

Name _____

Hour _____

AP Physics: Chapter 21 & 22
Reflection & Refraction

Question A:

As light travels from a vacuum ($n = 1$) to a medium such as glass ($n > 1$), does its velocity change? If so, how? Does its frequency change? If so, how? Does its wavelength change? If so, how?

Question B:

A beam of light initially travels through a liquid solution with a velocity v_0 , frequency f_0 , and wavelength λ_0 . The index of refraction of the liquid solution is n_0 . The light then encounters a second medium where its velocity is only $.8v_0$.

- Express the frequency of the light in the second medium in terms of f_0 .
- Express the wavelength of the light in the second medium in terms of λ_0 .
- Express the index of refraction in the second medium in terms of n_0 .

Question C:

A microwave oven is powered by an electron tube called a magnetron that generates electromagnetic waves of frequency 2.45 GHz. The microwaves enter the oven and are reflected by the walls. The standing wave pattern produced in the oven can cook food unevenly, with hot spots in the food at antinodes and cool spots at nodes, so a turntable is often used to rotate the food and distribute the energy. If a microwave oven is used with a cooking dish in a fixed position, the antinodes can appear as burn marks on foods such as carrot strips or cheese. The separation distance between the burns is measured to be 6.00 cm.

- Calculate an experimental value for the speed of the microwaves from this data.
- Why would the burn marks be considered antinodes instead of nodes?

Question D:

A ray of light travels from air into the water ($n = 1.33$) of a swimming pool at an angle of incidence of 40.0° .

- Calculate the angle of refraction of the ray of light as it travels into the water.
- Sketch a diagram of this situation. Label the angles of incidence and refraction.

Question E:

A laser ray leaves a diamond ($n = 2.42$) and travels into air with an angle of incidence of 15° .

- Calculate the angle of refraction of the laser ray as it travels into the air.
- Sketch a diagram of this situation. Label the angles of incidence and refraction.

AP Physics: Chapter 23
Mirrors & Lenses

Question A:

An object of height 1.2 cm is placed 6.00 cm in front of a concave mirror that has a 10.0 cm focal length.

- Determine the location of the image.
- Calculate the magnification of the mirror and the image height.

Question B:

A slide projector is made by placing an illuminated slide slightly more than one focal length away from a converging lens. The lens of a particular slide projector has a 10.0 cm focal length and its object distance can be adjusted to any value between 10.2 cm and 11.0 cm. For what range of distances between the projector and the screen can a sharp image be obtained?

Question C:

A transparent photographic slide is placed in front of a converging lens with a focal length of 2.44 cm. The lens forms an image of the slide 12.9 cm from the lens. How far is the lens from the slide if the image is . . .

- a) real?
- b) virtual?

Question D:

Mukluk, an Inuit, makes a converging lens out of ice that will enable him to concentrate light from the sun to start a fire. When he holds the ice lens 5.00 m from his igloo, the image of the igloo is projected on to a snow bank 1.00 m away. Calculate the focal length of the ice lens.

Question E:

In their Physics lab, Jerry & Johnny use a diverging lens with a focal length of -10.0 cm. They place the lens 18.0 cm from their textbook. How far from the lens will the image of the text form?

AP Physics: Chapter 24
Wave Optics

Question A:

Describe the change in the width of the central maximum of a single-slit diffraction pattern as the width of the slit is made smaller.

Question B:

A coating is applied to a lens to minimize reflections. The index of refraction of the coating is 1.55, and that of the lens is 1.48. If the coating is 177.4 nm thick, what wavelength is minimally reflected for normal incidence in the lowest order?

Question C:

A thin film of oil ($n = 1.38$) floats on water. What wavelength in the visible spectrum undergoes constructive interference and what is the color of the film at points where the oil thickness is 300 nm? Assume that the film is viewed from above with white light.

Question D:

In her Physics lab, Shari uses a diffraction grating with a groove spacing of 3.45×10^{-6} m. She shines a white light through the grating and observes the interference patterns on a screen, 1.50 m away.

- a) How far from the central maximum is the location of the first spot of 650 nm red light?
- b) How far from the central maximum is the location of the first spot of 450 nm blue light?

Question E:

Solar cells are often coated with a transparent thin film such as silicon monoxide to minimize reflective losses. Suppose a solar cell ($n = 3.50$) is coated with a thin film of silicon monoxide ($n = 1.45$). Determine the minimum thickness of the film that will cause destructive interference in light of wavelength 552 nm in air (381 nm in the film).