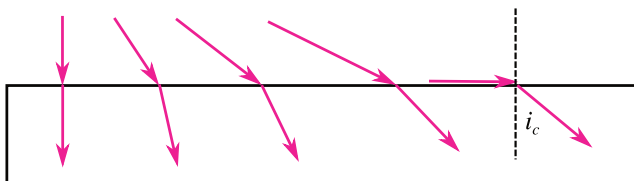
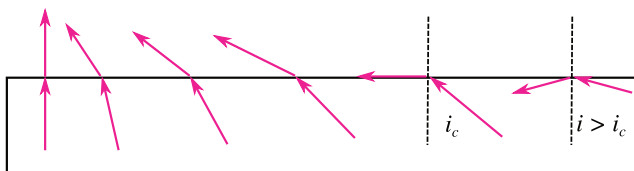


43 Total Internal Reflection ♥

The diagrams below show rays of light **entering** a glass block at different angles. The last one shows light hitting the boundary at a very glancing angle.



The next diagram shows the situation where light is **leaving** a glass block. Notice that these are identical to the rays shown above but with the direction reversed.



Where the angle of incidence is greater than i_c (the critical angle), the light cannot refract, and so it all **reflects** back inside the material.

Total internal reflection occurs when light attempts to **leave** a glass or Perspex block with an **angle of incidence** bigger than the **critical angle**. None of the light refracts. None of it leaves.

The critical angle for light leaving a glass block into air is 42° .

The critical angle for light leaving water into air is 49° .

The critical angle for light leaving diamond into air is 24° .

The critical angle for light leaving cubic zirconia into air is 28° .

The slower light travels in a material, the **higher** its refractive index, and the **smaller** its critical angle at an air boundary.

43.1 Given the previous critical angle data, put the five materials (air, glass, water, diamond, and cubic zirconia) in order of increasing speed of light.

43.2 The critical angle for the glass/water boundary is 62° . For TIR, from which medium must light hit the boundary?

43.3 Complete the table, stating whether **total internal reflection (TIR)** or **refraction (R)** will occur:

Light moving from	Light moving to	Angle of incidence	What happens?
Air	Glass	30°	(a)
Glass	Air	30°	(b)
Air	Glass	49°	(c)
Glass	Air	49°	(d)
Water	Air	43°	(e)
Glass	Water	70°	(f)
Water	Glass	82°	(g)
Diamond	Air	24°	(h)
Cubic Zirc.	Air	28°	(i)

43.4 The diagram shows a side view of a swimming pool. On the bottom are two people, P_1 and P_2 , trying to see objects O_1 , O_2 and O_3 outside the pool. The observers are also trying to see each other without looking directly at each other. Which of the rays shown are possibilities for observing?

(a) Is ray (a) possible?

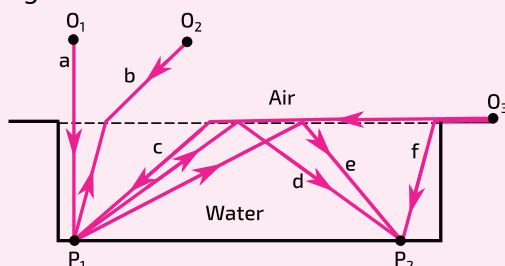
(b) Is ray (b) possible?

(c) Is ray (c) possible?

(d) Is ray (d) possible?

(e) Is ray (e) possible?

(f) Is ray (f) possible?



43.5 A jewel looks more sparkly the less light it allows to escape through the rear surface, and the more it is able to totally internally reflect light at the back. Which is the best material for making a sparkly jewel - cubic zirconia, glass or diamond?