

H1. This question is about the refraction of light.

The diagrams below show two different situations in which a monochromatic ray of light is incident on the boundary between two surfaces. In **Diagram 1** the boundary is between air and glass and in **Diagram 2** the boundary is between water and glass.

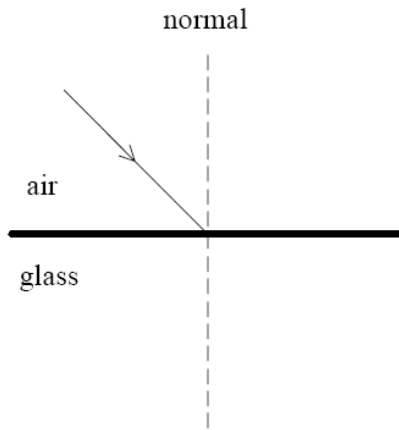


Diagram 1

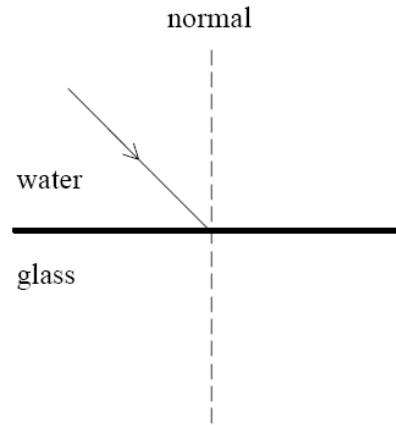


Diagram 2

The refractive index of glass is greater than that of water.

- (a) On each diagram sketch the reflected and refracted rays. [3]
- (b) The refractive index for glass is 1.5 and for water 1.3. Calculate the critical angle for the glass-water boundary. [1]

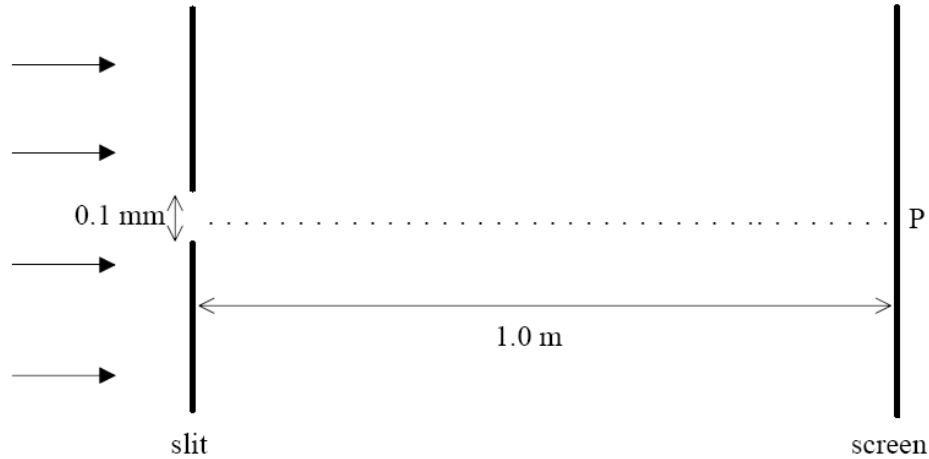
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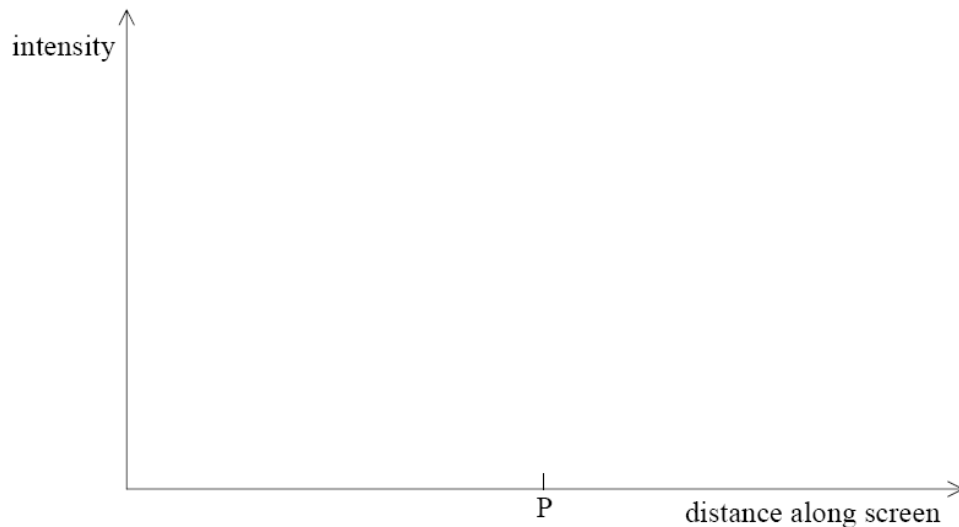
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H2. *This question is about diffraction.*

In the diagram below (not to scale) a monochromatic beam of light of wavelength 500 nm is incident on a single slit of width 0.1 mm. After passing through the slit the light is brought to a focus (the focusing lens is not shown) on a screen placed at a distance of 1.0 m from the slit.



- (a) On the axes below sketch a diagram showing how the intensity of the light varies at different points along the screen. (*Note that this is a sketch graph; no values are required.*) [3]



- (b) Calculate the width of the central maxima. [3]

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H4. *This question is about optical resolution*

Abigail looks at a particular star with her naked eye and she sees the star as a point of light. When she looks at the star through a telescope she sees that there are two points of light. The star Abigail is looking at is actually two stars close together.

(a) Explain, assuming that Abigail's eyes are functioning normally,

(i) why she is unable to distinguish the two stars with her naked eye. [3]

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(ii) how the telescope enables her to distinguish the two stars. [2]

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(b) The system that Abigail is observing is 4.2×10^{16} m from the Earth and the two stars are separated by a distance of 2.6×10^{11} m. Assuming that the average wavelength of the light emitted by the stars is 500 nm, estimate the minimum diameter of the objective lens of a telescope that will just enable the two stars to be distinguished. [3]

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