

IV-9

(a) A substance diffuses according to Fick's law, Assuming the diffusing matter is conserved, derive the diffusion equation $\frac{\partial \rho}{\partial t} = k \nabla^2 \rho$

Pf

由連續方程式 $\nabla \cdot J + \frac{\partial \rho}{\partial t} = 0$

$$\frac{\partial \rho}{\partial t} = -\nabla \cdot J = k \nabla \cdot (\nabla \rho) = k \nabla^2 \rho$$

(b) Bacteria of density ρ diffuse in a medium according to Fick's law and reproduce at a rate $\lambda \rho$ per unit volume (λ is a positive constant) Show that

$$\frac{\partial \rho}{\partial t} = k \nabla^2 \rho + \lambda \rho.$$

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$$\frac{\partial \rho}{\partial t} = -\nabla \cdot (\rho v)$$