. The refractive index of perspex is 1.50. A ray of light strikes a perspex block as shown. Calculate the angle θ between the normal and the ray in the perspex in each of the following cases.



2. Calculate the refractive index *n* of each of the materials below:



3. Calculate the missing angle in each of the following diagrams:

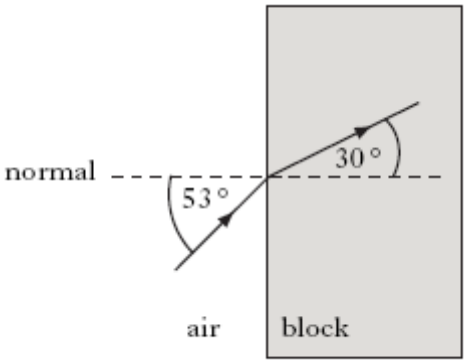


4. The refractive index of diamond is 2.4. What is the angle of refraction for an angle of incidence of 40^0 ?

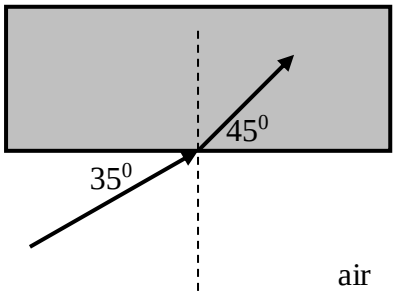
5. A ray of light strikes a glass plate with an angle of incidence of 50^0. If the angle of refraction is 42.5^0, what is the refractive index of the glass ?

6. From the following information, calculate the refractive index of material.

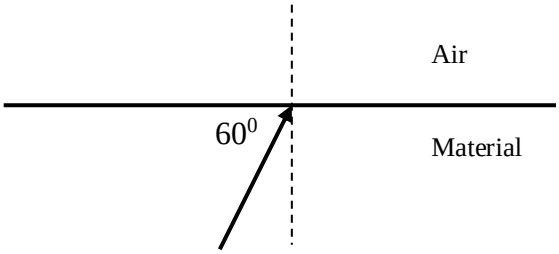
(a)



(b)



7. The refractive index of a material is 1.35.



At what angle does the ray of light emerge from the material ?

8. The refractive indices for a number of materials are given below.

GLASS	1.5 to 1.9
WATER	1.33
ICE	1.31
DIAMOND	2.42

(a) Give one possible reason why glass has a range of possible values for the refractive index.

(b) For an angle of incidence of 30^0 calculate the angle of refraction in water and ice.

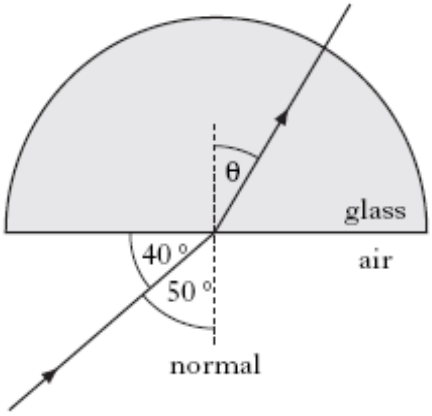
(c) A ray of light passes from air into diamond, producing a refracted angle of 15^0. What is the angle of incidence of the ray on entering the diamond.?

(d) The refractive index of red light is 1.513 for light entering crown glass from air, whereas for violet light it is 1.532. Use this information to help you explain why a spectrum is produced when white light passes through a prism of crown glass.

9. The wavelength of red light in air is 700 nm. Calculate the wavelength, speed and frequency in glass with a refractive index of 1.52.

10. The speed of light in diamond is 1.24 x 10^8 ms^{-1}. Calculate the refractive index of diamond.

11. A ray of light of wavelength 600 nm enters glass with a refractive index of 1.45 as shown.



(a) Calculate the angle of refraction.

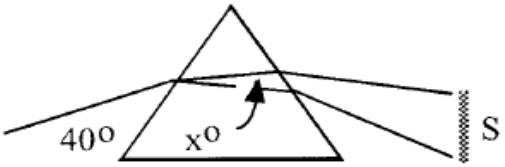
(b) Calculate the speed of light in the glass.

(c) Calculate the wavelength of the light in the glass.

(d) Calculate the frequency of the light in the glass.

(e) What is the frequency of the light in air ?

12. A ray of white light is dispersed by a prism producing a spectrum, S.
The angle x^0 is found to be 0.7^0.



If the refractive index for red light is 1.51, calculate the refractive index for blue light.

13. Light of frequency 6 x 10^{14} Hz travels from air into water of refractive index 1.33. Calculate the velocity, wavelength and frequency of the light in water.

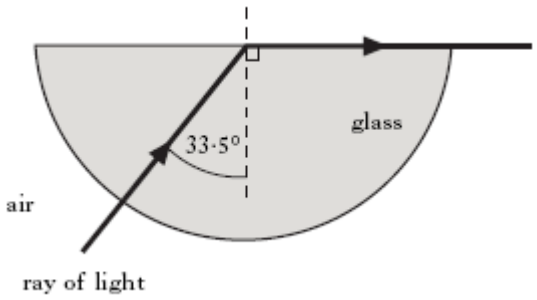
Critical Angle

14. Calculate the critical angle for the following materials :-

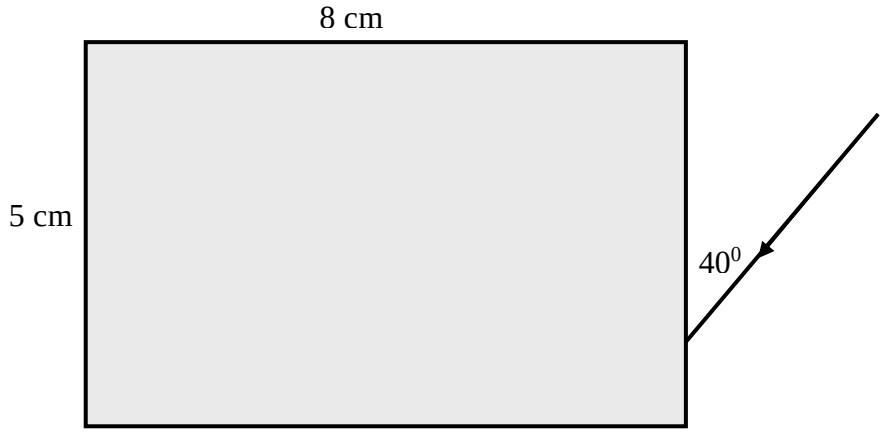
ICE	1.31
GLASS	1.54
PERSPEX	1.50
DIAMOND	2.42

15. The critical angle for glycerol is 43.9^0. Calculate the refractive index of glycerol.

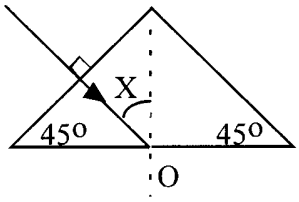
16. Calculate the refractive index for the semi-circular glass block shown below.



17. Copy the following diagram to scale and determine the exact path of the ray of light until it emerges from the block in which the refractive index is 1.33.



18. A ray of light enters a glass prism of absolute refractive index 1·52, as shown.



(a) Explain why the ray does not change direction on entering the glass prism.

(b) Calculate the value of angle X.

(c) Why does the ray undergo total internal reflection at O?

(d) Redraw the complete diagram showing the angles at O with their values.

(e) Explain what would happen when the experiment is repeated with a prism of material with refractive index 1·30.