An Arrhenius plot for the thermal decomposition of acetylene, a second-order reaction. This plot covers a very wide temperature range, from 600 K to 2500 K, and the rate constants range over a factor of more than $10^{10}$. The rates were measured by 11 different investigators, using a variety of experimental techniques [M. H. Back, *Can. J. Chem.*, 49, 2199 (1971)].

**EXAMPLE**

A second-order reaction in solution has a rate constant of $5.7 \times 10^{-5}$ dm$^3$ mol$^{-1}$ s$^{-1}$ at 25.0°C and of $1.64 \times 10^{-4}$ dm$^3$ mol$^{-1}$ s$^{-1}$ at 40.0°C. Calculate the activation energy and the preexponential factor, assuming the Arrhenius law to apply.

**SOLUTION**

To solve this type of problem it is convenient (but not necessary) to sketch an Arrhenius plot; this is shown in Figure 9.8, in which common logarithms are plotted. It is to be emphasized that, in taking the logarithms of the rate constants and the reciprocals of the rates, it is necessary to use enough significant figures as we are dealing with relatively small differences between the values.

The slope of the line in Figure 9.8 is

$$\frac{-4.244 - (-3.785)}{(3.3540 - 3.1934) \times 10^{-3}} = \frac{-0.459}{0.1606} \times 10^{3} \text{ K}$$

$$= -2.858 \times 10^{3} \text{ K}$$