Example 2. Graphite particles of 5 mm radius, and 2.2 g/ml density are burnt in 8% oxygen at 1 atm and 900 °C. The rate constant is \(k_s = 20 \text{ cm/s}\). Determine the time it takes to completely burn the particle. The resistance in gas film is negligible.

**Answer:**

\[
\tau = \frac{\rho_b R}{k_s C_{Ag}},
\]

we are given all the values except \(C_{Ag}\). We need \(C_{Ag}\) in g/cm\(^3\).

From ideal gas law,

\[
C_{Ag} = \frac{M_w}{RT} \cdot \frac{P_A}{R} = 32 \times \frac{0.08}{0.08206 \times 1173} = 0.0266 \frac{g}{lit} = 26.6 \times 10^{-6} \frac{g}{cm^3}
\]

\[
\tau = \frac{\rho_b R}{k_s C_{Ag}} = \frac{2.2 g}{cm^3} \times 0.5cm \times \frac{1s}{20cm} \times \frac{cm^3}{26.6 \times 10^{-6} g} = 2068 s \approx 35 \text{ min}
\]