

Chapter 11 Review (Alternative Format)

Goal • To review the concepts from Chapter 11.

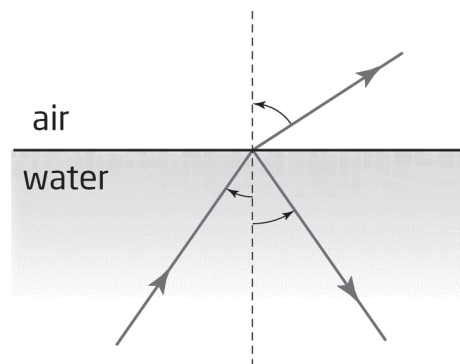
Reviewing Key Terms

Use a key term from the list below to fill in the blanks in statements 1 to 5.

critical angle
dispersion
index of refraction

mirage
shimmering

- The ratio of the speed of light in a vacuum to the speed of light in a medium is the _____ of the medium. (11.1)
- _____ is the separation of white light into its colours. (11.1)
- The angle of incidence for which the angle of refraction is 90° is called the _____. (11.2)
- _____ is the apparent movement of objects seen through hot air over objects and surfaces. (11.3)
- When you think that you are seeing an object but it is not really there, you are seeing a _____. (11.3)
- Label the following in this diagram: incident ray, normal, refracted ray, reflected ray, angle of incidence, angle of refraction, and angle of reflection.



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Knowledge and Understanding

Fill in the blanks to complete the statements in questions 7 to 15.

7. When light goes from air into water at an angle, the speed of the light _____ and the light refracts _____ the normal.
8. In a given medium, the speed of each _____ of light is different. For this reason, indices of refraction are measured using a pure _____ light with a wavelength of 589 nm.
9. a. When light crosses into a medium with a lesser index of refraction, the angle of refraction will be _____ than the angle of incidence.
b. When light crosses into a medium with a greater index of refraction, the angle of refraction will be _____ than the angle of incidence.
10. Two factors that can affect the index of refraction of a given substance are _____ and _____.
11. When light crosses the boundary between two substances that have different indices of refraction, the _____ of _____ determines the proportion that is reflected.
12. A light ray is travelling from a medium with a larger index of refraction to a medium with a smaller index of refraction. If the angle of incidence increases from 0° , _____ of the incident light is refracted. When the angle of incidence becomes greater than the critical angle, _____ of the incident light is reflected.
13. White light can be dispersed into a spectrum of colours because each colour has a _____ wavelength, travels at a different speed, and is refracted at a different _____.
14. Rainbows are produced by a combination of reflection and refraction in _____, while sundogs are a result of _____ in _____.
15. While standing in the shallow end of a swimming pool, you see a coin on the bottom of the pool several metres ahead of you. This coin is _____ the surface of the water than it appears.

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Thinking and Investigation

16. A clear plastic cube is submerged in a container of water. Why would the cube be difficult to see if the plastic has exactly the same index of refraction as water?

17. a. The speed of light in a solid is 1.96×10^8 m/s. Calculate the index of refraction for the solid.

- b. Calculate the speed of light in diamond, which has an index of refraction of 2.42.

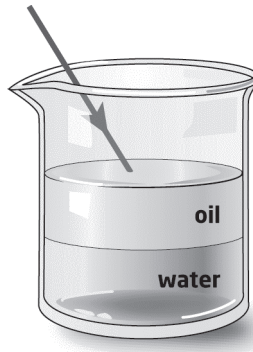
- c. Calculate the speed of light in ethyl alcohol, which has an index of refraction of 1.362 at 20 °C.

- d. The speed of light in a solid is 1.56×10^8 m/s. Calculate the index of refraction. Then, use the data in Table 11.1 to help identify the solid (see page 454 of your textbook).

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18. Why is a small critical angle desirable for optical fibres? What problem could a larger critical angle cause?

19. The beaker in this diagram contains water and cooking oil. The oil has a higher index of refraction than the water. Draw the refracted ray in the oil and in the water.



20. Some of the astronauts who landed on the Moon placed retroreflectors there. The distance between Earth and the Moon can be determined by measuring the time it takes for a pulse of a laser light to reach the reflector and then return to Earth. What properties of light would you have to know in order to calculate the distance between Earth and the Moon?

21. Review Investigation 11-D in your textbook. The method you used to determine the critical angle of water only works for some liquids. Describe how you could determine the critical angle of a flat piece of glass.

Communication

22. Describe how society has benefited from the development of

a. optical fibres

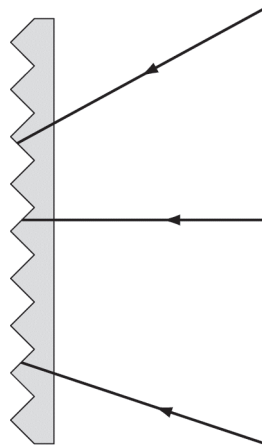
b. retroreflectors

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23. Using a sketch, explain the daytime and nighttime settings for a prism-type rearview mirror.

24. Complete this ray diagram to show how a retroreflector reverses the direction of incident light rays.

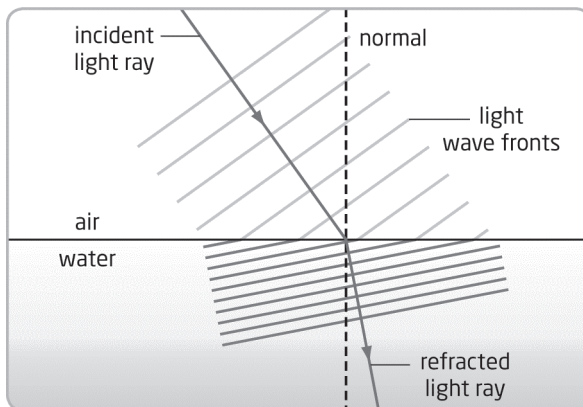


25. Imagine that you and a friend are hiking across a hot desert. Your map shows no sources of water in the area. However, your friend is sure he can see a pool of water off to one side, and wants to turn toward it. Explain how hot temperatures change the index of refraction of air and create the effect that your friend mistakes for water.

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26. The following diagram shows wave fronts of light travelling across the boundary between air and water.
- a. Explain the significance of the change in spacing of the wave fronts as the light passes from air into water.

- b. Beside this diagram, draw a similar diagram, but with an angle of incidence of 0° , so that the wave fronts are parallel to the boundary. Describe what happens when the light crosses the boundary.



27. Review your observations for Activity 11-1, The Re-appearing Coin, on page 447 of your textbook. Explain these observations in terms of what you have learned about refraction in this chapter.

Application

28. Identify two careers related to the optics described in this chapter.

29. Astronomers can learn a lot about stars by studying the wavelengths of the light that they emit. Some of the early instruments used to analyze starlight contained prisms. What do you think the function of these prisms is?
