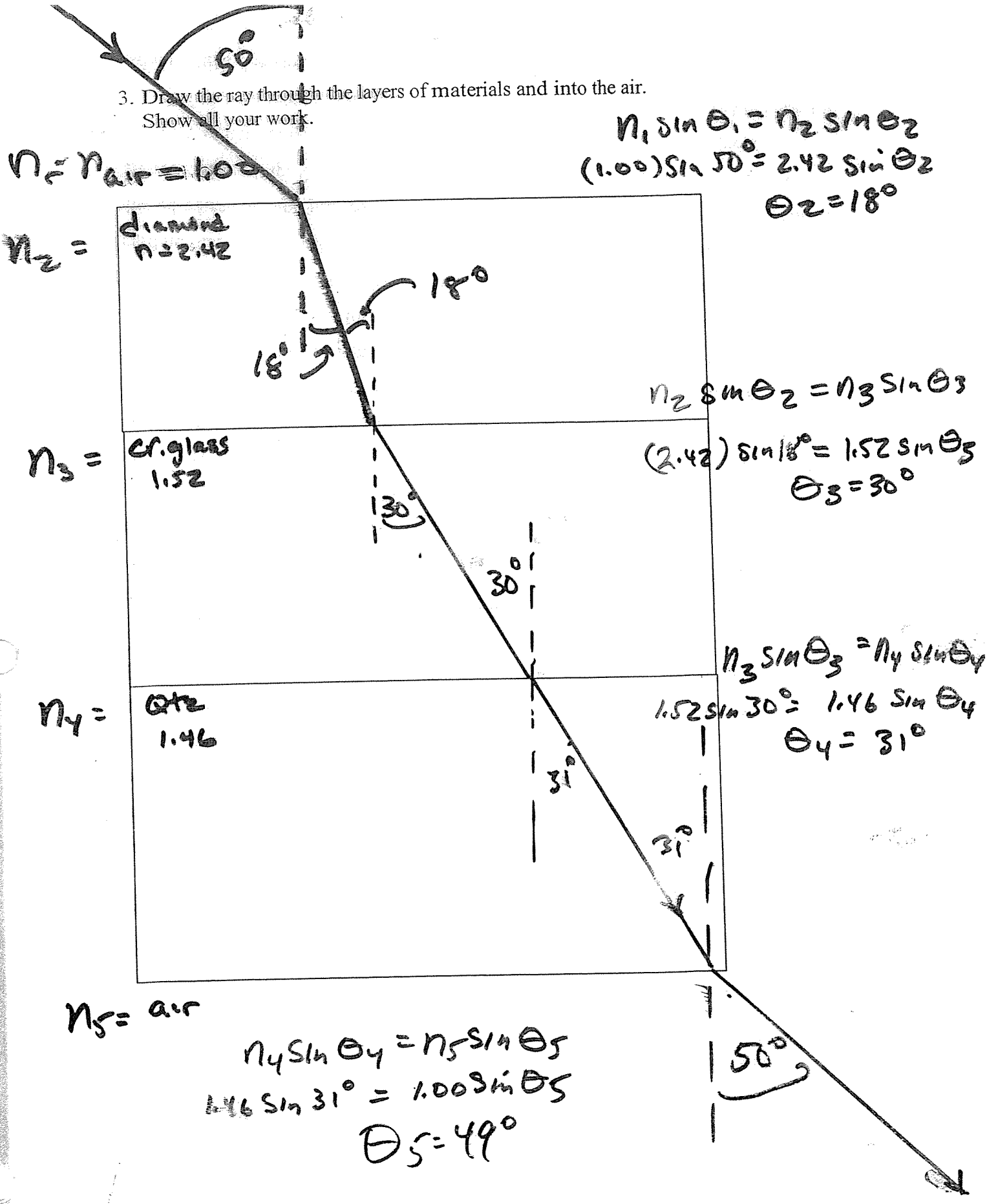
3. Draw the ray through the layers of materials and into the air.
Show all your work.



$n_1 \sin\theta_1 = n_2 \sin\theta_2$

$(1.00)\sin 50° = 2.42 \sin\theta_2$

$\theta_2 = 18°$

$n_2 \sin\theta_2 = n_3 \sin\theta_3$

$(2.42)\sin 18° = 1.52 \sin\theta_3$

$\theta_3 = 30°$

$n_3 \sin\theta_3 = n_4 \sin\theta_4$

$1.52 \sin 30° = 1.46 \sin\theta_4$

$\theta_4 = 31°$

$n_4 \sin\theta_4 = n_5 \sin\theta_5$

$1.46 \sin 31° = 1.00 \sin\theta_5$

$\theta_5 = 49°$

Light

REFRACTION

UNITS!

Name: Perle

Date: 1 Aug

31

1. Light travels through an unknown transparent substance at a speed of 2.15×10^8 m/s. What is the index of refraction of the substance?

$n = \frac{c}{v} = \frac{3 \times 10^8 \text{ m/s}}{2.15 \times 10^8 \text{ m/s}} = 1.39$

$n =$ ~~1.39~~ 1.4

2. At what speed does light travel through a diamond?

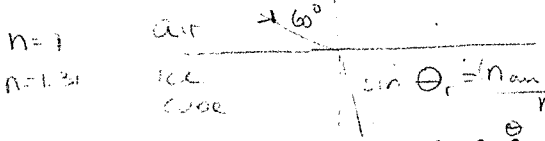
$n = \frac{c}{v}$

$v = \frac{c}{n} = \frac{3 \times 10^8 \text{ m/s}}{2.42} = 1.24 \times 10^8$

$v = 1.24 \times 10^8$ m/s

($v_{\text{Light in ice}} = 2.29 \times 10^8$ m/s)

3. a. A ray of light traveling in air enters a clear ice cube with an angle of incidence of 60.0°. What is the angle of refraction?

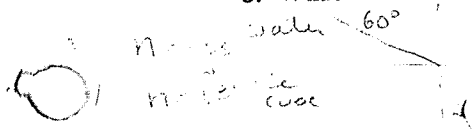


$\sin\theta_r = \frac{n_{air}(\sin 60°)}{n_{ice}} = \frac{1 \times \sin 60°}{1.31} = .66$

$\theta_r = 41°$

$\theta_2 = 41°$

b. What would be the angle of refraction if the ray were traveling in water when it reached the ice cube?

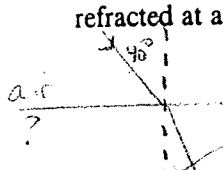


$\sin\theta_r = \frac{(n_{water})(\sin 60°)}{n_{ice}} = \frac{(1.33)(\sin 60°)}{1.31} = .88$

$\theta_r = 62°$

$\theta_2 = 62°$

4. A ray of light traveling in air enters a transparent substance with an angle of incidence of 40°. It is refracted at an angle of 25°. How fast does the light travel through the substance?



$n_{air}(\sin 40°) = (n_{sub})(\sin 25°)$

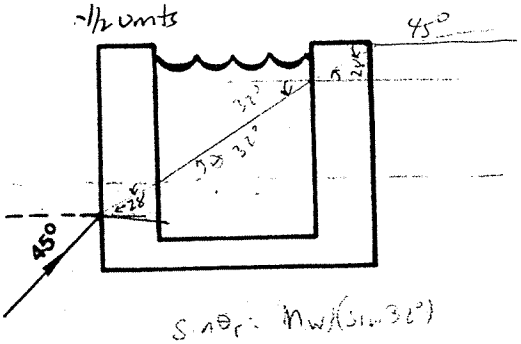
$1.52 \quad n_{sub}$

$V = \frac{3 \times 10^8 \text{ m/s}}{1.52} =$

$v = 1.97 \times 10^8$ m/s

5. A ray of light traveling in air enters a square container made of crown glass and filled with water. It strikes the container at an angle of incidence of 45°. (See drawing at right.)

-1/2 units



a. Trace the light ray through the container, water, container, and back into the air. -1 if not complete.

b. What is the angle of refraction as the light ray goes from the glass wall *into* the water? -2 if incorrect.

$\theta_r = n_{air}\sin\theta_i$

$= \frac{n_{cg}(1.00)(\sin 45°)}{1.52}$

$= .47$

$\theta_r = 28°$

θ_i (crown to water) $= 28°$

$\sin\theta_r = n_{cg}\sin 28° = .537$

$= \frac{(1.52)\sin 28°}{1.33}$

$= 32$

$\sin\theta_r = \frac{n_w(\sin 32°)}{n_{cg}}$

$= \frac{(1.33)\sin 32°}{1.52}$

$\theta_r = 28$

$\sin\theta_r = \frac{n_{cg}\sin 28°}{n_{air}} = .71$

$\theta_r = 45.5°$

Table of Index of Refraction

SUBSTANCE	n
crown glass	1.52
water	1.33
air	1.00
ice	1.31
diamond	2.42

Name: _____ Date: _____

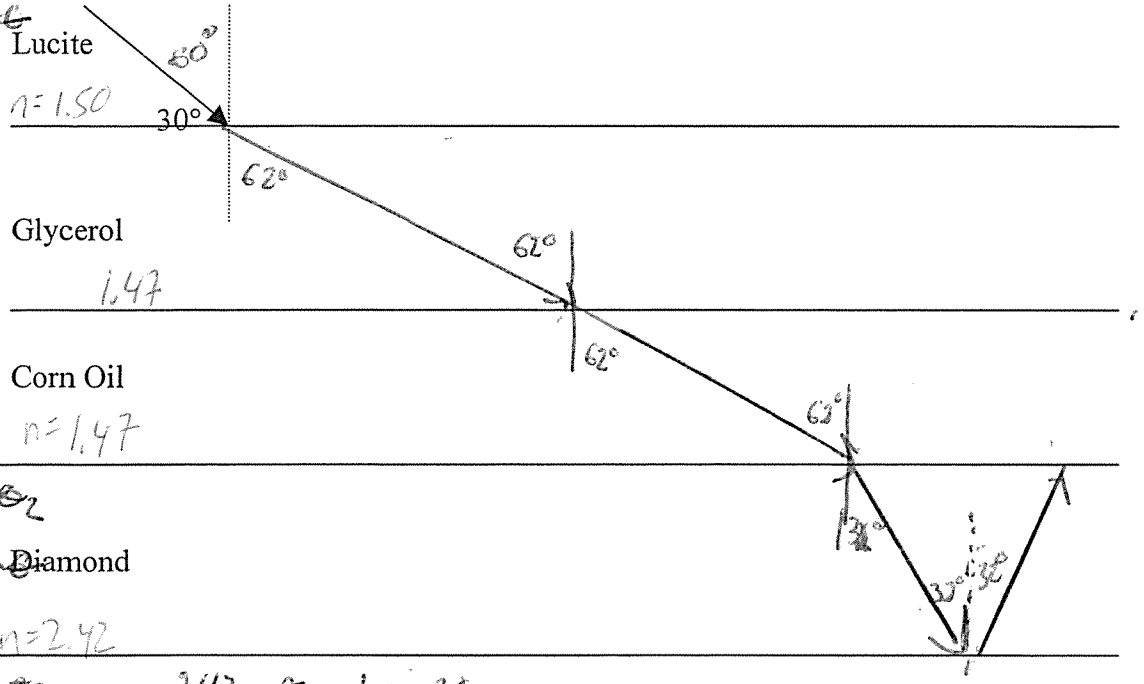
Physics: Refraction through Several Surfaces

1. Using a protractor, draw the refracted rays as they move through different layers of material.

$n_1 \sin\theta_1 = n_2 \sin\theta_2$

$1.5 \sin 60 = 1.47 \sin\theta$

$\sin\theta = .8837$



$n_1 \sin\theta_1 = n_2 \sin\theta_2$

$1.47 \sin 62 = 2.42 \sin\theta_2$

$n_1 \sin\theta_1 = n_2 \sin\theta_2$

$2.42 \sin 32 = 1 \sin\theta$ Air $n=1$

$2.42 \sin\theta = 1 \sin 90$

Critical Angle = 24.4°

2. A light ray strikes a triangular shaped diamond. The light is coming from water into diamond. Show the path the light ray with travel with angle measures.

Critical Angle

$\sin\theta = \frac{1}{2.42} \sin 90$

$\frac{1.33}{2.42}$

33°