$\boxed{26.1}$

Since $n = c/v \longrightarrow v = \frac{c}{n}$

$n_{Benzene} = 1.501$ (From table 26.1 in the textbook)

$\therefore\ v_{Benzene} = \frac{3.00 \times 10^8 \text{ m/sec}}{1.501} = 1.99866 \times 10^8 \text{ m/sec} = \boxed{2.00 \times 10^8 \text{ m/sec}}$ (to two sig. figures)

26.

$n = 1.5$

$s = 4.0 \times 10^{-3} m$

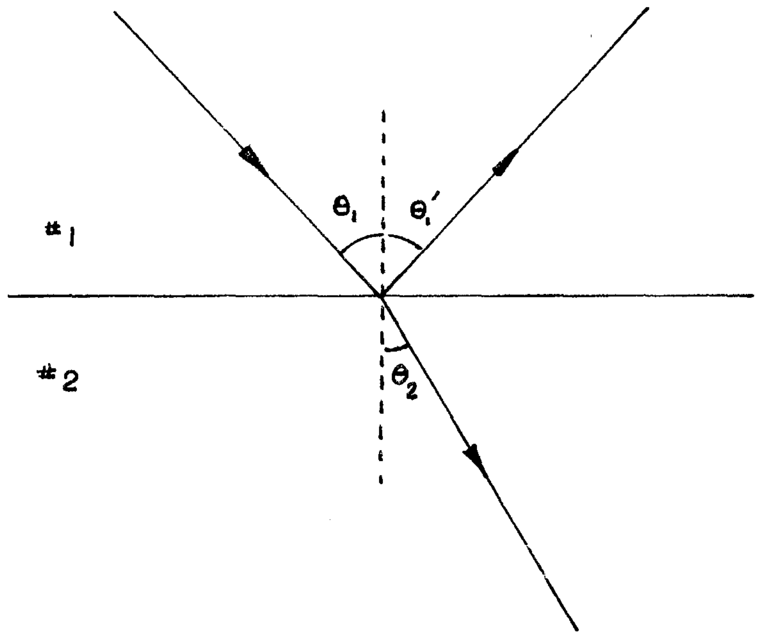
$t = ?$

From $n = c/v \longrightarrow v = \frac{c}{n} = \frac{3.00 \times 10^{8} m/sec}{1.5} = 2.00 \times 10^{8} m/sec.$

Since $s = vt \longrightarrow t = \frac{s}{v}$

$$\therefore t = \frac{4.0 \times 10^{-3} m}{2.00 \times 10^{8} m/sec} = \boxed{2.0 \times 10^{-11} sec}$$

$\boxed{26.9}$



with $\theta_1 = 43°$ and with substances #1 & #2 being air and water respectively:

a. $\theta_1' = \theta_1 = \boxed{43°}$ (law of reflection)

b. Since $n_2 \sin\theta_2 = n_1 \sin\theta_1$,

$$\sin\theta_2 = \left(\frac{n_1}{n_2}\right)\sin\theta_1$$

$$n_1 = n_{air} = 1.000293$$
$$n_2 = n_{water} = 1.333$$

$$\therefore \sin\theta_2 = \left(\frac{1.000293}{1.333}\right)\sin 43° = 0.5117765$$

and

$$\theta_2 = \sin^{-1}(0.5117765) = \boxed{31°}$$

$\boxed{26.23}$

As light travels from a substance with a higher index of refraction n_1 and into a substance with a lower index of refraction n_2, Snell's law predicts that the angle of refraction θ_2 will be greater than the angle of incidence θ_1. See fig. 1.

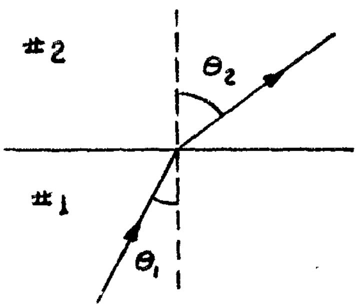


fig. 1

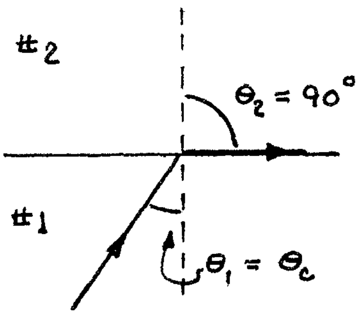


fig. 2

The critical angle θ_c is the angle of incidence that produces an angle of refraction of 90°. See fig. 2.

From Snell's law, $n_1 \sin\theta_1 = n_2 \sin\theta_2$

therefore, $n_1 \sin\theta_c = n_2 \sin 90°$

Since $\sin 90° = 1$, $\quad n_1 \sin\theta_c = n_2 \longrightarrow n_1 = \dfrac{n_2}{\sin\theta_c}$

$$\therefore\ n_1 = \frac{n_{air}}{\sin 40.5°} = \frac{1.0003}{0.64945} = \boxed{1.54}$$

$\boxed{26.26}$

$n_{CS_2} = 1.632$
$n_{air} = 1.000$

The critical angle is that angle the light makes in the material of higher index of refraction (CS_2) that produces an angle of $90°$ in the material of lower index of refraction. When this condition is applied to Snell's law

$$n_{CS_2} \sin\theta_{crit.} = n_{air} \sin 90° = n_{air}$$

$$\therefore \theta_{crit.} = \sin^{-1}\left(\frac{n_{air}}{n_{CS_2}}\right) = \sin^{-1}\left(\frac{1.000}{1.632}\right) = 37.7882572°$$

Rounded to four significant figures, $\theta_{crit.} = \boxed{37.79°}$

$\boxed{26.44}$

$f = -32$ cm.
$d_o = 19$ cm.

a. Since $\frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{f}$

$$d_i = \frac{d_o f}{d_o - f} = \frac{(19\,\text{cm})(-32\,\text{cm})}{51\,\text{cm.}} = -11.92156863\,\text{cm.}$$

$\therefore\ d_i = \boxed{-12\ \text{cm.}}$ rounded to two significant figures.

b. $$m = \frac{-d_i}{d_o} = \frac{-(-11.92156863\,\text{cm})}{19\,\text{cm.}} = \boxed{0.63}$$

c. Because the image is located on the incident side (i.e. d_i is negative), it is a $\boxed{\text{virtual}}$ image.

d. The image is $\boxed{\text{upright}}$ because the magnification is positive.

e. The image is $\boxed{\text{reduced}}$ because $|m| < 1$.

$\boxed{26.49}$

$f = -25$ cm.
$d_i = ?$
$d_o = 38$ cm.

a. From the thin lens equation $\frac{1}{d_i} = \frac{1}{f} - \frac{1}{d_o}$. You may use an algebraic rearrangement of this equation to find d_i more directly:

$$d_i = \frac{d_o f}{d_o - f} = \frac{(38\text{cm})(-25\text{cm})}{38\text{cm} - (-25\text{cm})} = -15.08 \text{ cm.}$$

Rounded to two significant figures, $d_i = \boxed{-15 \text{ cm.}}$

b. Because the image distance is negative, the image is located on the incident side of the lens (not a location for a real image). Therefore the image is $\boxed{\text{virtual}}$

$\boxed{26.63}$

$f_1 = 12.0\text{ cm.}$
$d = 30.0\text{ cm.}$
$f_2 = -6.00\text{ cm.}$
$d_{o_1} = 36.0\text{ cm.}$

a. To find d_{i_2}, the distance of the final image from the diverging lens, we first determine d_{i_1}:

$$d_{i_1} = \frac{d_{o_1} f_1}{d_{o_1} - f_1} = \frac{(36.0\text{cm})(12.0\text{cm})}{24.0\text{ cm.}} = 18.0\text{cm}$$

Because the diverging lens (lens #2) is 30.0cm behind the converging lens (lens #1), the real image formed 18.0cm. behind lens #1 becomes an object to lens #2 and appears $d_{o_2} = d - d_{i_1} = 30.0\text{cm} - 18.0\text{cm} = 12.0\text{cm}$ ahead of lens #2. Therefore, with $d_{o_2} = 12.0\text{cm}$

$$d_{i_2} = \frac{d_{o_2} f_2}{d_{o_2} - f_2} = \frac{(12.0\text{cm})(-6.00\text{cm})}{18.00\text{cm}} = \boxed{-4.00\text{cm}}$$

The image is 4.00 cm on the incident side of lens #2.

b. $$m_1 = \frac{-d_{i_1}}{d_{o_1}} = \frac{-(18.0\text{cm})}{36.0\text{cm.}} = -0.500$$

$$m_2 = \frac{-d_{i_2}}{d_{o_2}} = \frac{-(-4.00\text{cm})}{12.0\text{ cm.}} = 0.333\cdots$$

$$\therefore\ m = m_1 m_2 = (-0.500)(0.333\cdots) = -0.16666\cdots \text{ or } \boxed{-0.167}$$

c. Because the image is on the incident side of lens #2 (as shown in part a.), the image is $\boxed{\text{virtual}}$

d. Because the total magnification, $m = -0.167$, is negative, the final image is $\boxed{\text{inverted}}$ relative to the object and

e. is $\boxed{\text{smaller}}$ than the original object because the magnitude of m is less than one.

$\boxed{26.66}$

$f_1 = 9.00\text{ cm.}$
$f_2 = 6.00\text{ cm.}$
$s = 18.0\text{ cm.}$
$d_{o_1} = 12.0\text{ cm.}$

a. $d_{i_1} = \dfrac{d_{o_1} f_1}{d_{o_1} - f_1} = \dfrac{(12.0\text{cm})(9.00\text{cm})}{12.0\text{cm} - 9.00\text{cm}} = 36.0\text{ cm.}$

$d_{o_2} = s - d_{i_1} = 18.0\text{cm} - 36.0\text{cm.} = -18.0\text{cm.}$

$d_{i_2} = \dfrac{d_{o_2} f_2}{d_{o_2} - f_2} = \dfrac{(-18.0\text{cm})(6.00\text{cm})}{-18.0\text{cm.} - 6.00\text{cm.}} = \boxed{4.50\text{ cm.}}$

b. $m_1 = \dfrac{-d_{i_1}}{d_{o_1}} = -\dfrac{(36.0\text{ cm})}{12.0\text{cm.}} = -3.00$

$m_2 = \dfrac{-d_{i_2}}{d_{o_2}} = \dfrac{-(4.50\text{cm})}{-18.0\text{cm.}} = 0.250$

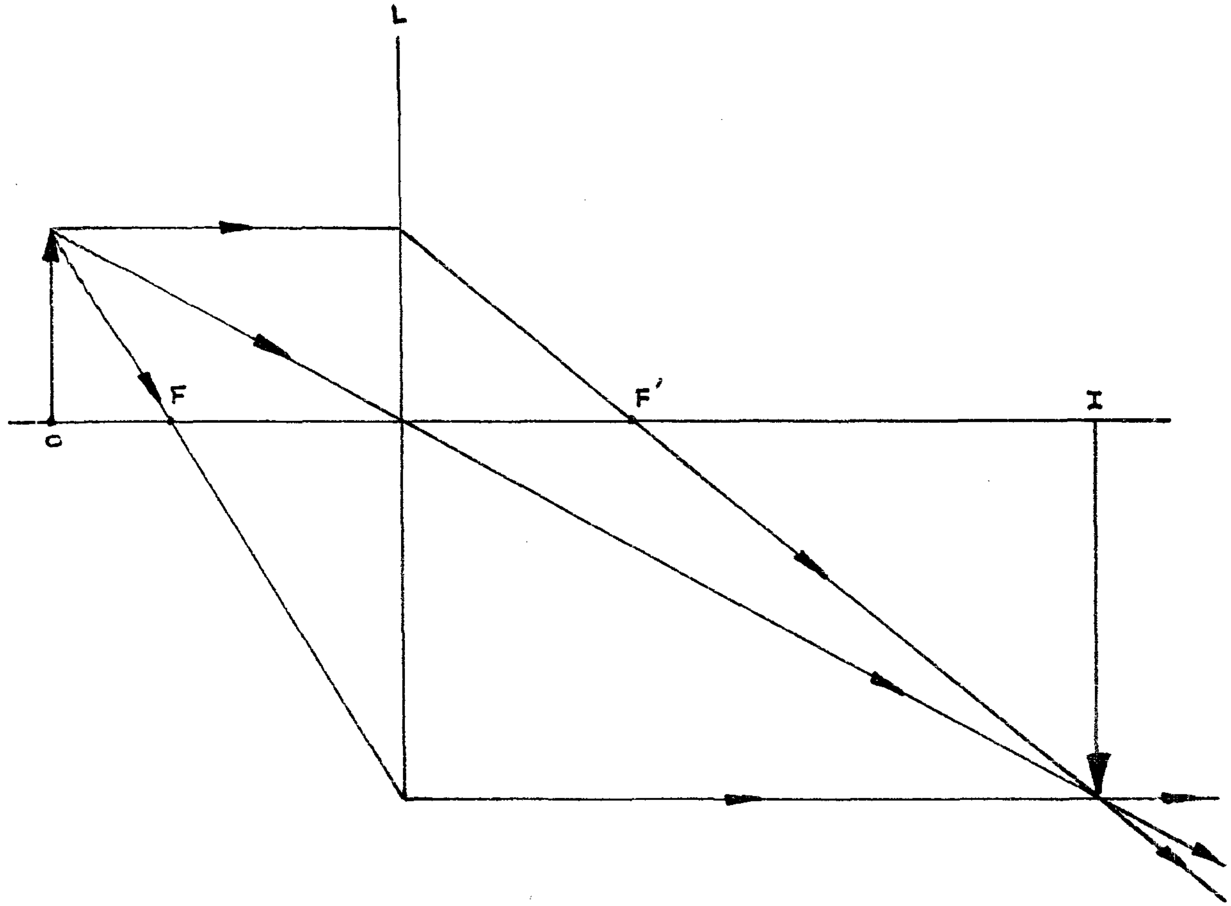
$\therefore\ m = m_1 m_2 = (-3.00)(0.250) = \boxed{-0.750}$

c. The final image is located $+4.50$cm away from lens #2. That puts the image on the refracted side of lens #2 (where real images form.) Therefore, the final image is $\boxed{\text{real.}}$

d. Because the overall magnification (-0.750) is negative, the final image is $\boxed{\text{inverted.}}$

e. Because $|m| < 1$, the final image is $\boxed{\text{smaller.}}$

26.97



I dont know what sort of paper the author expected you to use to do this problem if we don't scale down the dimensions. Here, I've let 5.0 cm = 1.0 in. and have arbitrarily chosen an object height of one inch. I've placed my object 1.8 in. on the incident side of the lens (to correspond to 9.0 cm) and have observed an image 3.6 in o the refracted side of the lens – which means the image is $\boxed{\text{18 cm away.}}$

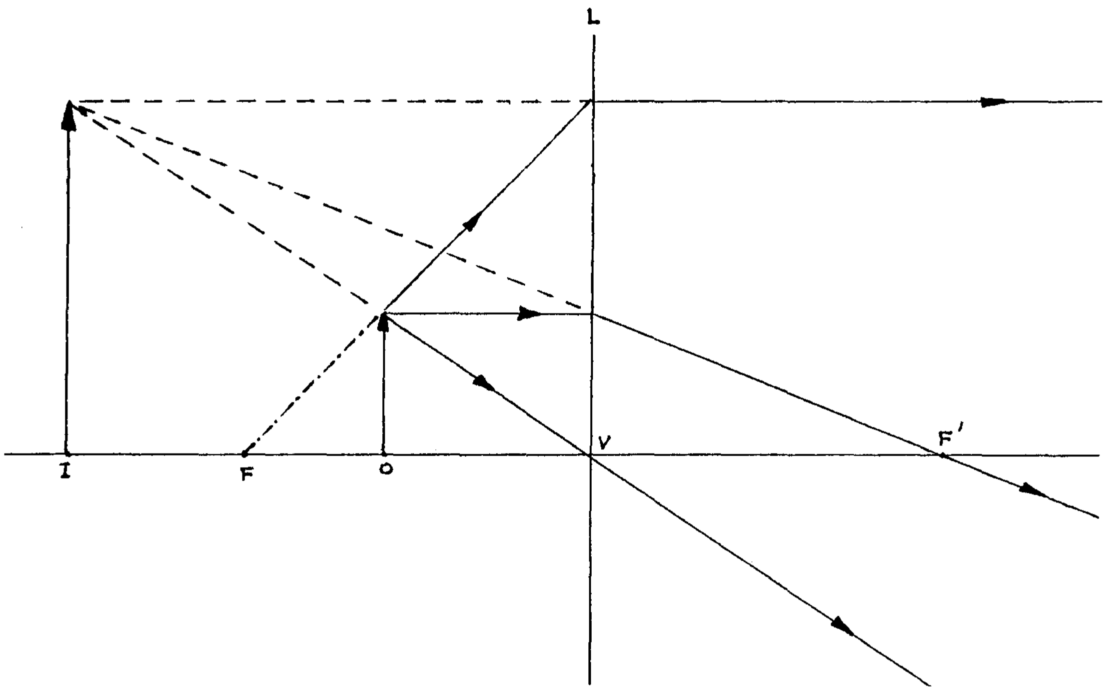
26.103

$d_o = 30.0\,\text{cm}.$

$f = 50.0\,\text{cm}.$

$$d_i = \frac{d_o f}{d_o - f} = \frac{(30.0\,\text{cm})(50.0\,\text{cm})}{30.0\,\text{cm} - 50.0\,\text{cm}} = -75.0\,\text{cm}.$$

$$m = \frac{-d_i}{d_o} = \frac{-(-75.0\,\text{cm})}{30.0\,\text{cm}.} = 2.5$$



26.103