Physics 41 HW #9 Chapter 36 Solutions Serway 8th Edition

Ch 36: 51, 52, 55, 56, 63

51. A camera is being used with a correct exposure at *f*/4 and a shutter speed of (1/16) s. In order to photograph a rapidly moving subject, the shutter speed is changed to (1/128) s. Find the new *f*-number setting needed to maintain satisfactory exposure.

P36.51 The same light intensity is received from the subject, and the same light energy on the film is required:

$$IA_1\Delta t_1 = IA_2\Delta t_2$$

$$\frac{\pi d_1^2}{4}\Delta t_1 = \frac{\pi d_2^2}{4}\Delta t_2$$

$$\left(\frac{f}{4}\right)^2\left(\frac{1}{15}\text{ s}\right) = d_2^2\left(\frac{1}{125}\text{ s}\right)$$

$$d_2 = \sqrt{\frac{125}{15}}\frac{f}{4} = \frac{f}{1.39} = \boxed{\frac{f}{1.4}}$$

52. A nearsighted person cannot see objects clearly beyond 25.0 cm (her far point). If she has no astigmatism and contact lenses are prescribed for her, what power and type of lens are required to correct her vision?

P36.52 (a) $P = \frac{1}{f} = \frac{1}{p} + \frac{1}{q} = \frac{1}{\infty} - \frac{1}{0.250\text{ m}} = \boxed{-4.00\text{ diopters}}$

(b) The power is negative: a $\boxed{\text{diverging lens}}$.

55. The distance between eyepiece and objective lens in a certain compound microscope is 23.0 cm. The focal length of the eyepiece is 2.50 cm, and that of the objective is 0.400 cm. What is the overall magnification of the microscope?

P36.55 Using Equation 36.26, $M \approx -\left(\frac{L}{f_o}\right)\left(\frac{25.0\text{ cm}}{f_e}\right) = -\left(\frac{23.0\text{ cm}}{0.400\text{ cm}}\right)\left(\frac{25.0\text{ cm}}{2.50\text{ cm}}\right) = \boxed{-575}$

56. The Yerkes refracting telescope has a 1.00-m diameter objective lens of focal length 20.0 m. Assume it is used with an eyepiece of focal length 2.50 cm. (a) Determine the magnification of the planet Mars as seen through this telescope. (b) Are the Martian polar caps right side up or upside down?

P36.56 $f_o = 20.0\text{ m}$, $f_e = 0.025\,0\text{ m}$

(a) The angular magnification produced by this telescope is $m = -\frac{f_o}{f_e} = \boxed{-800}$.

(b) Since $m < 0$, the image is $\boxed{\text{inverted}}$.

63. The lens and mirror in Figure P36.63 are separated by d = 1.00 m and have focal lengths of +80.0 cm and −50.0 cm, respectively. An object is placed p = 1.00 m to the left of the lens as shown. (a) Locate the final image, formed by light that has gone through the lens twice. (b) Determine the overall magnification of the image and (c) state whether the image is upright or inverted.

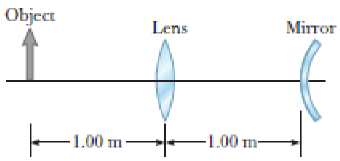

Figure P36.63

P36.63 (a) Start with the first pass through the lens.

$$\frac{1}{q_1}=\frac{1}{f_1}-\frac{1}{p_1}=\frac{1}{80.0\text{ cm}}-\frac{1}{100\text{ cm}} \qquad q_1=+400\text{ cm}$$

or 400 cm to right of the lens.

The object of the mirror is 400 cm – 100 cm = 300 cm to the right of the mirror, so the object is virtual. Therefore, for the mirror, $p_2 = -300$ cm:

$$\frac{1}{q_2}=\frac{1}{f_2}-\frac{1}{p_2}=\frac{1}{(-50.0\text{ cm})}-\frac{1}{(-300\text{ cm})} \qquad q_2=-60.0\text{ cm}$$

or 60.0 cm to the right of the mirror.

The image formed by the mirror is 100 cm + 60 cm = 160 cm to the right of the lens.

Therefore, for the second pass through the lens, $p_3 = 160$ cm:

$$\frac{1}{q_3}=\frac{1}{f_1}-\frac{1}{p_3}=\frac{1}{80.0\text{ cm}}-\frac{1}{160\text{ cm}} \qquad q_3=\boxed{160\text{ cm to the left of lens}}$$

(b) $$M_1=-\frac{q_1}{p_1}=-\frac{400\text{ cm}}{100\text{ cm}}=-4.00 \qquad M_2=-\frac{q_2}{p_2}=-\frac{(-60.0\text{ cm})}{(-300\text{ cm})}=-\frac{1}{5}$$

$$M_3=-\frac{q_3}{p_3}=-\frac{160\text{ cm}}{160\text{ cm}}=-1 \qquad M=M_1M_2M_3=\boxed{-0.800}$$

(c) Since $M < 0$ the final image is $\boxed{\text{inverted}}$.