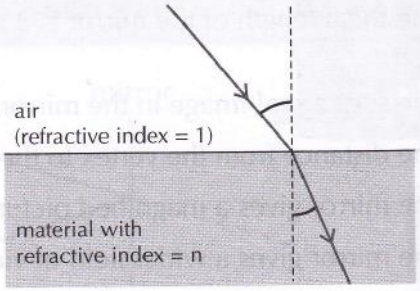
1

Here is a diagram of a ray of light entering a material with **refractive index n**.



a) Label the following parts of the diagram:

Incident ray **Normal line** **Refracted ray**

Angle of incidence, i **Angle of refraction, r**

b) Snell's law relates the refractive index, **n** to the two angles **i** and **r**. Write down Snell's law.

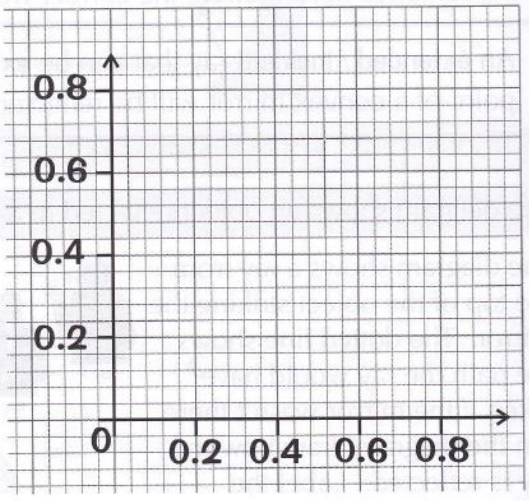
2

A light ray was shone from air into some water. The ray had an **angle of incidence** of **30°** and an **angle of refraction** of **22°**. Use this data to calculate the **refractive index** of water.

3

A student was investigating the refractive index of a transparent material. She shone yellow light at various **angles of incidence (i)** and measured the **angles of refraction (r)**. She then filled in the table below:

i	r	sin i	sin r
10.0°	8.3°		
20.0°	16.4°		
30.0°	24.8°		
40.0°	32.3°		
50.0°	39.8°		
60.0°	46.2°		



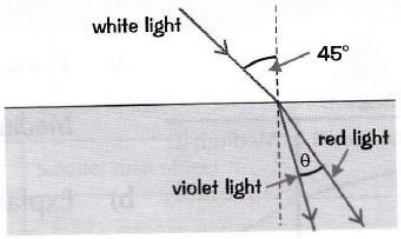
a) **Complete** the table and then draw a graph of **sin r** on the **y-axis** against **sin i** on the **x-axis**.

b) Explain why the **gradient** of the graph = **1/n**, where n is the refractive index of the material.

c) Use your graph to calculate the refractive index of the material for yellow light.

4

The diagram shows **white light** undergoing dispersion when it refracts from **air** into **glass**.



a) The refractive index in glass for red light is 1.514.
Calculate the **angle of refraction** for red light.

b) The refractive index in glass for violet light is 1.528.
What does this tell you about the **speed** of **violet** light in glass compared to **red** light?

c) Calculate the angle θ shown in the diagram.

5

Light passes through the acrylic bottom of a boat into the water below.
For blue light, the refractive index of **acrylic** is **1.498** (to 4 significant figures) and the refractive index of **water** is **1.337** (to 4 significant figures).

a) i) What happens to the **speed** of the light as it passes into the water?

ii) Complete this sentence by underlining the correct option.

The angle of refraction is greater than / less than **the angle of incidence.**

b) If the angle of incidence were equal to the critical angle, what would the **angle** of **refraction** be?

c) What happens to light which enters the water at an angle **greater** than the critical angle?

d) Calculate the **critical angle** for the **acrylic to water** boundary for blue light, to the nearest degree.