

Notions of Transport Phenomena Final Exam

Closed Notes, Show All Work

Exercise 01 (08 Marks): “About heat transfer”

Heat is **conducted** through a metal with a temperature gradient of $-9000\text{ }^\circ\text{C/m}$. The thermal conductivity of the material is 25 W/m.K .

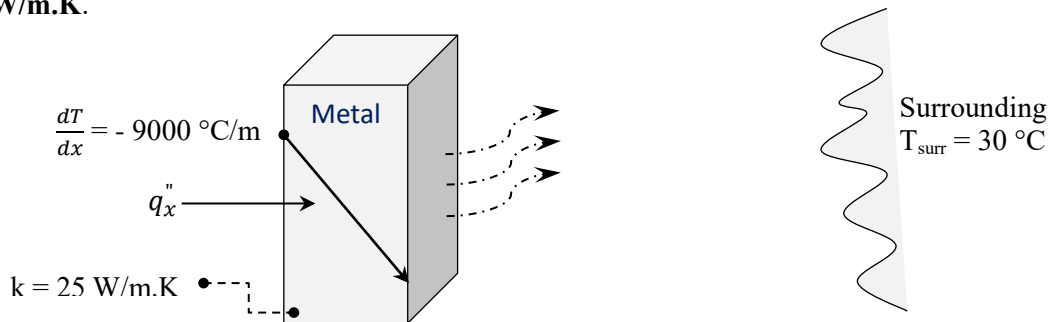


Figure 01 – heat transfer phenomena.

- 1- How many main ways can heat be transferred? What are they?
- 2- What is the **law** that governs heat conduction through this metal?
- 3- Give **its** equation.
- 4- What do you think about the **effect** of temperature on the thermal conductivity of metals?

Part 01: If this heat is **convected** to surrounding at ($T_{\text{surr}} = 30\text{ }^\circ\text{C}$) with a convection coefficient of ($h = 345\text{ units}$).

- 5- Give the **equation** governing the convection heat transfer to the surrounding.
- 6- What is the **unit** of the convection heat transfer coefficient (h)?
- 7- Determine the surface temperature (T_s).

Part 02: If the heat is **radiated** to the surrounding at ($T_{\text{surr}} = 30\text{ }^\circ\text{C}$). Convection is neglected.

- 8- Determine the surface temperature (T_s).

Exercise 02 (07 Marks): “About mass transfer”

Based on **Figure 02** below, the diagram illustrates the molecular diffusion of spice (A) through medium (B),

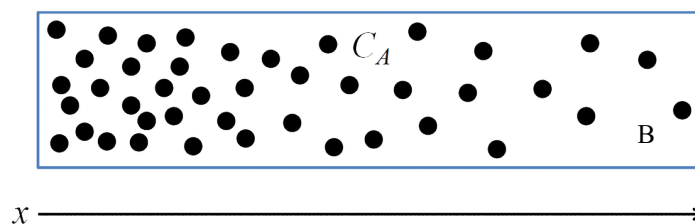


Figure 02 – Molecular diffusion of spice (A) through medium (B).

Where,

A: Ethanol

B: water

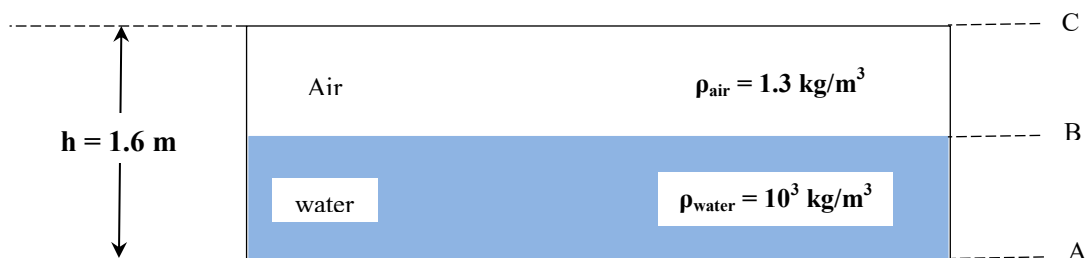
$D_{AB}(T = 298\text{K}): 1.2 \times 10^{-9}\text{ m}^2/\text{s}$ (diffusion coefficient of “A” through “B”).

Questions:

- 1- What **quantity of a gradient** causes molecular diffusion?
- 2- Give the fundamental **equation** of molecular diffusion. How is it referred to?
- 3- For pure diffusion (no convection, no reactions, constant properties):
 - Draw the **concentration profile** of spices (A) as a function of (x).
- 4- In Fick's law, why is a negative sign used?
- 5- If we change the spices (A) and (B) by two **gases**:
 - Will the new rate of diffusional mass transfer **increase** or **decrease**?
- 6- There is two main types of mass transfer, the first one is molecular diffusion:
 - Which **other type of mass transfer** is not mentioned in this exercise?

Exercise 03 (05 Marks): “About momentum transfer”

The tank shown in **figure 03** is half filled water.



- 1- Calculate the pressure difference between points **A** and **B**.
- 2- Calculate the pressure difference between points **B** and **C**.
- 3- Compare these results.

Good Luck,
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