

# Chapter K - Problems

Blinn College - Physics 2426 - Terry Honan

## Problem K.1

A He-Ne (helium-neon) laser has a wavelength of 632.8 nm. If this is shot at an incident angle of  $55^\circ$  into a glass block with index  $n = 1.52$  then

- (a) what is the frequency of this light,
- (b) what is the speed of the light in the glass,
- (c) what is the wavelength of the light in the glass and
- (d) what is the angle the beam makes from the normal to the surface when inside the glass?

## Problem K.2

When under water a swimmer sees the sun make a  $50^\circ$  angle from the surface. What is the true angle of the sun above the water's surface?

## Problem K.3

What is the critical angle for total internal reflection for a fiber optic tube with index 1.40? If the tube is submerged in water then what is the critical angle?

## Problem K.4

Consider a clear thick flat horizontal surface with a small imperfection 1.10 cm below the surface. When a penny is placed directly over the imperfection it cannot be seen at all but when a dime is placed over the imperfection it can be seen by viewing from an angle. What does this imply about the index of refraction of the plastic? A dime has a radius of 0.875 cm and a penny has a 0.950 cm.

## Problem K.5

The indices of refraction of red and violet light in a glass prism are 1.51 and 1.53, respectively. Suppose the prism has an apex angle of  $55^\circ$  and the light is incident at  $40^\circ$ . What is the total angle of deflection for red, for violet and what is the total angle of dispersion?

## Problem K.6

The minimum angle of deviation when a light beam is shot through a prism with a  $45^\circ$  apex angle is  $31^\circ$ . What is the index of refraction for the prism?

### Problem K.7

Consider a convex mirror with a 40 cm radius.

- (a) If an object is 30 cm from the mirror then where is the image and what is its magnification?
- (b) Repeat (a) if the object is 60 cm from the mirror.

### Problem K.8

A concave mirror has a 60 cm radius.

- (a) If a 5 cm high object is placed 90 cm from the mirror then where is the image and what is its height?
- (b) Repeat (a) if the same object is placed 20 cm from the mirror.
- (c) Trace the rays for both cases.

### Problem K.9

When an object is 30 cm away from a spherical mirror an image is created that is inverted and four times larger than the object. What is the radius of the mirror? Is it concave or convex? Trace the rays for this arrangement.

### Problem K.10

A concave make-up mirror has a radius  $R$ . To create an upright image that is four times larger than the object, where must the object be placed?

### Problem K.11

Arctic explorers see a frozen animal that is 50 cm below the surface of a glacier. How far below the surface does the animal appear when viewed from directly above? The index of refraction of ice is 1.31 .

### Problem K.12

A glass ( $n = 1.50$ ) sphere with a 15 cm radius has a small imperfection 5 cm above the center. When viewed from directly above where is the image? Is it above or below the surface

### Problem K.13

A goldfish is inside a spherical bowl with a 12 cm radius. Assume the glass of the bowl is thin so that the glass layer can be neglected. If a person views the bowl with his face at the same level as the center of the bowl and the goldfish is on the same radial line as the face. Where does the goldfish see the face if the face is 20 cm from the edge of the bowl? Where if the face is 5 cm from the bowl.

### Problem K.14

What is the focal length of a biconvex lens with surfaces of 10 cm and 15 cm radii, if the lens is made of a plastic material with  $n = 1.60$ ? Would this change if the lens is reversed?

### Problem K.15

When an object is placed 10 cm from a thin lens a virtual image is seen 15 cm from the lens. What is the focal length of the lens? What type of lens is it, converging or diverging?

### Problem K.16

A slide projector uses a converging lens to project a 35 mm wide slide to fill a 70 cm wide screen. If the distance from the slide to the screen is to be 6.3 m then where must the slide be placed and what focal length must the lens have?

### Problem K.17

An object is 20 cm from a diverging lens with  $f = -32$  cm. Where is the image and what is its magnification? Trace the rays for this arrangement.