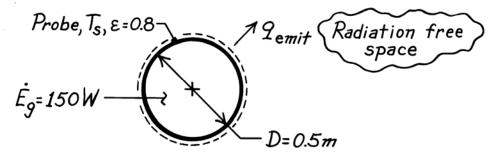
## **PROBLEM 1.25**

**KNOWN:** Diameter and emissivity of spherical interplanetary probe. Power dissipation within probe.

**FIND:** Probe surface temperature.

## **SCHEMATIC:**



**ASSUMPTIONS:** (1) Steady-state conditions, (2) Negligible radiation incident on the probe.

**ANALYSIS:** Conservation of energy dictates a balance between energy generation within the probe and radiation emission from the probe surface. Hence, at any instant

$$\begin{aligned}
-\dot{E}_{out} + \dot{E}_{g} &= 0 \\
\varepsilon A_{s} \sigma T_{s}^{4} &= \dot{E}_{g} \\
T_{S} &= \left(\frac{\dot{E}_{g}}{\varepsilon \pi D^{2} \sigma}\right)^{1/4} \\
T_{S} &= \left(\frac{150W}{0.8\pi (0.5 \text{ m})^{2} 5.67 \times 10^{-8} \text{ W/m}^{2} \cdot \text{K}^{4}}\right)^{1/4}
\end{aligned}$$

$$T_{S} = 254.7 \text{ K}.$$

**COMMENTS:** Incident radiation, as, for example, from the sun, would increase the surface temperature.

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