N07 HL3

H1. This question is about refraction.

(a) Define *refractive index*.

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(b) In a certain medium, the speed of light of a particular frequency is $2.1 \times 10^8 \text{ m s}^{-1}$. Calculate the refractive index of the medium for this frequency.

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(c) With reference to your answer in (b), describe what is meant by optical dispersion.

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H2. This question is about image formation by a plane mirror.

(a) State the **two** laws of reflection of light.

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2. . . . . .

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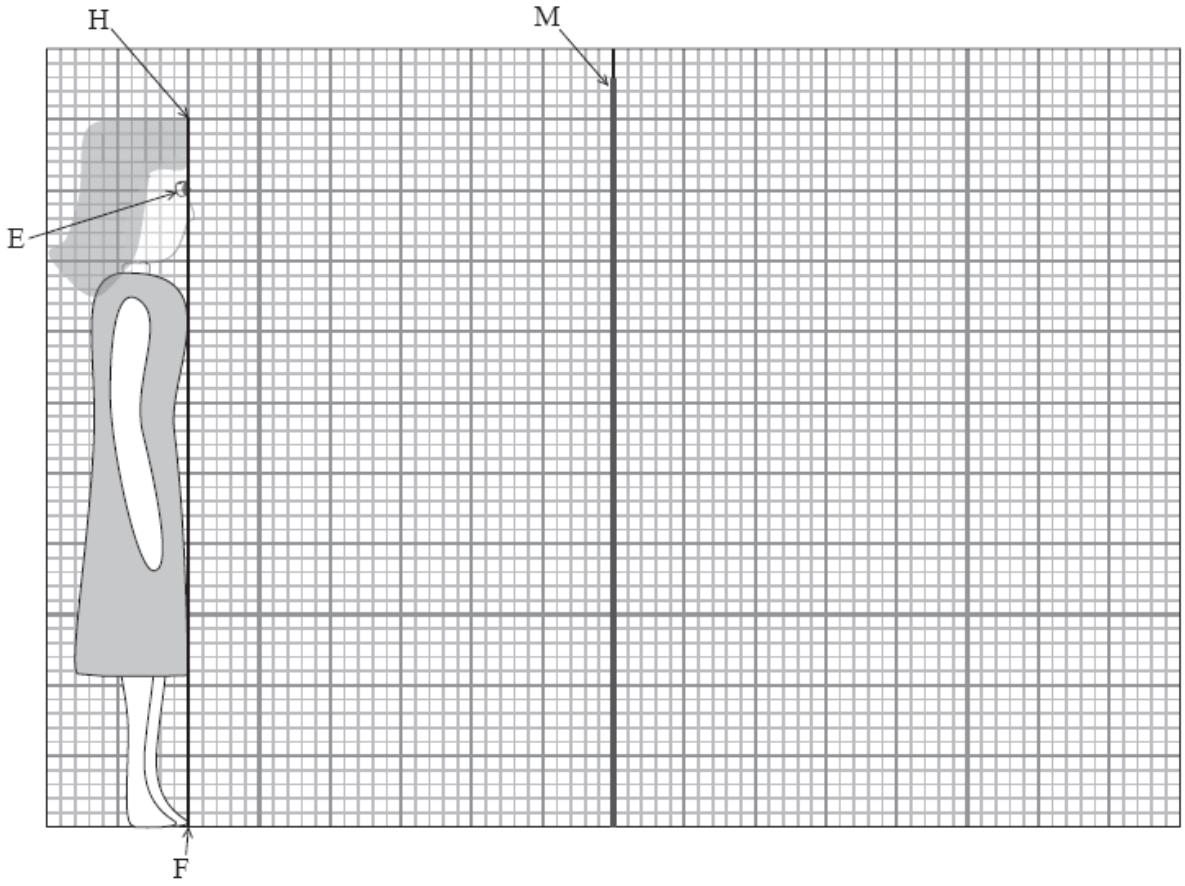
(b) In the diagram below, the line labelled HF represents a person standing in front of a vertical mirror labelled *M*. The position of the person's eye is labelled E.



On the diagram above draw

(i) the position of the image of the person, formed by the mirror.

(ii) a ray from the foot F, and a ray from the top of the head H, to show the reflection of these rays into the eye E.

(c) The height of the person is 1.50 m and her eye is 1.35 m above the floor. The length and height of the mirror above the floor are adjusted so that she can just see the whole of her image in the mirror.

By reference to your ray diagram in (b)(ii), deduce

(i) the minimum length of the mirror.

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(ii) the height of the lower edge of the mirror above the floor.

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(d) The person now stands further away from the mirror. State the effect, if any, that this has to your answers in (c)(i) and (ii).

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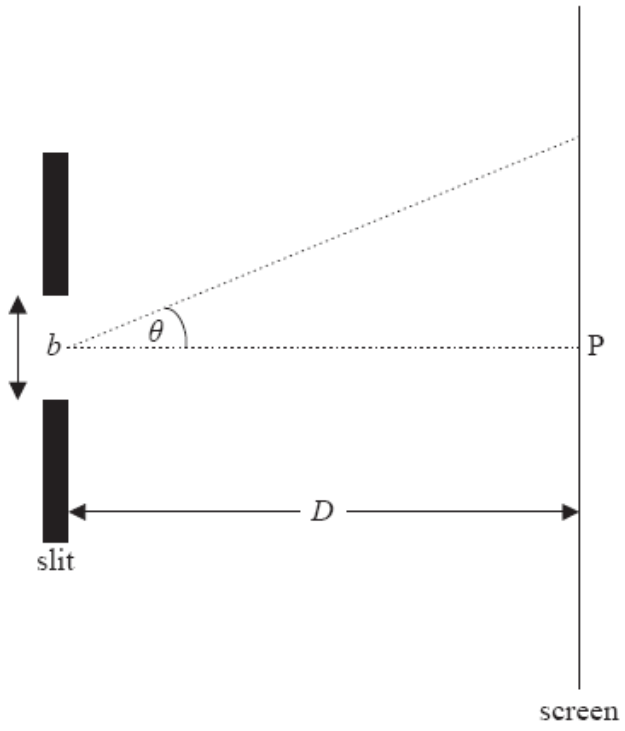
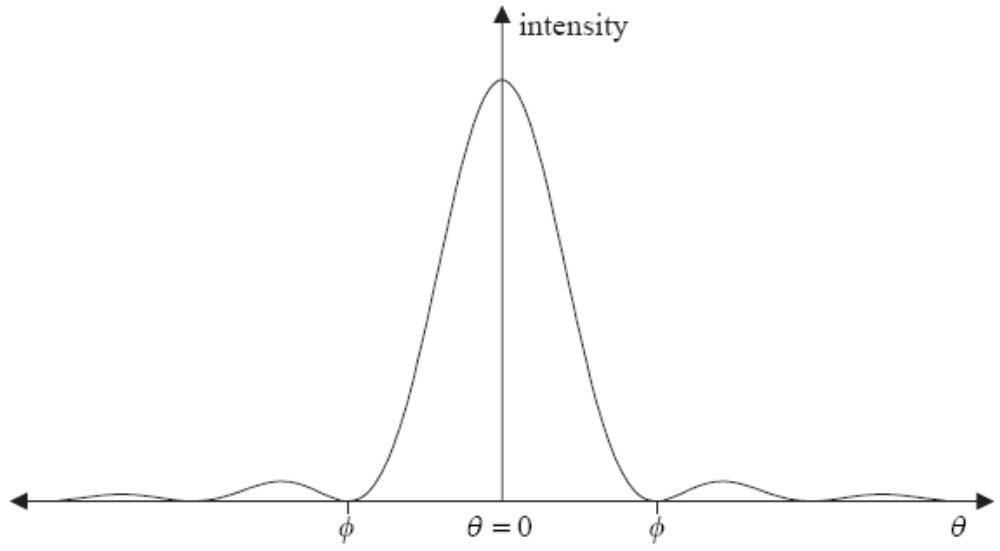
H4. This question is about diffraction.

Plane wavefronts of monochromatic light of wavelength λ are incident on a rectangular slit of width b. After passing through the slit, the light is brought to a focus on a screen distance D from the slit as shown below. The width of the slit is comparable to the wavelength of the incident light and $b \ll D$. The point P on the screen is opposite the centre of the slit.



The sketch graph below shows that the variation with angle θ of the intensity of the light on the screen.



(a) Explain qualitatively, this intensity distribution.

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(b) The angle $\theta = \phi$ is the angular half-width of the central maximum of the intensity distribution and is given by the expression $\phi = \frac{\lambda}{b}$. Derive an expression in terms of D, λ and b for the half-width d of the central maximum.

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(c) The single slit is replaced by two rectangular slits of width b. The distance between the centre of the slits is equal to $2b$.

On the axes below, draw a sketch of the of the intensity distribution on the screen. (The intensity distribution of a single slit is shown by the dotted line.)