703.

Problem 49.5 (RHK)

A cavity whose walls are held at 1900 K has a small hole, 1.00 mm in diameter, drilled in its wall. Find the rate at which energy is escaping through this hole from the interior of the cavity.

Solution:
The total radiation power per unit area emitted from a cavity aperture is given by the Stefan-Boltzmann law, which states that

$I(T) = \sigma T^4$,
$\sigma = 5.670 \times 10^{-8}$ W m^{-2} K^{-4} .

Therefore, the rate at which energy will escape from a hole of diameter 1.0 mm from a cavity whose walls are held at 1900 K will be

$$\mathcal{E} = 5.670 \times 10^{-8} \times \pi \times (0.5 \times 10^{-3})^2 \times (1900)^4 \text{ W.}$$
$$= 0.58 \text{ W}$$