2021 Sec 3 Physics Assignment 3.1

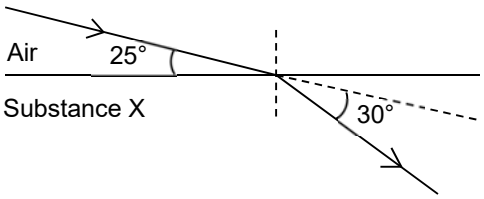
Refraction

15

Name: Answers ( ) Class: 3/ ___ Date: _____

1 The diagram shows the path of a ray of light travelling from air into a substance X.

(a) Determine the angle of incidence and the angle of refraction r.



i = 65°

r = 35°

(b) What is the refractive index of the substance X?

$$n_{air} \sin\theta_{air} = n_X \sin\theta_X$$
$$(1.00) \sin 65° = n_X \sin 35°$$
$$n_X = \frac{\sin 65°}{\sin 35°} = 1.58 \quad \text{(3 s.f.)}$$

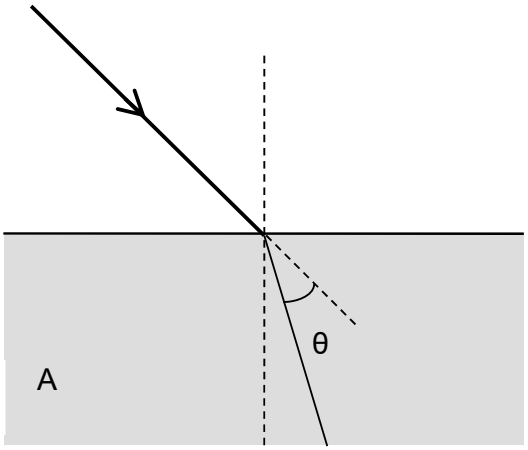
Refractive index of X = 1.58

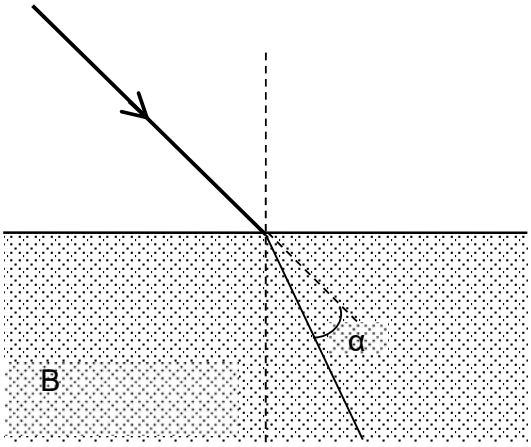
2 Two substances A and B have refractive indices of 1.90 and 1.25 respectively.

(a) For a light ray travelling from air into each substance,
(i) measure the angles of incidence and
(ii) calculate the angles of refraction. [2]

(b) Construct the refracted rays and label the angles of incidence and refraction below. [1]

i = 45° r = 22° i = 45° r = 34°



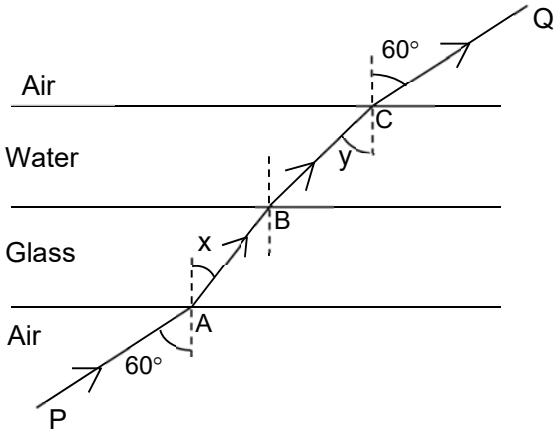


(c) Based on your calculations above, which substance would cause light to refract more? Explain your answers clearly.

In A, the change in direction for the ray, θ, is greater than that for B, α, for the same angle of incidence. Therefore, A causes light to refract more.

[2]

3 The diagram below shows a horizontal slab of glass of uniform thickness with a layer of water above it. A ray of light PQ is incident upwards on the lower surface of the glass and is refracted successively at A, B and C, the points where it crosses the interfaces.



Given that the refractive index of glass is 1.52 and that of water is 1.35, calculate:

(a) angle x

Consider point A,

$$n_{air} \sin 60° = n_{glass} \sin x$$

$$(1.00) \sin 60° = (1.52) \sin x$$

$$\sin x = \frac{\sin 60°}{1.52} \qquad x = 34.7°$$

x = 34.7°

[2]

(b) angle y

Consider point C,

$$n_{air} \sin 60° = n_{water} \sin y$$

$$(1.00) \sin 60° = (1.35) \sin y$$

$$\sin y = \frac{\sin 60°}{1.35} \qquad y = 39.9°$$

y = 39.9° [2]

4 Construct cones of light to show how the eye E_1 sees the image P_1 and eye E_2 sees the image P_2 of a point P under the glass block. [4]