

# LET THERE BE LIGHT

1. Why do windows on a building look darker during the daytime than the building itself?

Light goes in the window but does not come out. Room absorbs the light inside.

2. Why does wet sand look darker than dry sand?

Wet sand absorbs some light by refraction like a lens. Dry sand reflects more light like a mirror.

3. What is TIR? How does it apply to optical fibers? Sketch the cross-section of a typical fiber.

Total Internal Reflection. Light is trapped in a transparent material like plastic or glass by TIR. In fiber optics, information is carried by TIR.

4. Why does a diamond sparkle? Calculate its critical angle (assume it's surrounded by air).

$\theta_c = \sin^{-1}\left(\frac{1}{2.417}\right) = 24.41^\circ$ . Light is flipped inside diamond by refraction and TIR.

5. Calculate the critical angle for light passing from crown glass to air. Compare to diamond.

$$\theta_c = \sin^{-1}\left(\frac{1}{1.52}\right) = 41.14^\circ$$

6. Define dispersion. Draw a sketch and explain what happens to white light entering a prism.

Dispersion means breaking up or spreading out. When white light passes through a prism or a diffraction grating, it breaks into a rainbow.

7. What conditions are necessary for viewing a rainbow? Draw a sketch and explain how it is formed.

Grass says eyes. Angle of sunlight hitting raindrop has to be between 40 and 42 degrees. Sunlight hitting raindrop has to be between 40 and 42 degrees. It breaks into a rainbow.

8. What conditions are necessary for viewing an inferior mirage? How is it formed? Is it a result of reflection or refraction? Draw a sketch and explain.

Colder air is denser, hotter less dense. Light rays bend away from the normal. Air, real water, secondary rainbow, primary rainbow.

9. Some eyeglasses for near vision darken upon exposure to daylight. The process is reversed when the exposure to sunlight is removed (so-called "transition lenses"). What causes this reversible change?

Chem. reaction:  $AgBr \xrightarrow{\text{light}} Ag^+ + Br^-$ . Colorless (AgBr) turns Purple (Ag<sup>+</sup>) and Brown (Br<sup>-</sup>).

10. H.G. Wells' Invisible Man was invisible because he changed his body's index of refraction to an appropriate chosen value. What was this value? Could such an invisible man see anything at all?

$n$  would have to be 1 (same as air).

Retina. ND does not focus on retina.

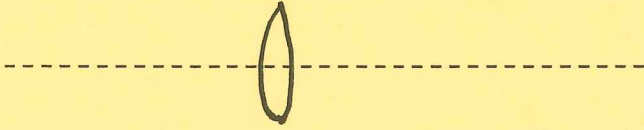
11. Can you get a sunburn or otherwise damage your skin on a cloudy day or through glass? Explain.

Yes, Ultra Violet passes through.

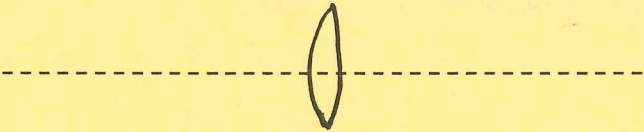
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## HOCUS FOCUS

1. A converging lens has a focal length of 16 cm. An object is placed 40 cm in front of the lens. Draw a lens ray diagram and calculate the position and magnification of the image. What type of image is formed?

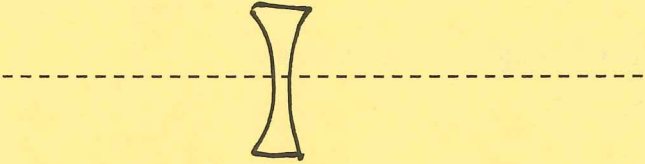


2. An object is placed 50 cm from a converging lens of 75 cm focal length. Draw a lens ray diagram and calculate the position and magnification of the image. What type of image is formed?

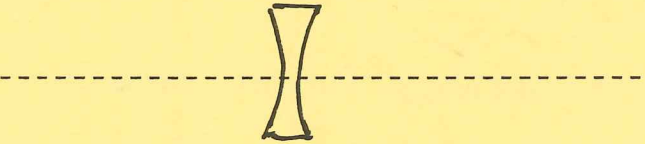


3. An object 60 cm from a lens produces a real image 40 cm from the lens. Calculate the focal length of the lens.

4. An object is placed 108 cm from a diverging lens of -36 cm focal length. Draw a lens ray diagram and calculate the position and magnification of the image. What type of image is formed?



5. An object is placed 1.2 m from a diverging lens of -0.40 m focal length. Draw a lens ray diagram and calculate the position and magnification of the image. What type of image is formed?



6. What happens to the focal length of a magnifying glass when placed under water? Why?

7. How are your eyes able to see? Why does it help to wear a mask underwater?

8. Would a convex-shaped air bubble under water converge or diverge light? Does the object look larger or smaller?

9. Why does the moon have a reddish hue during a lunar eclipse?

10. Why is it not a good idea to water your lawn during the daytime? When is the optimum time?