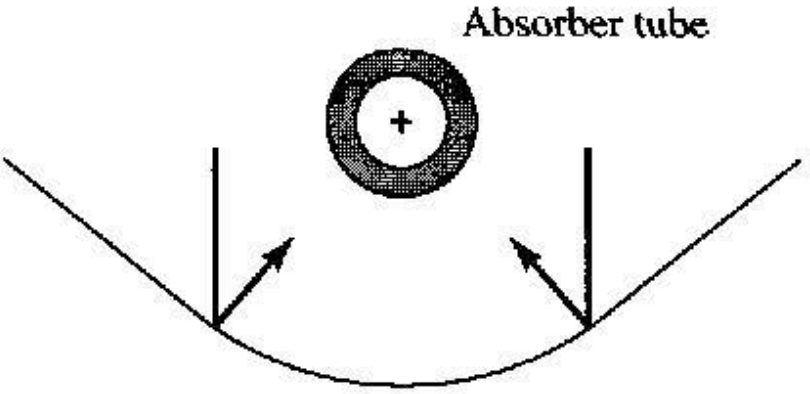

Figure P15.29

Under these conditions, what is the efficiency of the collector, defined as the ratio

$$\varepsilon = \frac{\text{useful heat removal rate } q_u}{\text{insolation}}$$

15.29 A solar water heater is designed as in Fig. P15.29. Water flows through a copper tube of diameter $D = 60$ mm at a flowrate of $w = 0.01$ kg/s. The water enters the tube at $T_i = 20°C$, and we want to heat the water to $T_o = 80°C$. The tube is aligned with the focal point of a parabolic reflector. As a consequence, solar radiation is reflected and concentrated on the tube. From independent measurements, we know that the concentrated heat flux *absorbed* by the tube is $q_s = 2000$ W/m^2. (This is a value averaged over the circumference and length of the tube.)

a. What tube length is required to yield an exit temperature $T_o = 80°C$?

b. What is the surface temperature of the *tube* at the outlet? Ignore radiation losses for this calculation.