

Physics 200 (Stapleton)
Optics Practice Quiz

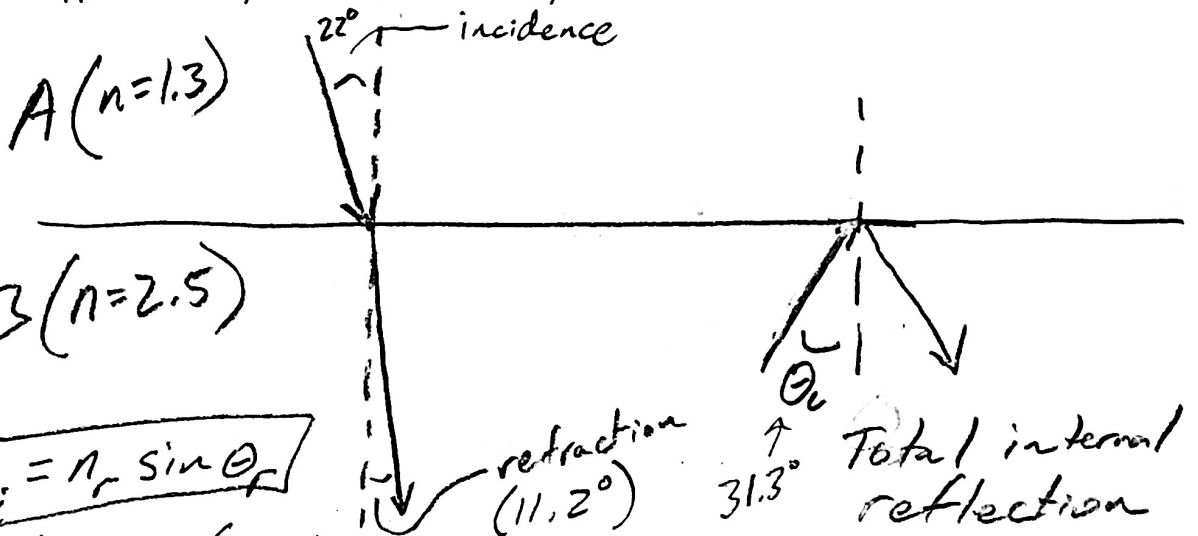
Name: Key

1. Substance A ($n = 1.3$) is separated from substance B ($n = 2.5$) by a flat plane. A ray of light travels from substance A to substance B, meeting the planar boundary between the substances at a 22° angle of incidence.

$$n_1 \sin \theta_i = n_2 \sin \theta_r \quad \theta_c = \sin^{-1} \left(\frac{n_2}{n_1} \right)$$

$$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i} \quad M = \frac{h_i}{h_o} = \frac{-d_i}{d_o}$$

- Sketch a simple diagram showing the ray refracting as it travels from substance A to substance B.
- On your sketch, label the normal, the angle of incidence, and the angle of refraction. Calculate the angle of refraction and add that number to your diagram.
- On another part of your diagram (or in a new diagram) show a ray of light with an angle of incidence equal to its critical angle. Calculate and label the critical angle, . Draw what happens to the ray when it hits the boundary between the two substances.



$$n_i \sin \theta_i = n_r \sin \theta_r$$

$$1.3 (\sin 22^\circ) = 2.5 (\sin \theta_r)$$

$$0.195 = \sin \theta_r$$

$$\sin^{-1}(0.195) = \theta_r$$

$$\theta_r = 11.23^\circ$$

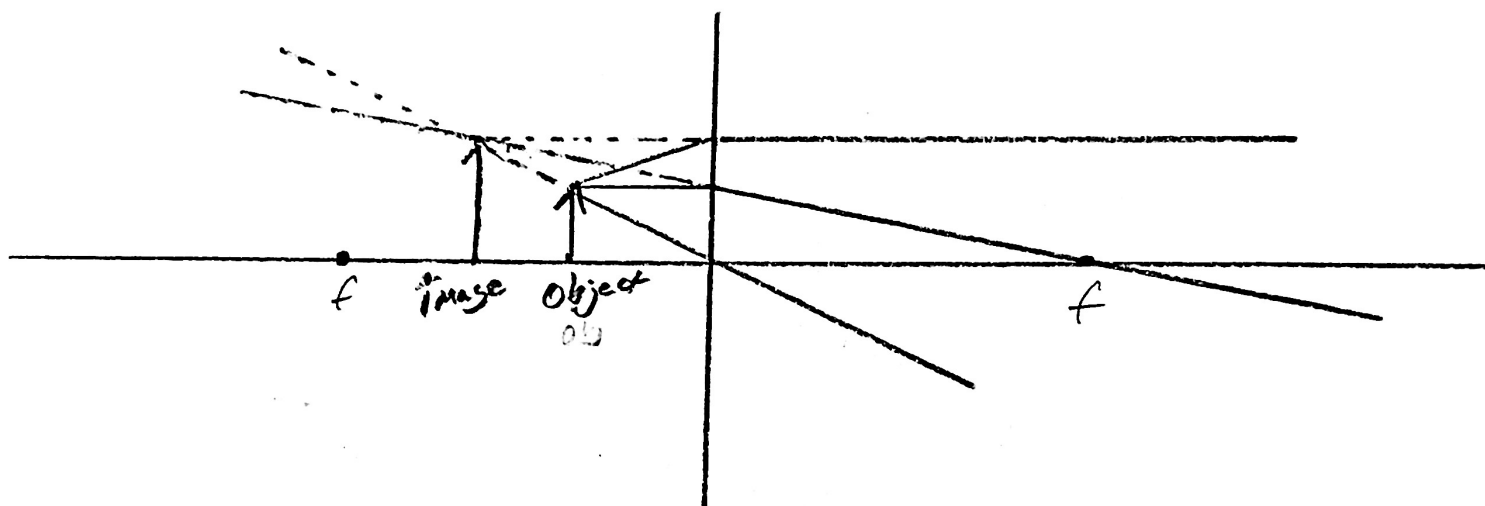
Total internal reflection only occurs when light travels from greater n to lesser n , (B to A)

$$\theta_c = \sin^{-1} \left(\frac{n_r}{n_i} \right)$$

$$\theta_c = \sin^{-1} \left(\frac{1.3}{2.5} \right)$$

$$\theta_c = 31.3^\circ$$

2. A thin convex lens has a focal length of ⁵~~2~~ cm. An object ¹~~2~~ cm tall is placed on the lens' principal axis, at a distance of 2 cm from the center of the lens.
- Is the object's image real or virtual?
 - Is the image upright or inverted?
 - What is the distance of the image from the lens? *3.3 cm (same side as object)*
 - What is the height of the image? *1.7 cm*
 - What is the magnification (M) of the object in this situation? *1.7*
 - Draw a ray diagram to confirm your answers.



3. The same object (5 cm tall) is placed on the principal axis of the same convex lens ($f=2$ cm), but this time the object is placed at a distance of ³~~40~~ cm from the center of the lens.
- Is the object's image real or virtual? *12*
 - Is the image upright or inverted?
 - What is the distance of the image from the lens? *4.5 cm (opposite side of lens)*
 - What is the height of the image? *-0.5 cm*
 - What is the magnification (M) of the object in this situation? *-0.5*
 - Draw a ray diagram to confirm your answers.

