

## PROBLEM 11.10

Find  $\dot{Q}_{12}$ .

KNOWN: Schematic diagram of a control volume.

FIND: Heat transfer rate  $\dot{Q}_{12}$ .

SCHEMATIC: A schematic diagram of a control volume. It shows a rectangular box with a top surface, a bottom surface, and a right side. The top surface is labeled  $T_1$  and has a heat flux  $\dot{Q}_1$  entering. The bottom surface is labeled  $T_2$  and has a heat flux  $\dot{Q}_2$  leaving. The right side is labeled  $T_3$  and has a heat flux  $\dot{Q}_3$  leaving. The left side is labeled  $T_4$  and has a heat flux  $\dot{Q}_4$  entering. The control volume is surrounded by a fluid at temperature  $T_{\infty}$ . The control volume is divided into two sections by a vertical line. The left section is labeled  $V_1$  and the right section is labeled  $V_2$ . The control volume is also divided into two sections by a horizontal line. The top section is labeled  $V_3$  and the bottom section is labeled  $V_4$ . The control volume is also divided into two sections by a diagonal line. The top-left section is labeled  $V_5$  and the bottom-right section is labeled  $V_6$ . The control volume is also divided into two sections by a vertical line. The left section is labeled  $V_7$  and the right section is labeled  $V_8$ . The control volume is also divided into two sections by a horizontal line. The top section is labeled  $V_9$  and the bottom section is labeled  $V_{10}$ . The control volume is also divided into two sections by a diagonal line. The top-left section is labeled  $V_{11}$  and the bottom-right section is labeled  $V_{12}$ .

ASSUMPTIONS: 1. Steady-state conditions. 2. Uniform temperatures at the boundaries.

PROPERTIES: Properties of the fluid are not given.

ANALYSIS: The control volume is shown in the schematic diagram. The heat transfer rates are indicated by arrows.

Energy balance for the control volume:

$$\dot{Q}_1 - \dot{Q}_2 - \dot{Q}_3 + \dot{Q}_4 = 0$$

$$\dot{Q}_{12} = \dot{Q}_2 - \dot{Q}_3 + \dot{Q}_4$$

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