

What are Lenses?

Worksheet

A lens refracts light at two curved surfaces to form an image; the thin lens equation $1/f = 1/d_o + 1/d_i$ relates focal length, object distance and image distance.

$$1/f = 1/d_o + 1/d_i$$

f = focal length (m)

d_o = object distance (m)

d_i = image distance (m)

Questions

1. Which lens is thicker at the center than the edges?
A) Diverging lens
B) Converging lens
C) Flat lens
D) Neither
2. An object placed inside a converging lens's focal length produces...
A) A real, inverted image
B) A virtual, upright, magnified image
C) No image at all
D) A real, reduced image
3. For $f = 10$ cm and $d_o = 30$ cm, what is d_i ?
A) 7.5 cm
B) 15 cm
C) 20 cm
D) -15 cm
4. A diverging lens always produces...
A) A real image
B) A virtual, upright, reduced image
C) A magnified real image
D) No refraction
5. An object sits 30 cm from a converging lens with $f = 10$ cm. Find the image distance.
6. An object sits 5 cm from the same lens ($f = 10$ cm), inside the focal length. Find the image.
7. An object is 20 cm from a diverging lens with $f = -15$ cm. Find the image distance.
8. Define: Converging vs diverging lens?
9. Define: What is the focal point?
10. Define: Real vs virtual image?

Answer Key

1. B) Converging lens — Converging (convex) lenses bulge outward and are thickest at the center.
2. B) A virtual, upright, magnified image — Inside f , the lens acts like a magnifying glass — image is virtual, upright and enlarged.
3. B) 15 cm — $d_i = (10 \times 30)/(30 - 10) = 15$ cm.
4. B) A virtual, upright, reduced image — Diverging lenses only ever form virtual, upright, reduced images.
5. $d_i = f \cdot d_o / (d_o - f)$ $d_i = (10 \times 30)/(30 - 10) = 300/20$ $d_i = 15$ cm (real image)
6. $d_i = (10 \times 5)/(5 - 10) = 50/-5$ $d_i = -10$ cm $\rightarrow$ virtual, upright, magnified image (like a magnifying glass)
7. $d_i = (-15 \times 20)/(20 - (-15)) = -300/35$ $d_i \approx -8.6$ cm $\rightarrow$ virtual, reduced image
8. A converging (convex) lens bends light inward to a focal point; a diverging (concave) lens spreads light outward.
9. The point where parallel rays meet (or appear to originate) after passing through the lens.
10. A real image forms where light rays actually meet and can be projected; a virtual image only appears to form and can't be projected.

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