## Challenge Exercises for Further Study

B-1: $\quad$ The Hale telescope at the Yerkes Observatory in Wisconsin has an objective lens with a focal length of 19 m . (For an object at infinity, the image distance equals the focal length.) If the telescope is used to observe Saturn that is $1275 \times 10^{9} \mathrm{~m}$ from Earth, what will be the apparent diameter of the rings if their actual diameter is $27 \times 10^{7} \mathrm{~m}$ ?

B-2: $\quad$ Dr. Kirwan is preparing a slide show that he will present to the executive board at tonight's committee meeting. He places a $3.50-\mathrm{cm}$ slide behind a lens of 20.0 cm focal length in the slide projector. a) How far from the lens should the slide be placed in order to shine on a screen 6.00 m away? b) How wide must the screen be to accommodate the projected image?

B-3: $\quad$ Madeline is working for the Eye-Spy Detective Agency and her assignment is to secretly photograph the pages of a journal. Madeline's tiny camera has the film located 2.10 cm behind the lens, and she must fill the entire piece of $1.00-\mathrm{cm}$ film with the picture of the $25.0-\mathrm{cm}$-tall document. How close must Madeline be to the journal pages to get a clear image on the film?

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