Physics 41  
Ms. Smith

1. Define/Illustrate:
   1. Refraction

* 1. Normal Line
  2. Index of refraction
  3. Snell’s Law
  4. Apparent Depth

* 1. Total Internal Reflection

* 1. Polarization
  2. Glare
  3. Brewster’s Angle
  4. Dispersion
  5. Lenses
  6. Converging Lens
  7. Diverging Lens
  8. Focal length

1. Short Answer:
   1. How is a rainbow formed?
   2. Explain the phenomena of Total Internal Reflection: How it occurs, when it occurs, and how we can find out if it is occurring.
   3. Explain why light travels at a slower speed in a medium than it does in a vacuum.
   4. In what scenario will a ray of light move from one medium to another, changing speeds but *not* refracting? Use Snell’s law to prove this.
   5. Explain how polarized sunglasses work

* 1. Explain why dispersion occurs

* 1. Under what specific condition will light pass from one medium to another *without* refracting? Explain this phenomena.

1. Solve the following problems:
   1. Use a protractor to measure the angle of incidence where the ray strikes the glass. Use Snell’s Law and calculate the angle of refraction, then draw it in. Use that as the new incident ray on the opposite side of the shape and find & draw in the final angle of refraction when the light leaves the glass.

N=1.45

N=1.45

N=2.419

1. Using the Thin Lens Equation & Magnification Equation, fill in the following chart (all blank spots)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Type of Lens | Focal Length (f) | Object Distance (dO) | Image Distance (di) | Object Height (hO) | Image Height (hi) | Magnification (M) | Upright/ inverted | Real/ Virtual |
| Converging | 15 | 60 | 20 | 7 | -2.3 | -0.3333 | Inverted | Real |
| Converging | 13.1 | 7.4 | -17 | 8 | 18.4 | 2.3 | Upright | Virtual |
| Diverging | -12 | 4 | -3 | 4 | 3 | 0.75 | Upright | Virtual |
| Converging | 10 | 5 | -10 | 2 | 4 | 2 | Upright | Virtual |
| Diverging | -36 | 12 | -9 | 2 | 1.5 | 0.75 | Upright | Virtual |
| Diverging | -25 | 16.67 | -10 | 5 | 3 | 0.6 | Upright | virtual |

5. When an object 5 cm. tall is placed 12 cm. from a converging (convex) lens, an image is produced on the same side of the lens as the object, but 61 cm. from the lens. Find the focal length of the lens, and the size of the image.

F=15cm

hi=25.42

6. An object is placed 12 cm. from a diverging lens whose focal length is -8.5 cm. Using the lens/mirror equation, find the location and the magnification of the image.

Di=-5cm

M=0.42cm

7. A certain type of plastic has a critical angle of 52° in air. Find the index of refraction of the plastic, and then find the critical angle for light *in the plastic* when it is submerged in water.

Nplastic=1.27

No Өc – going from faster to slower

8. Consider the following two lens system: A converging lens (f1 = 10 cm) is 49 cm. to the left of another converging lens (f2 = 15 cm.) The final image is formed 32 cm. to the right of the second lens (15cm. focal length). If the original object is located left of the first lens, find how far the object is from the lens. Also find the magnification and orientation of the final image. Assume all images are real.

Do=19.26

M=1.13

9. Light is traveling from air into a piece of glass (nglass = 1.57). If the angle of incidence is 44°, find the angle at which the light refracts in the glass.

Ө2=26.26

10. Light travels through a diamond (n=2.419) and strikes the interface of the diamond and several different mediums (below) at an angle of incidence of 33˚. Determine if the light refracts for each, and if it does, find the angle of refraction.

a. Diamond to air (n=1)

Өc=24.42

NO REFRACTION

b. Diamond to water (n=1.33)

Өc=33.35

NO REFRACTION (barely)

c. Diamond to silicone (n=1.4)

Өc=35.36

REFRACTS

Ө2=66.06

d. Diamond to Zircon (n=1.92)

Өc=52.43

REFRACTS

Ө2=43.31

11. Light enters air from water (n=1.33) with an angle of refraction of 45˚. Find the angle of incidence.

70

12. A shell is submerged 3m under the water (n=1.33). How far under the water does it appear to a child viewing it from above, in the air?   
  
2.26

13. A toy submerged in a tank of unknown liquid appears to a child to be 2.5m under the surface. A marking on the side of the tank indicates it is 3m deep. What is the index of refraction of the liquid?

N=1.2

14. An object is placed 20cm in front of a lens with a focal length of 15cm. Another identical lens is placed 70cm behind the first lens. Where is the final image formed?

60cm to the LEFT of the second lens

15. An object is placed 50cm in front of a lens with a focal length of 10cm. A lens with a focal length of 20cm is placed 40cm from the first lens. Where is the final image formed?

73.33cm to the right of the second lens

16. An object is placed 16cm in front of a lens with a focal length of 7cm. A second lens is placed 25cm from the first lens. An image is formed 50cm to the right of the second lens. What is the focal length of the second lens?

F=10cm

17. Draw a ray diagram for the following scenarios