Worksheet: Critical Angle for Total Internal Reflection

Q1: Which of the following formulas correctly shows the relation between the critical angle for total internal reflection θ_c for a light ray, the refractive index n_i of the substance the light is propagating in, and the refractive index n_r of the substance when the light is reflected from its surface?

A $\theta_c = \sin\left(\frac{n_r}{n_i}\right)$

B $\sin\theta_c = \sin\left(\frac{n_r}{n_i}\right)$

C $\sin\theta_c = \frac{n_i}{n_r}$

D $\sin\theta_c = \frac{n_r}{n_i}$

E $\theta_c = \frac{n_r}{n_i}$

Q2: What is the critical angle for a light ray traveling in water with a refractive index of 1.33 that is incident on the surface of water above which air is with a refractive index of 1.00? Answer to the nearest degree.

A 90°

B 49°

C 37°

D 41°

E 53°

Q3: What is the critical angle for a light raytraveling in water with a refractive index of 1.33 that is incident on thesurface of water above which ice is with a refractive index of 1.31? Answer to the nearest degree.

A 90°

B 37°

C 9.9°

D 45°

E 80°

Q4: Light rays travel through kerosene. A layer of water thathas a refractive index of 1.33 floats on the surface of the kerosene. Lightrays that are incident on the interface of kerosene and water at angles of 16.9° fromthe surface or less are totally internally reflected. What is the refractiveindex of the kerosene? Answer to three significant figures.

A 1.27

B 3.64

C 4.58

D 1.39

E 2.57

Q5: The critical angle required for total internal reflection at a boundary between two substances is 30°. The refractive index of themedium that light is reflected from is 1.1. What is the difference between the refractive index of the medium from which the light is reflected and the refractiveindex of the medium in which the light propagates before it is reflected?

A 1.1

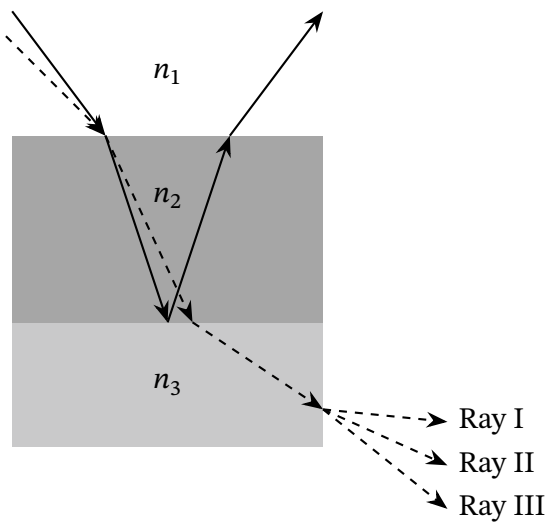
B 1.9

C 2.2

D 4.4

E 2.5

Q6: Light rays take the paths shown in the diagram between substances with refractive indexes n_1, n_2, and n_3. Three pathsare shown for the hypothetical rays—ray I, ray II, and ray III—that emergefrom the substance with the refractive index n_3 into the substance with the refractive index n_1.



Which of n_1, n_2, and n_3 is the largest refractive index?

A n_3

B n_1

C n_2

Which of n_1, n_2, and n_3 is the smallest refractive index?

A n_2

B n_1

C n_3

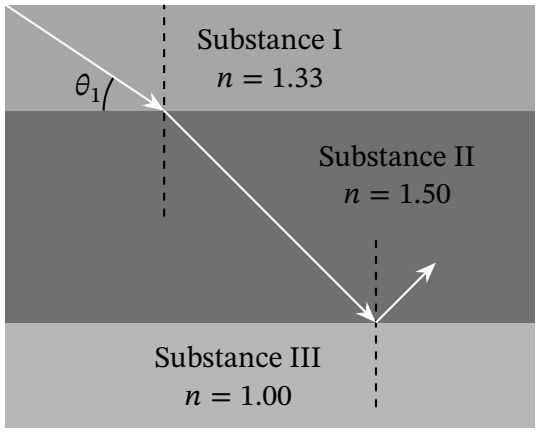
Which of ray I, ray II, and ray III correctly shows the path that light wouldtake?

A Ray III

B Ray II

C Ray I

Q7: The diagram shows a light ray that is transmitted from substance I to substance II at angle θ_1 to the boundary between thesubstances. The ray is totally internally reflected back into substance II atthe boundary to substance III. For any angle of θ greater than θ_1,the light ray is transmitted to substance III. Find the angle θ_1 tothe nearest degree.



A 28°

B 34°

C 41°

D 49°

E 57°