

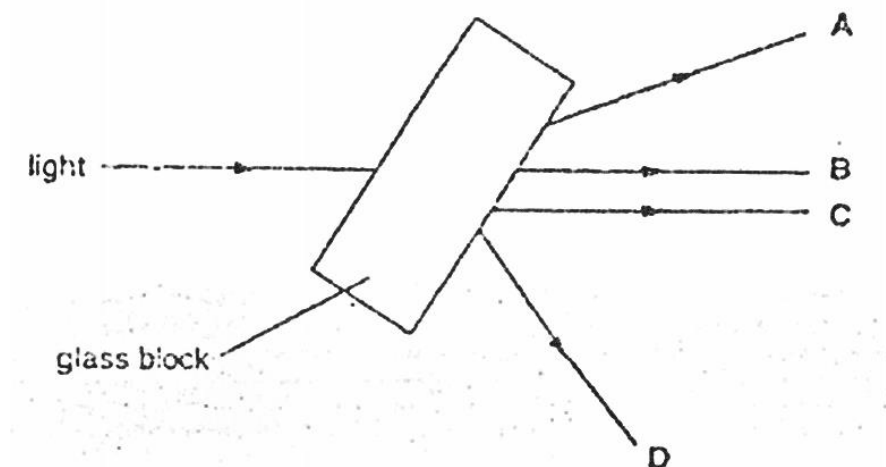


2.10: Refraction exercise (physics)

The following questions have been adapted from RI past-year MYCT papers or other sources.

PART A: MCQ QUESTIONS

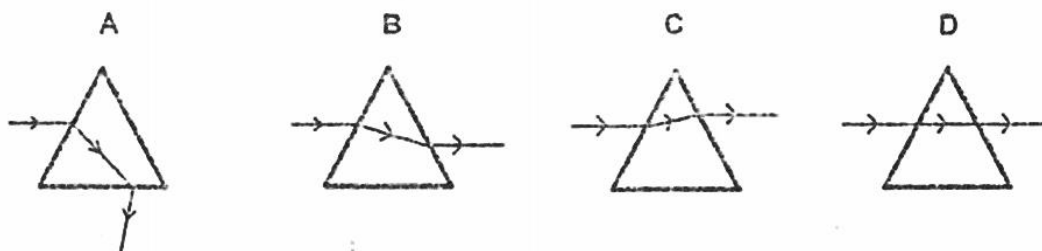
- Which ray shows the path of light after it has passed through the transparent glass block?



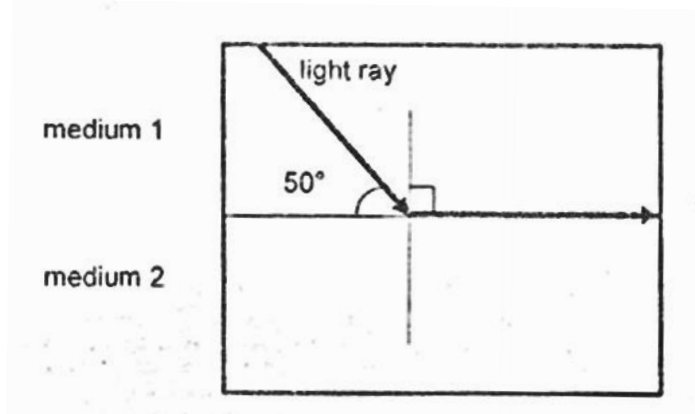
- The refractive index of paraffin oil is higher than that of water. What can you deduce about the speed of light in paraffin oil compared to water and the path of the light ray when it passes from paraffin oil to water?

	Speed of light	Path of light
A	Higher in paraffin oil	Bends away from normal
B	Higher in paraffin oil	Bends toward normal
C	Lower in paraffin oil	Bends away from normal
D	Lower in paraffin oil	Bends toward normal

- A ray of light travels from air into a glass block. Which diagram correctly shows the path of the light ray passing through the glass block?

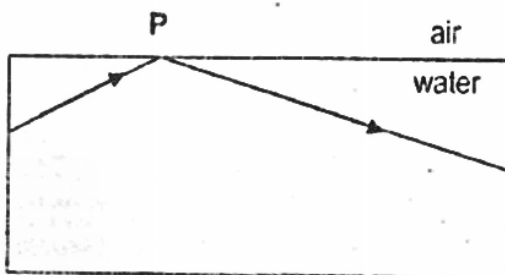


4. The diagram below shows a light ray entering medium 1. Both media are in the solid state.



Which one of the following statements is true?

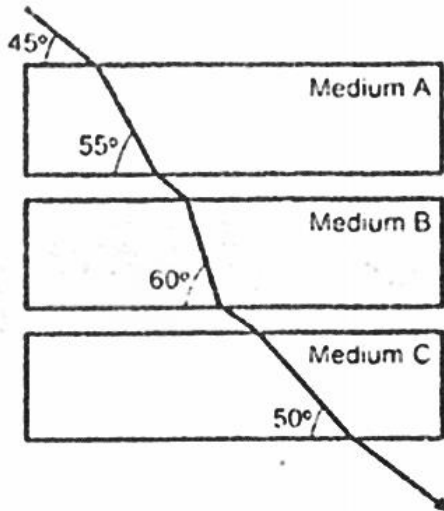
- A If the angle of incidence is increased, refraction occurs when light passes from medium 1 to medium 2.
 - B The critical angle at the boundary when the light ray passes from medium 1 to medium 2 is 50°
 - C The information provided is sufficient to calculate the refractive index of medium 1.
 - D The speed of light is lower in medium 1 than in medium 2.
5. The diagram shows a light ray from water incident upon the boundary between air and water at point P.



The phenomenon at point P is due to:

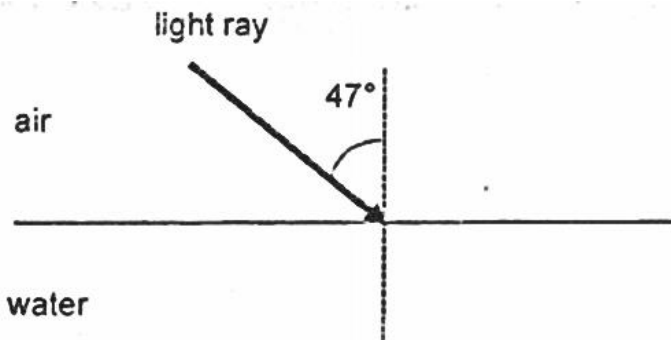
- A Refraction of light
- B Reversibility of light
- C Total internal reflection of light
- D Total internal refraction of light

6. A ray of light travelled through three transparent materials, from medium A to medium B and then through medium C. The angles formed between the ray of light and the surfaces of the three media are shown below.



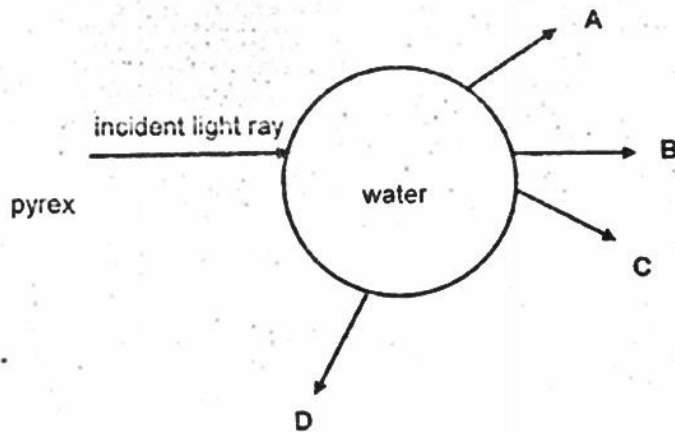
Which of the following statements is true?

- A Light travels slower in medium B than in medium C
 - B Medium B has a lower refractive index than medium A
 - C Medium C has the highest refractive index of the three media
 - D Light travels fastest in medium A as compared with media B and C
7. The diagram below shows a light ray entering a pool of water of refractive index 1.3. By how many degrees does the light ray change direction when it enters the pool of water?



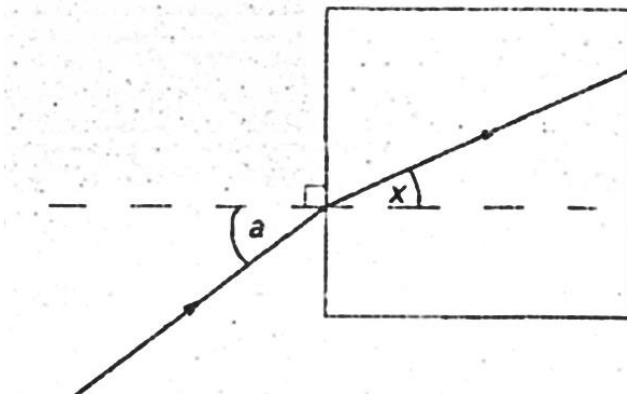
- A 13°
- B 25°
- C 34°
- D 72°

8. Pyrex has a refractive index of 1.5 while water has a refractive index of 1.3. Which of the following paths best shows how the incident light ray will behave, as it travels from pyrex into water and emerges back into the pyrex.



PART B: STRUCTURED QUESTIONS/CALCULATIONS

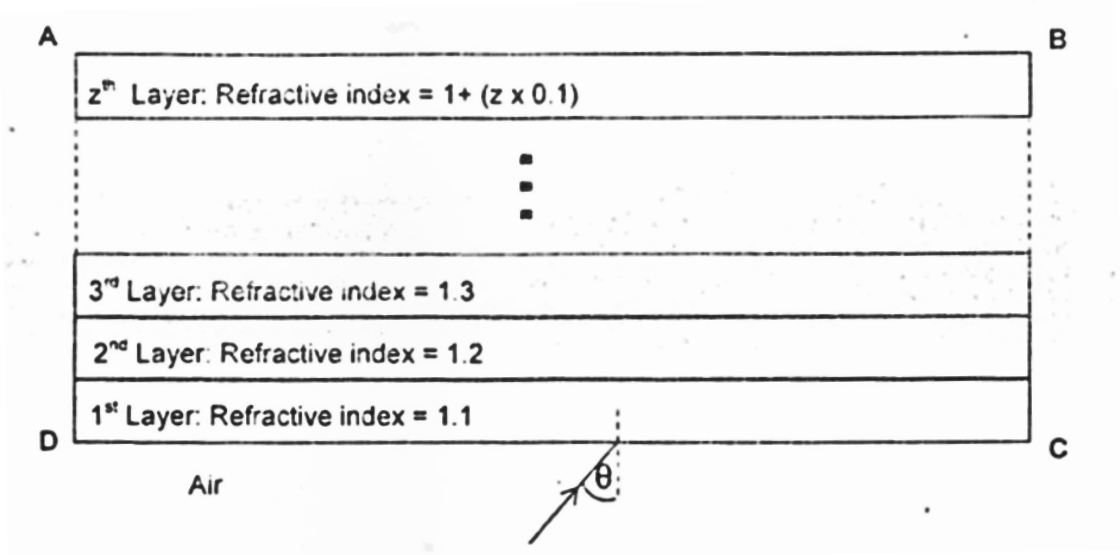
9. The figure below shows a ray of light passing through a transparent glass rectangular block (from air). Complete the table of data below for the same transparent glass block.



$a / ^\circ$	$x / ^\circ$	Refractive index of glass	Critical angle of glass / $^\circ$
60			35
	20		

10. The diagram below shows light ray entering a series of mediums that have their refractive indices according to the following equation.

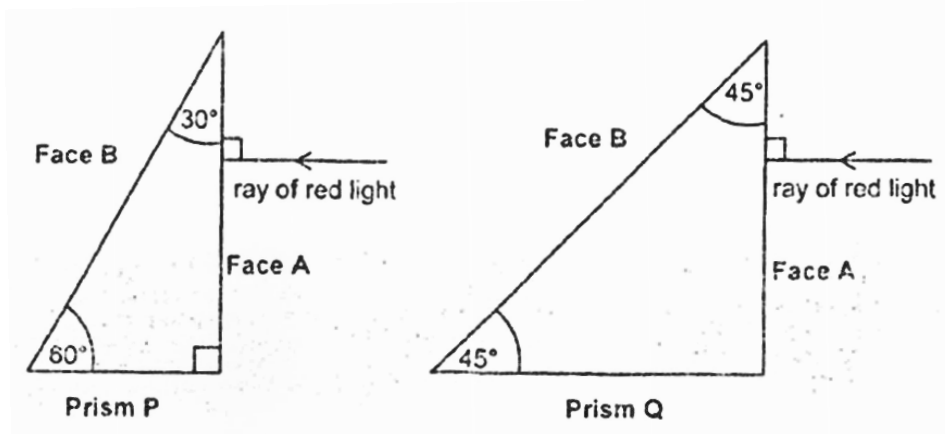
Refractive index = $1 + (z \times 0.1)$ where z refers to the position of the medium
 For example, the refractive indices of the first three layers are 1.1, 1.2 and 1.3 respectively.



What is the angle of refraction of the light ray in the 20th layer, given that $\theta = 70^\circ$?

Would the light ray in the above diagram ever leave the series of mediums from the side BC? Justify your answer

11. The 2 figures below show a ray of red light striking at the first boundary (labelled as Face A) between air and two right-angled glass prisms P and Q respectively.



Not shown in the diagram, the light ray incident upon Face A enters the prisms and strikes the second boundary (labelled as Face B) for both prisms P and Q. The critical angle of red light for both prisms P and Q is 42° . The speed of red light in air is 3×10^8 m/s.

Without carrying out any measurement, write down the values of the angles of incidence where the ray strikes Face B.

Angle of incidence at Face B for prism P: _____

Angle of incidence at Face B for prism Q: _____

Why does the ray only emerge from Face B for prism P but not prism Q?

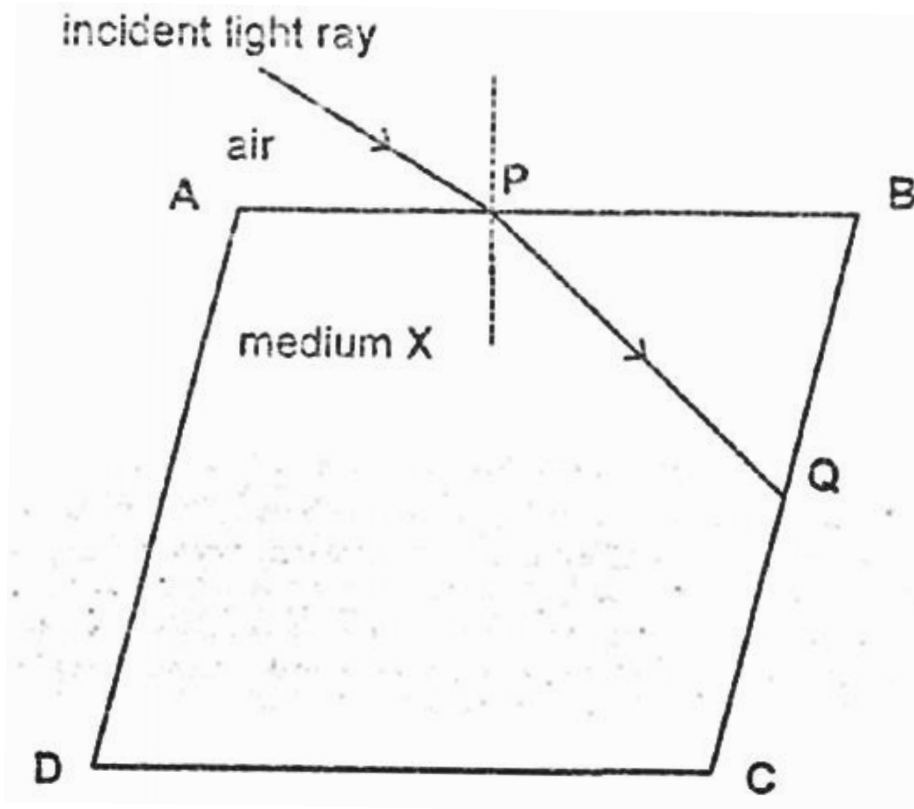
Calculate the refractive index of the glass.

Refractive index of glass = _____

Calculate the angle of refraction at Face B for prism P.

Angle of refraction = _____

12. A ray of light in air is incident on a transparent block ABCD of an unknown medium X, at point P, as shown in the figure below. (Figure is drawn to scale)



Measure the angle of incidence and refraction at point P. Record these values to the nearest whole number.

Angle of incidence = _____ Angle of refraction = _____

Calculate the refractive index of medium X. Assume that the refractive index of air is 1.0.

Refractive index = _____

Calculate the critical angle.

Critical angle = _____

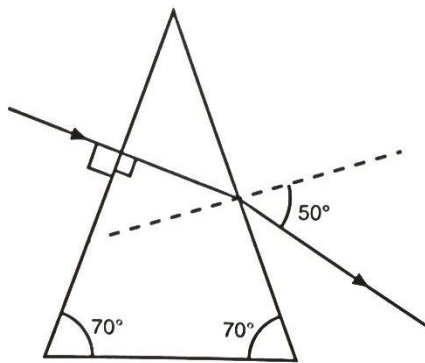
(please turn over)

State two conditions required for total internal reflection to take place.

Measure and label clearly the angle of the incident light ray at point Q in the above figure.

Draw as accurately as possible in the figure above how the predominant light ray subsequently emerges from the block to air. Measure and label all angles clearly. Show your workings clearly for any calculations.

13. *(Question adapted from Longman 'O' Level Physics Workout)*
 The diagram below (not drawn to scale) shows a ray of monochromatic light incident on a glass prism. The final refracted angle is 50° as shown.



Calculate the refractive index of this glass.

Refractive index = _____

Calculate the minimum angle of incidence for the ray to totally reflect internally as it strikes the boundary from glass to air.

Minimum angle = _____