Hecht 5.71:
(Solution in back of text.)

Hecht 5.77:
Solution in back of text is goofed up!

The wording of the problem is also a bit ambiguous. The statement that the object is “imaged 30 cm from the eyepiece” is meant to indicate that the intermediate image formed by the objective is located 30 cm in front of the eyepiece. One is not meant to interpret the “astronomical telescope” as having its lenses separated by the sum of their focal lengths in this problem.

The intermediate real image formed by the objective is indeed located 5 m behind the objective, but the transverse magnification of the objective is then $M_{To} = -5/20 = -0.25$, not $-0.5$ as given in the text.

For the eyepiece, the real image formed by the objective becomes the object, at an object distance of 30 cm in front of the eyepiece (as given). For a focal length of 60 cm, this puts the image at a distance of $-60$ cm from the eyepiece: i.e., a virtual image in front of the eyepiece. The transverse linear magnification by the eyepiece is then $M_{Te} = -(0.6)/0.3 = +2.0$, not $+1.2$ as given in the text.

Finally, the total linear magnification is

$$M_T = M_{To}M_{Te} = (-0.25) \times (2.0) = -0.5 .$$

Hecht 5.87:
(a) The magnifying power of the loupe is

$$MP = \frac{d_0}{f} + 1 = \frac{254\text{ mm}}{25.4\text{ mm}} + 1 = 11 .$$

(b) The magnifier allows the stone to be brought $11\times$ closer to the eye than the near point (which we take to be 254 mm); the virtual image appears at the near point, but subtends an angle $11\times$ greater. Hence it appears to be 55 mm in diameter.

(c) When held at the near point and viewed by the unaided eye, the diamond subtends an angle $\theta_u = \tan^{-1}(5.0/254) \approx 1.1^\circ$.

(d) When held $11\times$ closer and viewed through the magnifier (neglecting the eye–magnifier distance), the diamond subtends and angle $\theta_a = \tan^{-1}[5.0/(254/11)] \approx 12^\circ$.

Hecht 5.88:
(Solution in back of text.)