

Tutorial problems and questions

1. What are the units of \mathbf{J} , D and ∇c ?

Answer

1. Units of flux, \mathbf{J} : $\text{m}^{-2} \text{s}^{-1}$

Units of diffusivity, D : $\text{m}^2 \text{s}^{-1}$

Units of ∇c : m^{-1}

2. The diffusivity of atomic hydrogen in steel is given as $10^{-9} \text{ m}^2 \text{ s}^{-1}$. If hydrogen with a concentration of 1 kg m^{-3} is stored in a steel container of thickness 5 mm, calculate the amount of hydrogen that escapes the cylinder (per unit area per second).

Answer

Given: $D = 10^{-9} \text{ m}^2 \text{ s}^{-1}$. The concentration gradient across the wall of the container is 200 kg m^{-4} . Assuming that the steady state is attained after some time, using Fick's first law, we find that the flux is $2 \times 10^{-7} \text{ kg m}^{-2} \text{ s}^{-1}$.