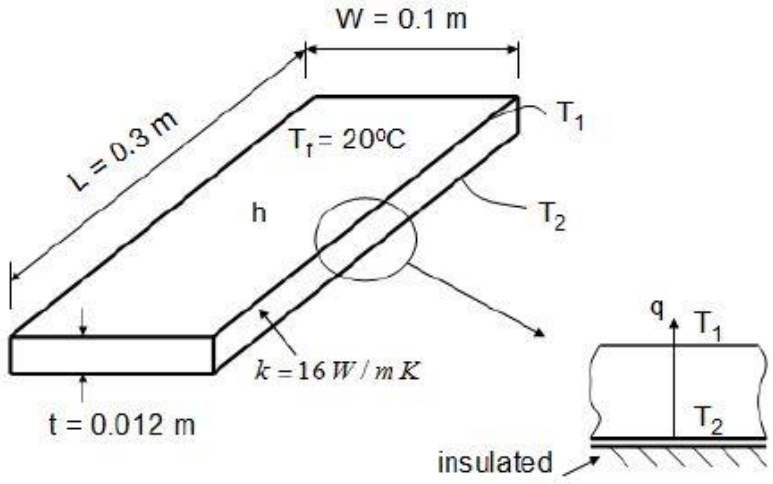
TUTORIAL

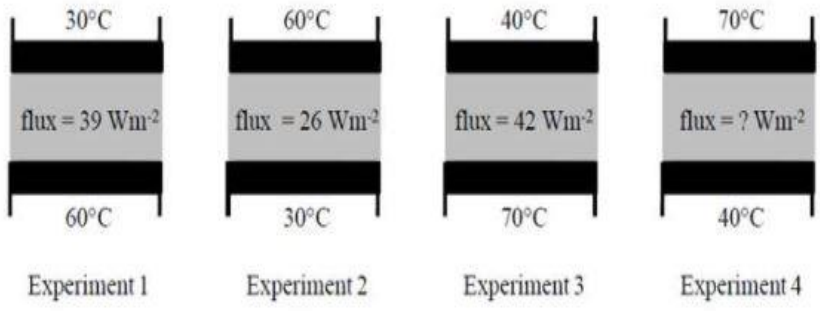
1.

A plate 0.3 m long and 0.1 m wide, with a thickness of 12 mm is made from stainless steel ($k = 16\ W / m\,K$), the top surface is exposed to an airstream of temperature 20°C. In an experiment, the plate is heated by an electrical heater (also 0.3 m by 0.1 m) positioned on the underside of the plate and the temperature of the plate adjacent to the heater is maintained at 100°C. A voltmeter and ammeter are connected to the heater and these read 200 V and 0.25 A, respectively. Assuming that the plate is perfectly insulated on all sides except the top surface, what is the convective heat transfer coefficient?



2.

In an experimental setup, mineral oil is filled in between the narrow gap of two horizontal smooth plates. The setup has arrangements to maintain the plates at desired uniform temperature. At these temperatures, ONLY the radiative heat flux is negligible. The thermal conductivity of the oil does not vary perceptibly in this temperature range. Consider four experiments at steady state under different experimental conditions, as shown in the figure below. The figure shows plate temperatures and the heat fluxes in the vertical direction.



What is the steady state heat flux (in W m^2) with the top plate at 70°C and the bottom plate at 40°C?

3.

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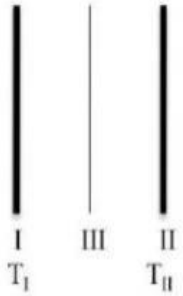
Q. 23 Two infinitely large parallel plates (I and II) are held at temperatures T_I and T_{II} ($T_I > T_{II}$) respectively, and placed at a distance 2d apart in vacuum. An infinitely large flat radiation shield (III) is placed in parallel in between I and II. The emissivities of all the plates are equal. The ratio of the steady state radiative heat fluxes with and without the shield is,



4.

The space between two below concentric spheres of radii 0.1 m and 0.2 m is under vacuum. Exchange of radiation (uniform in all directions) occurs only between the outer surface (S_1) of the smaller sphere and the inner surface (S_2) of the larger sphere. The fraction (rounded off to the second decimal place) of the radiation energy leaving S_2, which reaches S_1 is ____.