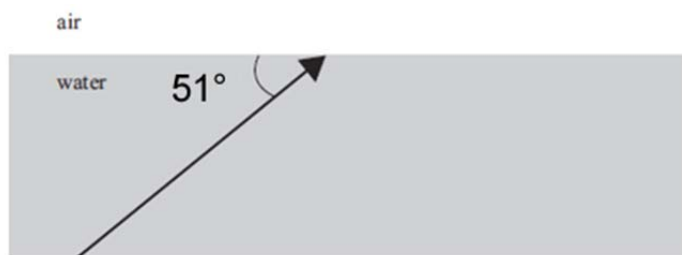


WAVES: TOTAL INTERNAL REFLECTION QUESTIONS

REFRACTION (2009;2)



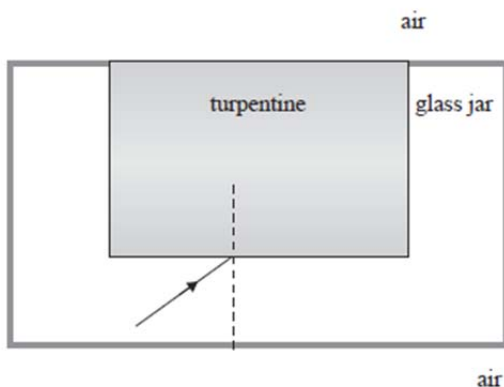
The refractive index of water is 1.33. The refractive index of air is 1.00.

Use the relationship $n_1 \sin \theta_1 = n_2 \sin \theta_2$ to derive the formula for the critical angle at an interface. Use the formula to show whether a ray that is incident on the water/air interface at an angle of incidence of 50° would be refracted into the air.

REFRACTION (2008;5)

Jane shone a laser beam through turpentine, which was in a glass jar. The refractive index of turpentine is 1.472. The refractive index of glass is 1.67.

- (a) The diagram below shows the path of a laser beam hitting the glass-turpentine interface at an angle of incidence greater than the critical angle for glass-turpentine. Continue the ray until it passes into the air.



- (b) Calculate the critical angle for the glass-turpentine interface.

THE OPTICIAN (2007;1)

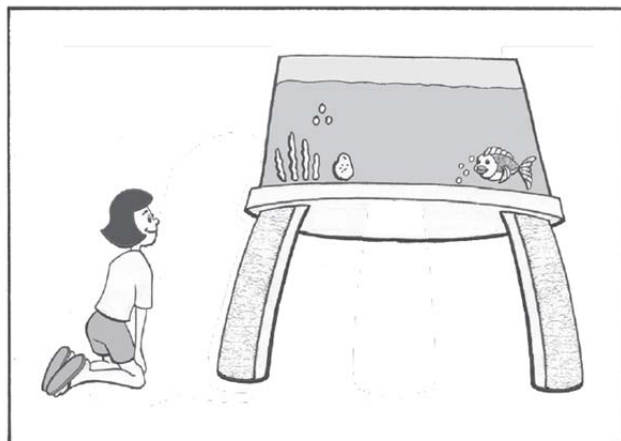
Pita is visiting the medical centre to get a new pair of glasses. He finds out that lenses can be made of either plastic or glass.

The refractive index of air is 1.00.
The refractive index of the plastic is 1.60.

Calculate the size of the critical angle at the plastic / air boundary.

LIGHT (2006;2)

Sally knelt down to take a closer look at the fish. While looking up at the surface of the water in the fish tank, she noticed that the surface of the water looked like a mirror and she could see the reflection of the fish in it.

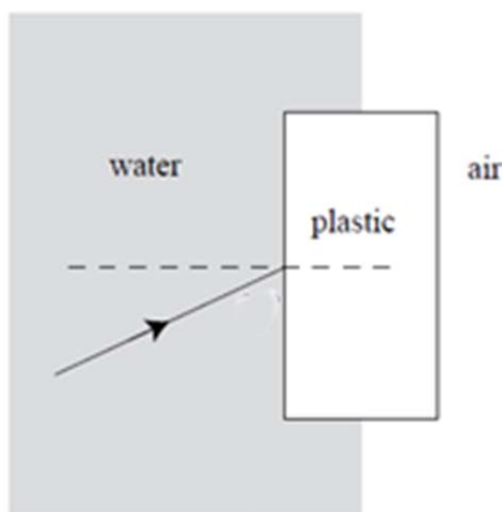


- Explain concisely, using physics principles, the conditions that are required for the rays of light from the fish to reflect off the water / air boundary (interface).
- Calculate the critical angle of the water / air interface. Express your answer to the correct number of significant figures. (The refractive index of water is 1.33).

(Note: It has been assumed that you remember that the refractive index of air = 1.00)

QUESTION TWO (2005;2)

Robbie and Amy decide to practise their underwater swimming. They are both wearing swimming goggles. The diagram below shows a ray of light entering the transparent plastic goggles. The refractive index of plastic is 1.5. The refractive index of air is 1.00.



- State the meaning of the term "critical angle".
- Calculate the critical angle for the plastic/air interface.

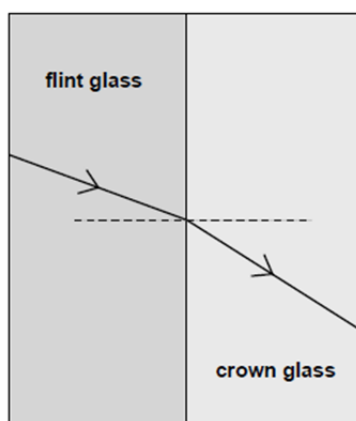
- (c) A short time later, Robbie and Amy are in the pool, swimming under water. Amy notices that when she looks forwards, she can see Robbie, but she can also see a reflected image of him. Draw TWO rays to show how Robbie's image is formed. Draw Robbie's reflected image in the correct place.



REFRACTION (2004;3)

Lee is a keen astronomer. He discovers that good telescope lenses are often made of two types of glass of different refractive index cemented together.

The diagram shows the path of a ray of light as it travels through two such pieces of glass.



Refractive index of crown glass	= 1.52
Refractive index of flint glass	= 1.66
Speed of light in crown glass	= $1.974 \times 10^8 \text{ ms}^{-1}$
Angle of incidence in flint glass	= 19.8°

- Calculate the size of the critical angle for the flint glass/crown glass boundary.
- Give a detailed explanation of what is meant by the phrase 'the critical angle for the flint glass/crown glass boundary'.