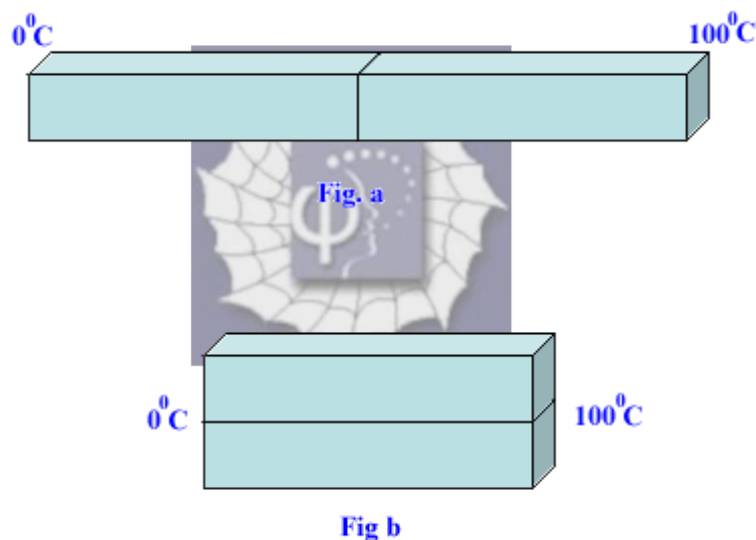


245.

Problem 25.54 (RHK)

Two identical rectangular rods of metal are welded end to end as shown in Fig. a, and 10 J of heat flows through the rod in 2.0 min. We have to calculate the time for 30 J to flow through the rods if they are welded as shown in the Fig. b.



Solution:

Let L be the length of each metal rod and A their cross-sectional area. Let k be the thermal conductivity of the metal of the rods. In the configuration shown in Fig. a 10 J of energy flows in 2.0 min. Temperature difference across the ends of the rods is 100 K.

From the equation of heat conduction we have

$$H_1 = \frac{kA \times 100}{2L} = \frac{10}{120} \text{ J s}^{-1}.$$

When the two rods are arranged in the configuration as shown in Fig b, the cross-sectional area is $2A$ and length is L . The rate of heat flow will be

$$H_2 = \frac{2Ak \times 100}{L} \text{ J s}^{-1} = \frac{2 \times 20}{120} \text{ J s}^{-1} = 20 \text{ J per minute}.$$

Therefore, time in which 30 J will flow through the rods will be 1.5 minute.

