

Modelling heat transfer using COMSOL Multiphysics

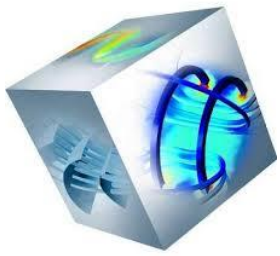
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Problem description

- Model time-dependent heat transfer

$$\rho c_p \frac{\partial T}{\partial t} + \nabla \cdot (-k \nabla T) = Q - \rho c_p \mathbf{u} \cdot \nabla T \quad \text{Generic heat transfer equation}$$



For how long can a man survive in the deep ocean water?

- Boundary temperature: $T = 4 \text{ }^\circ\text{C}$
- Human body heat capacity: $c_p \cong 3470 \text{ J}/(\text{kg} \cdot \text{K})$
- Human body thermal conductivity: $k \cong 0.67 \text{ W}/(\text{m} \cdot \text{K})$
- Metabolic heat production: $Q = 86 \text{ J/s}$ (to be converted in W/m^3)
- Human body density: $\rho \cong 1062 \text{ kg}/\text{m}^3$
- Critical temperature for death: $T_{cr} \cong 25 \text{ }^\circ\text{C}$
- **Human body as a vertical cylinder with 30 cm diameter and 1.8 m length**

