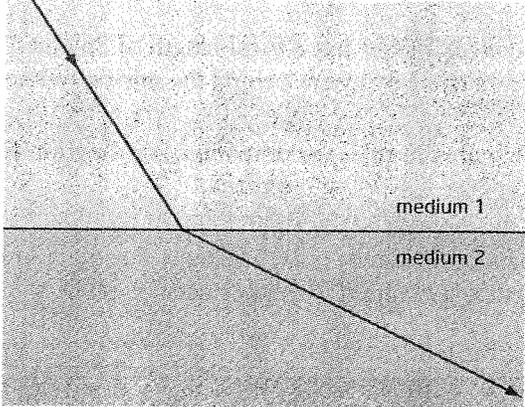


Section 11.1 Review

Refraction of Light

Multiple Choice

For each question below, select the best answer.

1. What is the surface between two different media called?
 - a. wave front
 - b. boundary
 - c. ray
 - d. beam
 - e. medium
2. What happens to light when it travels at an oblique angle from one medium to a different medium?
 - a. It changes direction.
 - b. It changes colour.
 - c. It changes speed.
 - d. A and C are true.
 - e. A and B are true.
3. What is the relationship between a ray and a wave front?
 - a. They are not related to each other.
 - b. They are parallel to each other.
 - c. They are perpendicular to each other.
 - d. They are on two extreme sides of the wave.
 - e. They never come together.
4. When a ray travels along the normal and through the boundary between two different media, what happens to the ray in the second medium?
 - a. It goes along the normal.
 - b. It bends away from the normal.
 - c. It bends toward the normal.
 - d. It goes along the surface of the second medium.
 - e. None of the above is true.
5. A ray goes from one medium to another at an oblique angle, and it is slower in the second medium than in the first medium. What happens to the refracted ray in this situation?
 - a. It goes along the normal.
 - b. It bends away from the normal.
 - c. It bends toward the normal.
 - d. It goes along the surface of the second medium.
 - e. None of the above is true.
6. A ray goes from one medium to another at an oblique angle, and it is faster in the second medium than in the first medium. What happens to the refracted ray in this situation?
 - a. It goes along the normal.
 - b. It bends away from the normal.
 - c. It bends toward the normal.
 - d. It goes along the surface of the second medium.
 - e. None of the above is true.
7. A ray travels from one medium to a second, different medium. The refracted ray bends *away* from the normal in the second medium. What is *true* about the speed in this medium?
 - a. The speed of light in the second medium is higher than the speed of light in the first medium.
 - b. The speed of light in the second medium is lower than the speed of light in the first medium.
 - c. The speed of light cannot be predicted.
 - d. The speed of light is the same in both media.
 - e. The speed of light in the first medium is equal to the speed of light in a vacuum.
8. What is *true* about the refracted ray in the following diagram?

The diagram shows a horizontal boundary line separating two media. The upper region is labeled 'medium 1' and the lower region is labeled 'medium 2'. A ray is incident from medium 1 at an oblique angle to the normal. The refracted ray in medium 2 bends away from the normal, indicating that light travels faster in medium 2 than in medium 1.

 - a. The refracted ray is bending away from the normal.
 - b. The refracted ray is bending toward the normal.
 - c. The refracted ray is travelling along the normal.
 - d. The refracted ray is travelling faster in medium 2 than in medium 1.
 - e. A and D are true.

Section 11.1 Review

Refraction of Light

Multiple Choice

For each question below, select the best answer.

9. In which medium is the speed of light the greatest?

- a. quartz
- b. water
- c. glass
- d. diamond
- e. a vacuum

10. What is *true* about a refracted ray?

- a. It passes through a second, different medium.
- b. It strikes a second medium.
- c. It bounces off the surface of a second medium.
- d. It always internally reflects at the boundary.
- e. none of the above

11. Why is it impossible for the index of refraction to be less than 1?

- a. The speed of light in the medium would be the same as the speed of light in a vacuum.
- b. The speed of light in the medium would be greater than the speed of light in a vacuum.
- c. The speed of light in the medium would be less than the speed of light in a vacuum.
- d. Refraction is not possible.
- e. Light cannot travel through a vacuum.

12. The measured index of refraction of a certain medium is 2.50. What is the speed of light inside this medium?

- a. 2.57×10^7 m/s
- b. 1.07×10^8 m/s
- c. 1.20×10^8 m/s
- d. 4.89×10^8 m/s
- e. 1.91×10^8 m/s

$$v = \frac{c}{n}$$

13. A ray of light travels from glass to air at an oblique angle. Compare its angle of refraction with its angle of incidence.

- a. The angle of refraction is less than the angle of incidence.
- b. The angle of refraction is greater than the angle of incidence.
- c. The angle of refraction is equal to the angle of incidence.
- d. The angle of refraction is infinite.
- e. The angle of refraction is zero.

14. A ray of light enters a second, different medium and refracts. What is *true* about the angle of refraction?

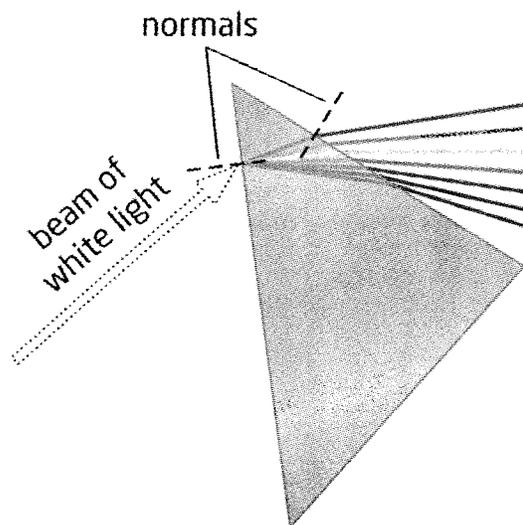
- a. The angle of refraction equals the angle of incidence.
- b. The angle of refraction is always less than the angle of incidence.
- c. The angle of refraction is always greater than the angle of incidence.
- d. The angle of refraction may be greater than, less than, or equal to the angle of incidence.
- e. The angle of refraction is always infinite.

15. Light goes from glass ($n = 1.51$) to water ($n = 1.33$). What is the ratio of the speed of light in glass to the speed of light in water?

- a. 1.14
- b. 0.881
- c. 1.51
- d. 1.33
- e. 1.00

$$\frac{1.51}{1.33} = 1.14$$

16. What happens to the light after it enters and leaves the prism in the following diagram?



- a. The light refracts once.
- b. The light refracts twice.
- c. The light disperses and refracts once.
- d. The light disperses and refracts twice.
- e. The light only disperses.

Section 11.1 Review

Refraction of Light

Written Answer

Answer the following questions in your notebook.

17. What is refraction?

Bending of light. Speed and direction change as light moves to a new medium.

18. Describe how light travels in a single medium in terms of speed and bending of light.

Constant speed and direction (straight line).

19. What happens when light enters a different medium at an angle other than 90° ?

Describe what will happen using the term *index of refraction*.

Light slows down and bends towards normal if new index of refraction is \uparrow .

20. Why does a ray of light bend when it changes media?

Speed changes and wave is "pulled" one way or another as it enters on an angle.

21. The speed of light in a vacuum is 3.0×10^8 m/s. In a certain type of glass, the speed of light is 2.0×10^8 m/s. What is the index of refraction of glass?

$$n = \frac{c}{v} = 1.5$$

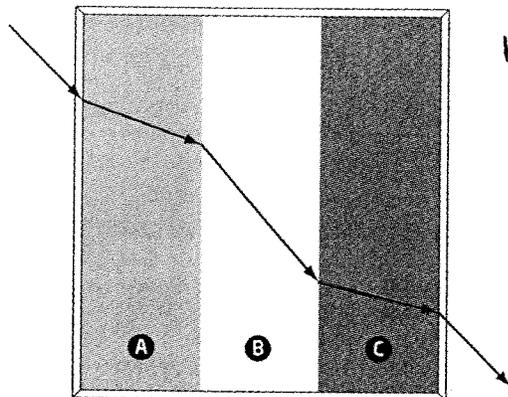
22. What is the angle of refraction?

Angle between refracted ray and the normal.

23. What is dispersion?

Separating colours of light by refraction.

24. In the following diagram, three transparent media are adjacent to each other. A ray of light enters A and exits C. List the three different media in order of highest index of refraction to lowest index of refraction.



Highest: C

A

Lowest: B

Section 11.1 Review

Refraction of Light

Written Answer

Answer the following questions in your notebook.

25. Why does white light separate into different colours when it passes through a prism?

It refracts twice which disperses the different colours.

26. Name the seven main colours that make up white light.

ROYGBIV

27. What factors affect the index of refraction in a gas?

Temperature and pressure.

28. What factors affect the index of refraction in liquids and solids?

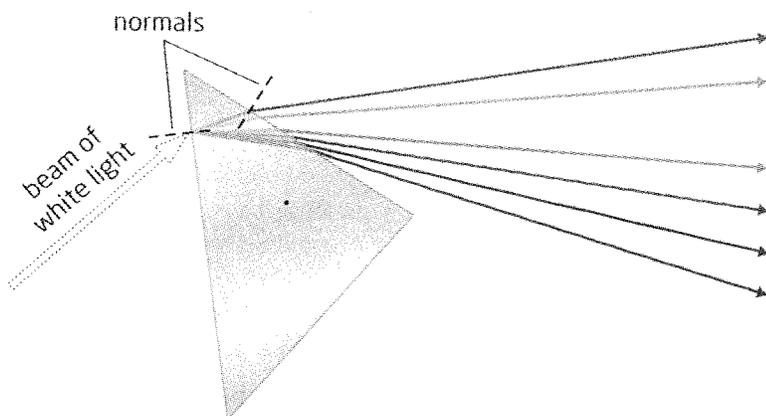
Temperature

29. The index of refraction for sodium chloride at 20°C is 1.54. Calculate the speed of light in sodium chloride.

$$v = \frac{c}{n} = \frac{3.0 \times 10^8 \text{ m/s}}{1.54} = 1.95 \times 10^8 \text{ m/s}$$

30. In the diagram below, which colour travels fastest and which colour travels slowest?

Give reasoning for both.



red → fastest
orange
yellow
green
blue
indigo
violet → slowest

31. You have two transparent objects, and you know that they have different indices of refraction. How could you determine through which object light would travel faster?

Shine a ray through each and measure the angle of refraction.

32. The index of refraction of cranberry juice is 1.35. What is the speed of light in cranberry juice?

$$v = \frac{c}{n} = \frac{3.0 \times 10^8 \text{ m/s}}{1.35} = 2.22 \times 10^8 \text{ m/s}$$