HW 5

Note: $g = 10$ m/s^2

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

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

$n = \frac{3 \times 10^8}{2.7 \times 10^8}$

$= 1.11$ ✓

1. Light traveling through air encounters a second medium which slows the light to 2.7 x 10^8 m/s. What is the index of the second medium?

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

$2 = \frac{3 \times 10^8}{v}$

$v = 1.5 \times 10^8$

2. What is the velocity of light in meters per second in a material with an index of refraction 2.0?

$\theta = 15$

3. If the index of refraction for a certain glass is 1.5, and the angle of refraction is 15 degrees for a ray of light traveling from air, what is the angle of incidence?

$n_1 \sin\theta = n_2 \sin\theta_2$
$1.5 \sin 15 = 1 \sin\theta_2$
$\theta_2 = 22.84$

4. A ray of light traveling from air into crown glass (n=1.52) strikes the surface at an angle of 30 degrees. What will the angle of refraction be? $1.52 \sin\theta = 1 \sin 30$
$\theta = 19.2$

5. A convex lens has focal length 20 cm. Calculate at what distance from the lens should the object be placed so that it forms an image at 40 cm on the other side of the lens.

$\frac{1}{f} = \frac{1}{d_o} - \frac{1}{d_i}$ d_i $f = 0.2$

$\frac{1}{0.2} = \frac{1}{d_o} + \frac{1}{0.4}$

$5 = \frac{1}{d_o} + 2.5$ $\boxed{d_o = 0.4}$

6. The focal length of a convex lens is 20 cm. If an object of height 2 cm is placed at 30 cm from the lens, what is the position of the image produced by the lens? d_i $h_o = 0.02$ $d_o = 0.3$

$\frac{1}{0.2} = \frac{1}{0.3} + \frac{1}{d_i}$
$5 = 3.33 + \frac{1}{d_i}$ $\boxed{d_i = 0.6}$

7. The focal length of a convex lens is 20 cm. If an object of height 2 cm is placed at 30 cm from the lens, what is the magnification of the object? $M = -\frac{d_i}{d_o} = \frac{-0.6}{0.3} = -2$

8. We have a convex lens with a focal length of 15 cm. We wish to place an object so that the final image will be 1/3 the size of the object. Where should we place that object? $d_i = \frac{1}{3} d_o$ / $\frac{1}{f} = \frac{1}{d_i} + \frac{1}{d_o}$

$\frac{1}{0.15} = \frac{3}{d_o} + \frac{1}{d_o}$

✗ $6.66 = \frac{4}{d_o}$ $d_o = 0.6$

9. A convex lens with a focal length of 15 cm is placed 25 cm from a lighted object. At what distance will an image be formed? Will it be real? $d_o = 0.6$

$\frac{1}{f} = \frac{1}{d_i} + \frac{1}{d_o}$ $6.66 = \frac{1}{d_i} + 4$
$\frac{1}{0.15} = \frac{1}{d_i} + \frac{1}{0.25}$ $d_i = \frac{1}{2.66} = 0.375$ Yes, real

$\boxed{d_i = -0.338}$

10. A lens produces a virtual image located 33.8 cm from the lens when the object is located 18.5 cm from the lens. Determine the focal length of the lens. $\frac{1}{f} = \frac{-1}{0.338} + \frac{1}{0.185}$ $d_o = 0.185$
$= -2.95 + 5.405 = 0.40$ m

11. A diverging lens has a focal length of -12.8 cm. An object is placed 34.5 cm from the lens's surface. Determine the image distance. $\frac{1}{f} = \frac{1}{d_i} + \frac{1}{d_o}$ $d_o = 0.345$ virtual image
$-0.078 = \frac{1}{d_i} + 2.898$ $d_i = \frac{1}{-2.97} = -0.335$ ✗ -0.0934

12. A magnified, inverted image is located a distance of 32 cm from a converging lens with a focal length of 12 cm. Determine the object distance and tell whether the image is real or virtual. $d_i = 0.32$ $f = 0.12$
$\frac{1}{0.12} = \frac{1}{0.32} + \frac{1}{d_o}$
$8.33 = 3.125 + \frac{1}{d_o}$ $d_o = 0.192$ ✓

13. An object located 32 cm in front of a lens forms an image on a screen 8 cm behind the lens. (a) Find the focal length of the lens. (b) Determine the magnification. (c) Is the lens converging or diverging?

$d_o = 0.32$
$d_i = 0.08$
$f = 0.064$ m

$M = -\frac{d_i}{d_o} = -0.25$

→ virtual

$$-\frac{1}{0.32} = \frac{1}{d_i} + \frac{1}{0.2} \longrightarrow d_i = -0.123$$

$$-3.125 = \frac{1}{d_i} + 5$$

14. An object is located <u>20 cm</u> to the left of a <u>diverging lens</u> having a focal length f=−32 cm. Determine (a) the location and (b) the magnification of the image. (c) Construct a ray diagram for this arrangement. d_i

$d_o = 0.2$ مسافة   (virtual) M $f = -0.32$

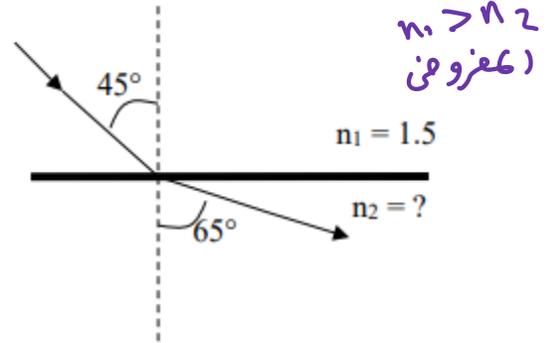$$M = -\frac{d_i}{d_o} = -\frac{(-0.123)}{0.2} = 0.615$$

15. For the drawings below, what is the value of n_2?

$$n_1 \sin\theta_1 = n_2 \sin\theta_2$$

$$1.5 \sin 45 = n_2 \sin 65$$

$$1.06 = n_2 \sin 65$$

$$n_2 = 1.17$$

$n_1 > n_2$
(عزومي في)

$45°$

$n_1 = 1.5$

$n_2 = ?$

$65°$

8) $$h_i = \frac{1}{3} h_o$$

$$m = \frac{h_i}{h_o} = \frac{\frac{1}{3} h_o}{h_o} = \frac{1}{3}$$

$$\frac{-d_i}{d_o} = \frac{1}{3}$$

$$\boxed{d_o = -3 d_i}$$

$$d_o = -3 (0.1)$$

$$= -0.3 \text{ m}$$

يكون الجسم معكوس
الصورة

$$\frac{1}{f} = \frac{1}{d_i} + \frac{1}{d_o}$$

$$\frac{1}{0.15} = \frac{3v}{3 d_i} - \frac{1}{3 d_i}$$

$$6.66 = \frac{2}{3 d_i}$$

$$19.98 d_i = 2$$

$$d_i = 0.1$$