25.3 The thin lens equation, $\frac{1}{p}+\frac{1}{q}=\frac{1}{f}$, gives the image distance as

$$q=\frac{pf}{p-f}=\frac{(100\text{ m})(52.0\text{ mm})}{100\text{ m}-52.0\times10^{-3}\text{ m}}=52.0\text{ mm}$$

From the magnitude of the lateral magnification, $|M|=h'/h=|-q/p|$, where the height of the image is $h'=0.092\,0\text{ m}=92.0\text{ mm}$, the height of the object (the building) must be

$$h=h'\left|-\frac{p}{q}\right|=(92.0\text{ mm})\left|-\frac{100\text{ m}}{52.0\text{ mm}}\right|=\boxed{177\text{ m}}$$

25.4 The image distance is $q\approx f$ since the object is so far away. Therefore, the lateral magnification is $M=h'/h=-q/p\approx-f/p$, and the diameter of the Moon's image is

$$h'=|M|h=\left(\frac{f}{p}\right)(2R_{moon})=\left(\frac{120\text{ mm}}{3.84\times10^{8}\text{ m}}\right)\left[2\left(1.74\times10^{6}\text{ m}\right)\right]=\boxed{1.09\text{ mm}}$$

25.12 (a) The lens should form an upright, virtual image at the near point $(q=-100\text{ cm})$ when the object distance is $p=25.0\text{ cm}$. Therefore,

$$f=\frac{pq}{p+q}=\frac{(25.0\text{ cm})(-100\text{ cm})}{25.0\text{ cm}-100\text{ cm}}=\boxed{33.3\text{ cm}}$$

(b) The power is $\mathcal{P}=\frac{1}{f}=\frac{1}{+0.333\text{ m}}=\boxed{+3.00\text{ diopters}}$

25.13 (a) The lens should form an upright, virtual image at the far point $(q=-50.0\text{ cm})$ for very distant objects $(p\approx\infty)$. Therefore, $f=q=-50.0\text{ cm}$, and the required power is

$$\mathcal{P}=\frac{1}{f}=\frac{1}{-0.500\text{ m}}=\boxed{-2.00\text{ diopters}}$$

(b) If this lens is to form an upright, virtual image at the near point of the unaided eye $(q=-13.0\text{ cm})$, the object distance should be

$$p=\frac{qf}{q-f}=\frac{(-13.0\text{ cm})(-50.0\text{ cm})}{-13.0\text{ cm}-(-50.0\text{ cm})}=\boxed{17.6\text{ cm}}$$

25.16 (a) The upper portion of the lens should form an upright, virtual image of very distant objects $(p \approx \infty)$ at the far point of the eye $(q = -1.5 \text{ m})$. The thin lens equation then gives $f = q = -1.5 \text{ m}$, so the needed power is

$$\mathcal{P} = \frac{1}{f} = \frac{1}{-1.5 \text{ m}} = \boxed{-0.67 \text{ diopters}}$$

(b) The lower part of the lens should form an upright, virtual image at the near point of the eye $(q = -30 \text{ cm})$ when the object distance is $p = 25 \text{ cm}$. From the thin lens equation,

$$f = \frac{pq}{p+q} = \frac{(25 \text{ cm})(-30 \text{ cm})}{25 \text{ cm} - 30 \text{ cm}} = +1.5 \times 10^2 \text{ cm} = +1.5 \text{ m}$$

Therefore, the power is $\mathcal{P} = \frac{1}{f} = \frac{1}{+1.5 \text{ m}} = \boxed{+0.67 \text{ diopters}}$

25.17 (a) The simple magnifier (a converging lens) is to form an upright, virtual image located 25 cm in front of the lens $(q = -25 \text{ cm})$. The thin lens equation then gives

$$p = \frac{qf}{q-f} = \frac{(-25 \text{ cm})(7.5 \text{ cm})}{-25 \text{ cm} - 7.5 \text{ cm}} = +5.8 \text{ cm}$$

so the stamp should be placed $\boxed{\text{5.8 cm in front of the lens}}$

(b) When the image is at the near point of the eye, the angular magnification produced by the simple magnifier is

$$m = m_{\max} = 1 + \frac{25 \text{ cm}}{f} = 1 + \frac{25 \text{ cm}}{7.5 \text{ cm}} = \boxed{4.3}$$

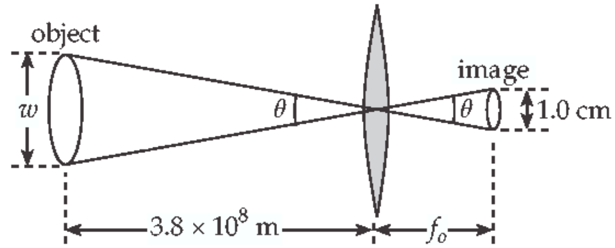
25.18 (a) With the image at the normal near point $(q = -25 \text{ cm})$, the angular magnification is

$$m = 1 + \frac{25 \text{ cm}}{f} = 1 + \frac{25 \text{ cm}}{25 \text{ cm}} = \boxed{+2.0}$$

(b) When the eye is relaxed, parallel rays enter the eye and

$$m = \frac{25 \text{ cm}}{f} = \frac{25 \text{ cm}}{25 \text{ cm}} = \boxed{+1.0}$$

25.26 The moon may be considered an infinitely distant object $(p \to \infty)$ when viewed with this lens, so the image distance will be $q = f_o = 1\,500 \text{ cm}$.



Considering the rays that pass undeviated through the center of this lens as shown in the sketch, observe that the angular widths of the image and the object are equal. Thus, if w is the linear width of an object forming a 1.00 cm wide image, then

$$\theta = \frac{w}{3.8 \times 10^8 \text{ m}} = \frac{1.0 \text{ cm}}{f_o} = \frac{1.0 \text{ cm}}{1\,500 \text{ cm}}$$

or $$w = \left(3.8 \times 10^8 \text{ m}\right)\left(\frac{1.0 \text{ cm}}{1\,500 \text{ cm}}\right)\left(\frac{1 \text{ mi}}{1\,609 \text{ m}}\right) = \boxed{1.6 \times 10^2 \text{ mi}}$$

25.28 Use the larger focal length (lowest power) lens as the objective element and the shorter focal length (largest power) lens for the eye piece. The focal lengths are

$$f_o = \frac{1}{+1.20 \text{ diopters}} = +0.833 \text{ m}, \text{ and } f_e = \frac{1}{+9.00 \text{ diopters}} = +0.111 \text{ m}$$

(a) The angular magnification (or magnifying power) of the telescope is then

$$m = \frac{f_o}{f_e} = \frac{+0.833 \text{ m}}{+0.111 \text{ m}} = \boxed{7.50}$$

(b) The length of the telescope is

$$L = f_o + f_e = 0.833 \text{ m} + 0.111 \text{ m} = \boxed{0.944 \text{ m}}$$