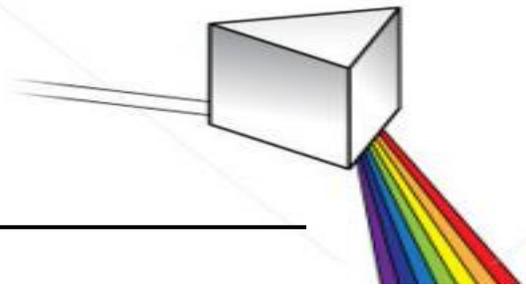
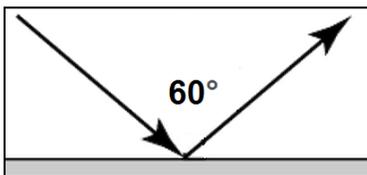


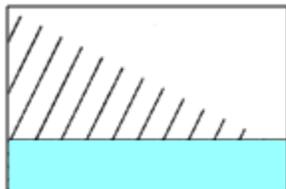
LIGHT AND OPTICS



1. Radio waves travel at the speed of light. How long would it take to send a message to a spacecraft orbiting Mars at a distance of 7.8×10^{10} m from Earth?
2. At the doctor's office, an X-ray of your hand is taken with electromagnetic radiation of frequency 3.00×10^{17} Hz. What is the wavelength of this radiation?
3. What is the frequency of a light wave having a wavelength of 5×10^{-7} m in a vacuum?
4. Electrons oscillating with a frequency of 2.0×10^{11} Hz produce electromagnetic waves of the same frequency. These waves would be classified as what?
5. What is the range of wavelength in the IR range of the electromagnetic spectrum?
6. The diagram below represents a light ray being reflected from a plane mirror. Draw and state the angle of incidence for this ray.

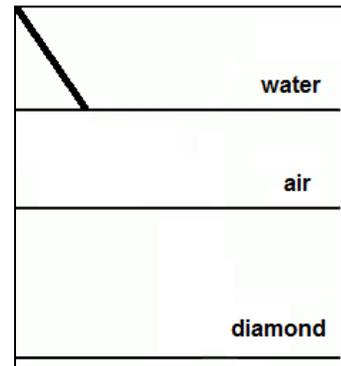


7. Draw the refracted rays for this air / water boundary.



8. Frequency, speed, period, phase – which change when a wave enters a new medium?
9. What is the speed of a light wave traveling in a substance with an index of refraction equal to 1.1?

10. A blue glow from a bug light strikes the Bradford's swimming pool at an angle of 35.0° . At what angle is the light refracted into the pool?
11. Draw a possible path of the incident light ray in the diagram below

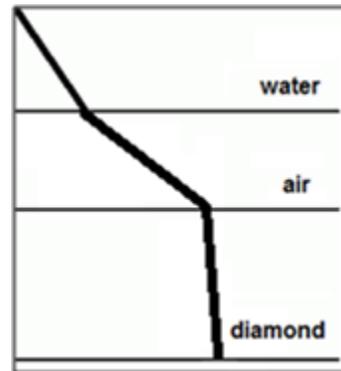


12. Does light travel faster in ethyl alcohol or water? What is the speed of light in each?
13. The speed of light in corn oil is the same as the speed of light in what other substance?
14. Light travels at 2×10^8 m/s in a substance. Calculate the index of refraction for light in this substance.
15. Heather is snorkeling in Oahu's Hanauma Bay when she looks up through the water at a palm tree on the shore. If the index of refraction of water is 1.33 and Heather sees the palm tree at an angle of 45° , at what angle is the palm tree really located with respect to the normal?
16. Spenser, a cat, enjoys watching the family goldfish from the top of the fish tank. If the goldfish, swimming in water, appears to be at an angle of 28.0° as seen by Spenser, at what true angle is the goldfish from the normal?
17. Eva spots a ring beneath an ice cube. If Eva looks down into the glass at an angle of 61.0°

but the ice cube refracts the ring at an angle of 42.0° , what is the index of refraction of ice?

18. In her bedroom, Mia has a fiber optic light that glows as hundreds of fiber optic cables are lit from below. If each fiber optic cable has an index of refraction of 1.48, at what critical angle must light enter the cable in order for total internal reflection to occur?

11.



12. Faster in water. $v_{\text{alcohol}} = 2.2 \text{ E } 8 \text{ m/s}$,
 $v_{\text{water}} = 2.3 \text{ E } 8 \text{ m/s}$

13. Glycerol

14. 1.5

15. 70.1°

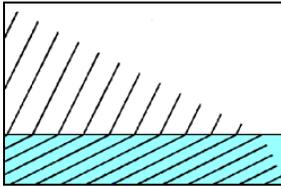
16. 20.7°

17. 1.31

18. 42.5°

ANSWERS

1. 260 seconds
2. $1.00 \text{ E } -9 \text{ m}$
3. $6.0 \text{ E } 14 \text{ Hz}$
4. Microwave
5. 10^{-6} m to 10^{-3} m
6. 30°
- 7.



8. Speed
9. $2.7 \text{ E } 8 \text{ m/s}$
10. 25.5°