Light & Optics

Name _____

Block _____

A. Light as a wave in the electromagnetic spectrum 22-5

1) You should be able to arrange the electromagnetic spectrum according to wavelength and frequency. Copy the chart on P 670 into you notes. You do not need to include numbers.

B. Measuring the Speed of Light 22-6

C. The ray model of light 23-1

D. Index of refraction 23-4

1) What is the index of refraction of a material? How do you calculate it?

2) Note the table or indicies of refraction on P 696. What is air_____ water_____ fused glass_____?

E. Refraction: Snell's Law 23-5

1) List Snell's law and describe it very carefully. (remember the soldiers)

1] A flashlight beam strikes the surface of a pane of glass (n=1.50) at an angle of 45 deg. What is the angle of refraction? (28.1 deg)

2] A diver shines a flashlight upward from beneath the water at a 28 deg angle to the vertical. At what angle does the light leave the water? (38.6 deg)

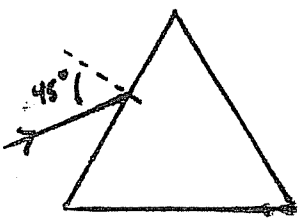
3] What is the speed of light in a clear plastic whose index of refraction is 1.40? (2.14 x 108 m/s)

4] A beam of light strikes the surface of a block of glass (n =1.50) and produces a refracted angle of 10°. What is the incident angle? (15.1°)

5] Monochromatic light has a wavelength of 6.0 x 10-7 m in air and 5.0 x 10-7 m in a clear liquid. What is the index of refraction of the clear liquid? (1.2)

6] A ray of light strikes the surface of water (n = 1.33) at an angle of 60.0° from the water surface. What is the angle of refraction? (22.1°)

7] Light is incident on an equilateral crown glass prism at a 45.0 deg angle to one face Calculate the angle at which light emerges from the opposite face. n = 1.56
(58.2 deg to normal)



F. Total internal reflection; fiber optics 23-6

1) What is total internal reflection? What is the critical angle?

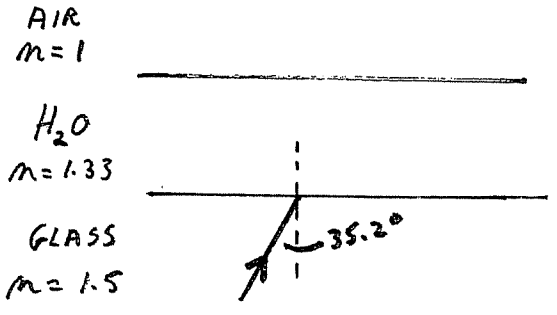
2) Draw and describe Figure 23-23.

8] What is the critical angle for a diamond-water interface? (33.3 deg) look up n's on P 696

9] The critical angle for a certain liquid-air surface is 57 deg. What is the index of refraction of the liquid? (1.19)

10] What is the critical angle for an air-glass interface if the index of refraction of glass is 1.50. (41.8°)

11] A ray of light travels from glass (n=1.5) into water (n = 1.33) into air as shown in the diagram. Illustrate the path followed by the light and calculate the angle that the light leaves the water-air interface. (59.8°)



Problems

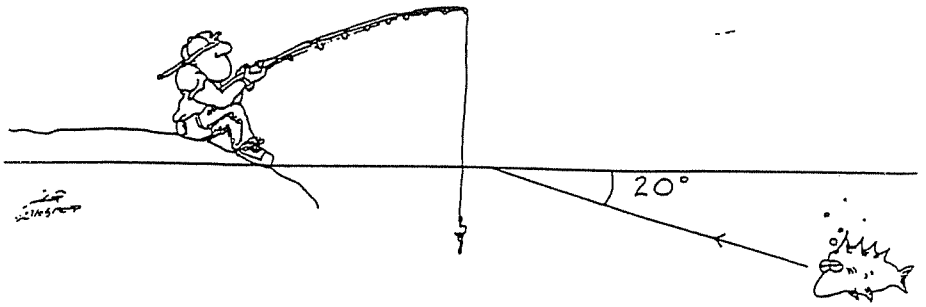
1] Light entering a block of glass at an angle of incidence of 18.5 degs leaves the boundary betweenthe air and the glass at an angle of 12 degs. What is the index of refration of this type of glass?

2] A beam of light is incident on a sheet of glass in a window at an angle of 30 degs. Describe exactly what path the light beam will take as it a) enters the glass (n = 1.5) and as it b) leaves the other side of the glass.

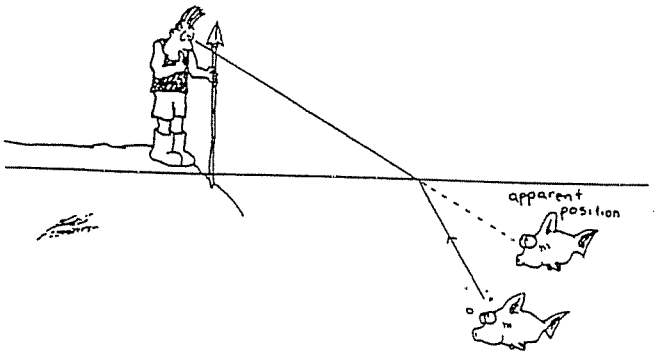
3] Calculate the critical angle for diamond (n = 2.42).

4] A certain material has a critical angle of 52 degs. What is its index of refraction?

5] Why can the fisherman **not** see the specific light ray coming from the fish? Can the fisherman see the fish at all?



6] a) The fisherman wants to spear the fish. Where should he aim?
b) a "high tech" fisherman wants to "zap" the fish with a laser. Where should she aim?



G. Section 23-2 Reflection; Image Formation by a Plane Mirror

What is the law of reflection?

_____

_____

Illustrate the formation of a virtual image by a plane mirror. Label the image distance, object distance, virtual image. (Figure 23-7)

How do you distinquish between a virtual and a real image?

_____

_____

12] Suppose that you want to take a photograph of yourself as you look at yourself as you look at your image in a flat mirror 2.5 m away. For what distance should the camera lens be focused? (5.0 m)

_____

H. Section 23-3 Formation of Images of Spherical Mirrors
Draw and describe convex and concave mirrors.

llustrate what happens when happens when rays parallel to the the principal axis strike a sperical mirror whose reflecting surface is small compared to the radius of curvature. Label the focus, focal length and the principal axis. (Fig 23-13)

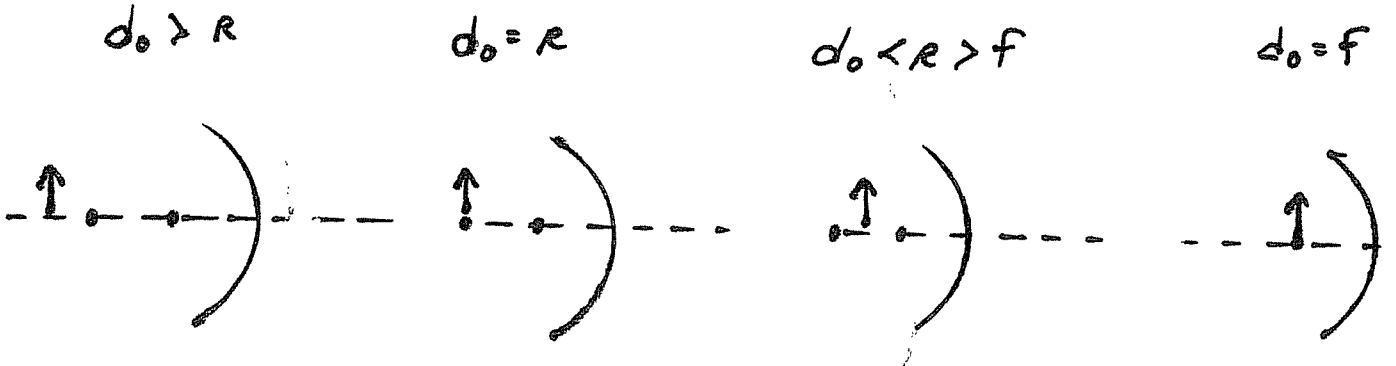
Define focal point and focal length.

How does the focal length relate to the radius of curvature?

_____

Draw 3 diagrams illustrating the three rays used to find the image produced
by a concave mirror. Label them 1, 2, and 3.

Draw diagrams illustrating the image formation in the following situations.

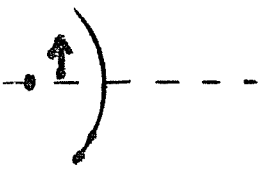


List and describe the mirror equation.

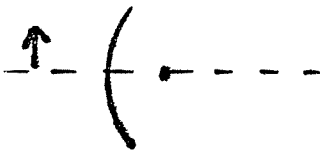
List and describe the magnifcation formula. Explain the negative sign.

Study example 23-3 and 23-5.

Describe the image you get if the object is within the focal point ? (Fig 23-16)
Illustrate as well.



Illustrate and describe the image formed by a convex mirrors. (Fig 23-17)



Study Example 23-6 and read Problem Solving (P695) carefully.

Summarize the sign conventions for concave and convex mirrors.

13] What is the radius of a concave reflecting surface that brings parallel light of a focus 22.4 cm in front of it? (44.8 m)

14] You try to look at yourself in a silvered ball of diameter 64.0 cm when you are 2.70 m away. Where is your image? Is it real or virtual ? Can you see yourself clearly? (-15.1 cm, virtual, 18 x smaller--hard to see)

15] A dentist wants a small mirror that, when 2.20 cm from a tooth, will produce a 5.5 x upright image. What kind of mirror must be used and what must its radius of curvature be? (concave, converging {concave}, r=5.38 cm)

16] A luminous object 3.0 mm high is placed 20 cm from a convex mirror of radius of curvature 20 cm a) Show by ray tracing that the image is virtual and estimate the image distance. b) Show that to compute this (negative) image distance from Eq 23-2, it is necessary to let the focal length be -10 cm. c) Compute the image size using Eq 23-3. (di =-6.67 cm, hi = 1.0 mm)

17] A 2.70 cm tall object is placed 32.0 cm from a spherical mirror. It produces a virtual image 3.80 cm high.
a) What type of mirror is being used?
b) Where is the image located?
c) What is the radius of curvature of the mirror?
(concave, di is 45 cm behind mirror, 22.2 cm)

18] The magnification of a convex mirror is 0.45 x for objects 3.0 m away. What is the focal length of this mirror? (-245 cm)

I. Section 23-7 Thin Lenses; Ray Tracing

Draw a double convex and double concave lens.

Define and give the symbol for focal point, focal length, focal plane, converging lens and diverging lens.

llustrate and learn to draw the three rays that can be used to illustrate the image produced by lenses. Label them 1,2 &3 (Fig 23-34, 23-36)

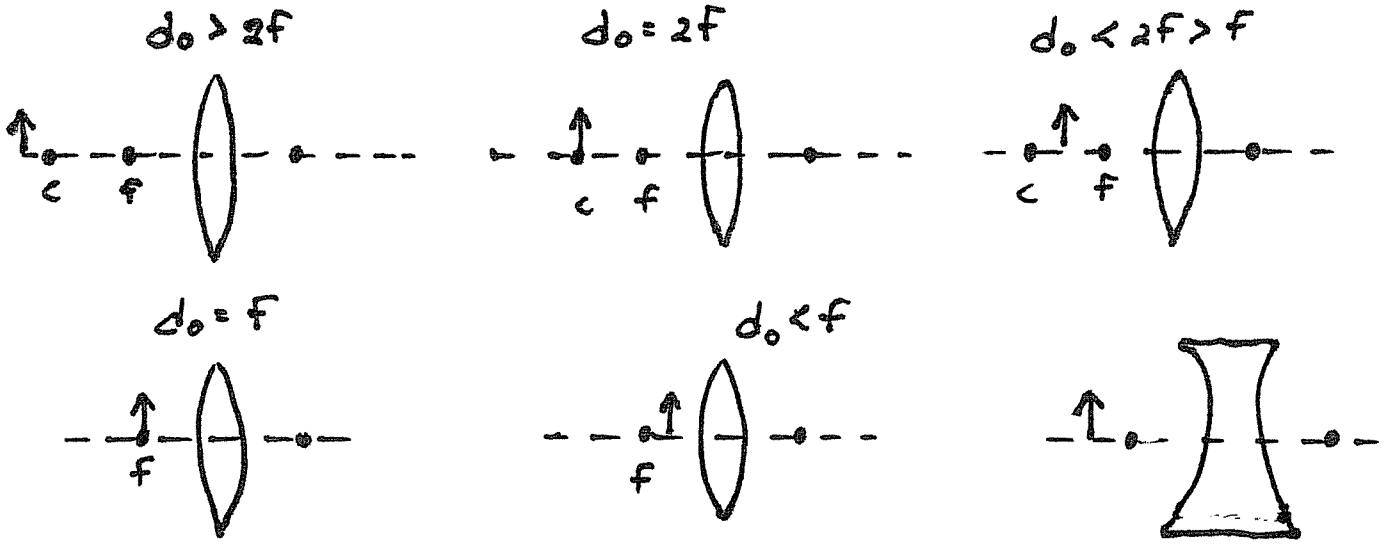
List and describe the lens equation.

In point form --list the sign conventions.

List and describe a formula to find lateral magnification. What does a negative magnification mean?

** Study Sec 23-9 and Examples 23-11, 23-12, 23-13 ---- very carefully **

Describe and illustrate the image (inverted or upright? larger or smaller?, real or virtual?) produced by:



19] A sharp image is located 58.0 mm behind a 50.0 mm-focal length converginglens. Calculate the object distance. (363 mm)

20] A leaf is placed 88.0 cm in front of a -710-mm-focal-length lens. Where is the image? Is it real or virtual? (393 mm in front, virtual)

21] A certain lens focuses an object 33.5 cm away as an image 5.0 cm on the other side of the lens. What type of lens is it and what is its focal length? Is the image real or virtual? (-4.3 cm, real)

22] a) An object 28.0 cm in front of a certain lens is imaged 8.10 cm in front of that lens (on the same side as the object). What type of lens is this and what is its focal length? Is the image real or virtual?
b) What if the image were located instead, 35.0 cm in front of the lens? (-11.4 cm, +140 cm)

23] a) How far from a 50.0-mm-focal-length lens must an object be placed if its image is to magnified 2.00x and be real?
b) What if the image is to be virtual and magnified 2.00x?
(75 mm, 25mm)

24] a) A 2.20 cm high insect is 1.20 m from a 135 mm-focal-length lens. Where is the image, how high is it, and what type is it? b) What if f = -135 mm?

(152 mm, -.279 cm, real and inverted --- -121 mm, .222 cm, virtual and upright)