Understanding the Physical World

Homework # 13 Solutions

Correct answers for multiple choice questions are in **bold type**.

1: Which of the following are statements are true? Include all that apply.

A) The speed of light is different in different materials.

B) Blue light refracts (bends) more as it passes through a water droplet than red light.

C) Electromagnetic waves transport electrical charge.

D) Some wavelengths of light can pass through materials like brick walls.

E) Light is an electromagnetic wave with its electric- and magnetic-field vectors pointing perpendicularly to the direction of propagation.

2: A stick is partially submerged in a jar of water. The portion in the water appears to be fatter than the portion above the water. This is due to

A) refraction

B) diffraction

C) reflection

D) dispersion

3: Rianbows are the result of

A) both dispersion and reflection

B) diffraction

C) reflection only

D) refraction

4: A slide projector is used to project an image on a wall 410 cm away. The slide is placed 8.5 cm from the lens. What is the focal length of the lens?

$D_I = 410$ cm *and* $D_O = 8.5$ cm *so*

$$\frac{1}{f} = \frac{1}{D_O} + \frac{1}{D_I} = \frac{1}{(8.5\text{ cm})} + \frac{1}{(410\text{ cm})} = 0.12086\text{ cm}^{-1}$$

$$\rightarrow \quad f = \frac{1}{0.12086\text{ cm}^{-1}} = 8.3\text{ cm}$$

5: What is the magnification of the image?

$$M = -\frac{D_I}{D_O} = \frac{(410\text{ cm})}{(8.5\text{ cm})} = -48.2$$

6: Is the image upright or inverted?

The negative magnification indicates that the image is inverted.

7: A physics professor is near sighted and must wear glasses to see distant objects. Her far point is 0.65 m. If she wants to see very distant objects, what power lens (diopters) does she need in her glasses? Do not include units. HINT: Take the object distance to be infinite.

$$P = \frac{1}{f} = \frac{1}{D_O} + \frac{1}{D_I}$$

but since $D_O \to \infty$, $1/D_O = 0$. *For farsightedness, we want to bring the image to the far point. So*

$$P = \frac{1}{D_I} = \frac{1}{(0.65\text{ m})} = 1.53\text{ d.}$$

8: The same professor also is far sighted (uh-oh, bifocals!) with a near point of 0.32 m. If she wants to read at a comfortable distance of 0.25 m, what power of lens does she need?

In this case, we want to take the image out to the near point. So $D_I = -0.32$ m. *The negative sign is there because we want the image on the front side. Also* $D_O = 0.25$ m.

$$P = \frac{1}{f} = \frac{1}{D_O} + \frac{1}{D_I} = \frac{1}{(0.25\text{ m})} + \frac{1}{(-0.32\text{ m})} = 0.875\text{ d.}$$