

# Honors Physics

## Light and Optics

This unit will allow each student to:

- gain a better understanding of the behavior and characteristics of light as an electromagnetic wave and particle
- continue making proper scientific measurements and calculations
- define and properly use all vocabulary
- properly apply all terms and concepts in describing/explaining real world examples
- continue making and interpreting scientific graphs
- teach someone else the concepts discussed
- practice proper laboratory safety

This will be accomplished by each student that is able to:

- describe the creation of light and relate to the spectra produced by specific atoms
- state the speed of light in a vacuum
- identify and properly arrange the different regions of the electromagnetic spectrum
- list/describe applications of different electromagnetic waves
- distinguish between primary colors of light and pigment
- identify complementary colors of light and pigment
- predict colors produced by the mixing of primary/complementary colors of light and pigment
- state the law of reflection; state the law of refraction
- draw light as a ray; draw and identify incident and reflected rays striking a flat surface
- identify the speeding up or slowing down (and associated bending) of light as it passes from one medium to another
- relate the speed of light to medium properties and the color of the light
- describe how a prism separates white light into the visible spectrum
- describe total internal reflection
- explain how a rainbow is formed by water droplets in the atmosphere
- properly draw a normal line (relative to flat and curved surfaces) to measure angle of incidence, angle of reflection, angle of refraction
- use the law of reflection and a ray diagram to predict the image formed by a plane (flat) mirror
- identify the following properties of an image: type, orientation, magnification, and location
- determine the focal point and center of curvature of a concave mirror
- properly draw and label ray diagrams for light rays on concave and convex mirrors as well as convex and concave lenses
- identify and draw the four easy rays for use with curved mirrors and lenses
- use easy rays to find and describe (4 properties) images formed by curved mirrors and lenses
- predict the properties of an image based on the object's relative location to the mirror or lens
- compare/contrast mirrors and lenses

### Textbook Reference – Physics

**Chapter 13 - Light and Reflection; Chapter 14 – Refraction; Chapter 15 - Interference and Diffraction**

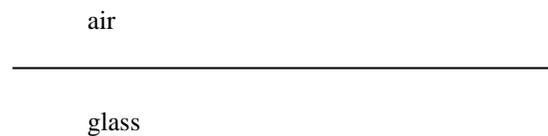
### Key Terms

electromagnetic radiation, electromagnetic spectrum, photon, diffraction, photoelectric effect, relativity, time dilation, opaque, translucent, transparent, light, pigment, reflection, angle of incidence, polarization, Doppler Effect, normal line, angle of reflection, refraction, angle of refraction, total internal reflection, concave, convex, virtual image, real image, focal point, apex, optical axis, optical center, mirror, lens, center of curvature

## Light and Optics review sheet – Answer completely

1. Sketch the electromagnetic spectrum include all 7 regions in order from low frequency to high frequency.
2. Give an application of each region of the electromagnetic spectrum.
3. What is the speed of light in a vacuum? Why could this be called a “universal speed limit”? What are relativity and time dilation as they relate to objects going near the speed of light?
4. Why is glass transparent for visible light, but opaque for infrared and ultraviolet light?
5. How is a light wave produced? Explain using the Bohr model of the atom and energy levels.
6. Is light a particle? Is light a wave? Explain. What is the experimental evidence?
7. What are the primary colors of light? What are the primary colors of pigment?
8. What is a complementary color?
9. What color results from the combination of magenta and green light? blue and green light? red, blue and green light?
10. What color results from the combination of yellow and cyan paint? cyan and magenta paint? yellow, magenta, and cyan paint?
11. What color results when a yellow light is shined on cyan paper? red light on a green leaf? blue light on magenta handkerchief?
12. Why the sky is blue? Why are sunsets red?

13. Explain how polarized sunglasses cut down on glare.
14. State the law of reflection.
15. Draw a light ray that reflects off a flat surface with an angle of reflection of  $30^\circ$ . Label both angles, normal line, and both light rays.
16. Draw a light ray as it passes from air into a piece of glass and back into the air again. Which way does the light bend relative to the normal line? If the index of refraction for glass is 1.52 and the light ray is incident on the glass at an angle of  $30^\circ$ , calculate the refracted angle.



17. How does the speed of light change as it travels from air into water? If the index of refraction for water is 1.33, then what is the speed of light in water?
18. Why does light travel slower through glass than it does through a vacuum?
19. How is white light separated into the various colors of the rainbow by a prism?
20. Which color of light travels slowest through transparent materials? which travels fastest?
21. Explain how water droplets in the atmosphere form a rainbow?
22. Explain how nearsightedness and farsightedness are corrected.
23. A flower is 30 cm in front of a convex lens. The convex lens has a focal length of 20 cm. Draw a ray diagram of this situation. Calculate the location of the image and the magnification of the image. Describe the image.