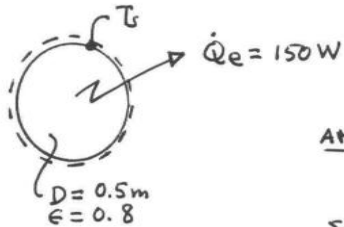


PROBLEM 2.53

KNOWN: Steady-state operating data are provided for a spherical interplanetary probe.

FIND: Determine the surface temperature of the sphere, in K.

SCHEMATIC & GIVEN DATA:



ENGR. MODEL:

1. The probe is at steady state.
2. The probe emits but does not receive radiation.

ANALYSIS: In this case, Eq. 2.32 applies:

$\dot{Q}_e = \epsilon \sigma A T_s^4$, where $A = \pi D^2$ and σ is the Stefan-Boltzmann constant, $5.67 \times 10^{-8} \text{ W/m}^2 \cdot \text{K}^4$. Solving for T_s

$$T_s = \left[\frac{\dot{Q}_e}{\epsilon \pi D^2 \sigma} \right]^{1/4} = \left[\frac{150 \text{ W}}{0.8 \pi (0.5 \text{ m})^2 (5.67 \times 10^{-8} \text{ W/m}^2 \cdot \text{K}^4)} \right]^{1/4} = 255 \text{ K} \leftarrow$$