Searle's Experiment.

It is a method of determination of K of a metallic rod. Here we are not much interested in the detailed description of the experimental setup. We will only understand its essence, which is the essence of solving many numerical problems.

In this experiment a temperature difference $(\theta_1 - \theta_2)$ is maintained across a rod of length l and area of cross section A. If the thermal conductivity of the material of the rod is K, then the amount of heat transmitted by the rod from the hot end to the cold end in time t is given by,

$$Q = \frac{KA(\theta_1 - \theta_2)t}{l} \quad \text{.....(i)}$$

In Searle's experiment, this heat reaching the other end is utilized to raise the temperature of certain amount of water flowing through pipes circulating around the other end of the rod. If temperature of the water at the inlet is θ_3 and at the outlet is θ_4, then the amount of heat absorbed by water is given by, $Q = mc(\theta_4 - \theta_3)$ .....(ii)

Where, m is the mass of the water which has absorbed this heat and temperature is raised and c is the specific heat of the water

Equating (i) and (ii), K can be determined i.e. $$K = \frac{mc(\theta_4 - \theta_3)l}{A(\theta_1 - \theta_2)t}$$

Note: In numerical we may have the situation where the amount of heat travelling to the other end may be required to do some other work e.g., it may be required to melt the given amount of ice. In that case equation (i) will have to be equated to mL.

i.e. $$mL = \frac{KA(\theta_1 - \theta_2)t}{l}$$