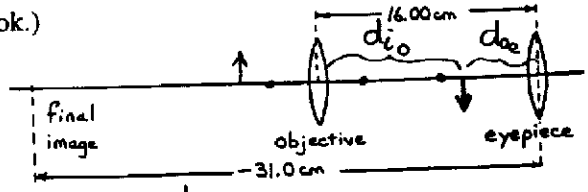
C2. A compound microscope consists of an objective lens of focal length 0.450 cm and an eyepiece lens of focal length 4.00 cm, separated by a distance of 16.0 cm.

(a) Calculate the distance from the objective lens at which an object must be placed so that the image formed by the eyepiece lens is at −31.0 cm. (Note: do not the approximate formula given in the text book.)



0.467 cm

$$d_{o_e} = \left(\frac{1}{f_e} - \frac{1}{d_{i_e}}\right)^{-1} = \left(\frac{1}{4.00\text{cm}} - \frac{1}{(-31.0\text{cm})}\right)^{-1}$$

$$d_{o_e} = 3.54\text{ cm}$$

from diagram, $L = d_{i_o} + d_{o_e}$ so $d_{i_o} = L - d_{o_e}$

$$d_{i_o} = 16.00\text{ cm} - 3.54\text{cm} = 12.46\text{cm}$$

$$d_{o_o} = \left(\frac{1}{f_o} - \frac{1}{d_{i_o}}\right)^{-1} = \left(\frac{1}{0.450\text{cm}} - \frac{1}{12.46\text{cm}}\right)^{-1} = 0.467\text{ cm}$$

(b) For the microscope adjusted as in (a), calculate the magnification obtained when a person with a nearpoint of 25.0 cm uses the microscope.

− 188

$$M = m_o M_e = \left(-\frac{d_{i_o}}{d_{o_o}}\right)\left(\frac{1}{f_e} - \frac{1}{d_{i_e}}\right)N$$

$$M = \left(-\frac{12.46\text{cm}}{0.467\text{cm}}\right)\left(\frac{1}{4.00\text{cm}} - \frac{1}{(-31.0\text{cm})}\right)25.0\text{cm}$$

$M = -188$