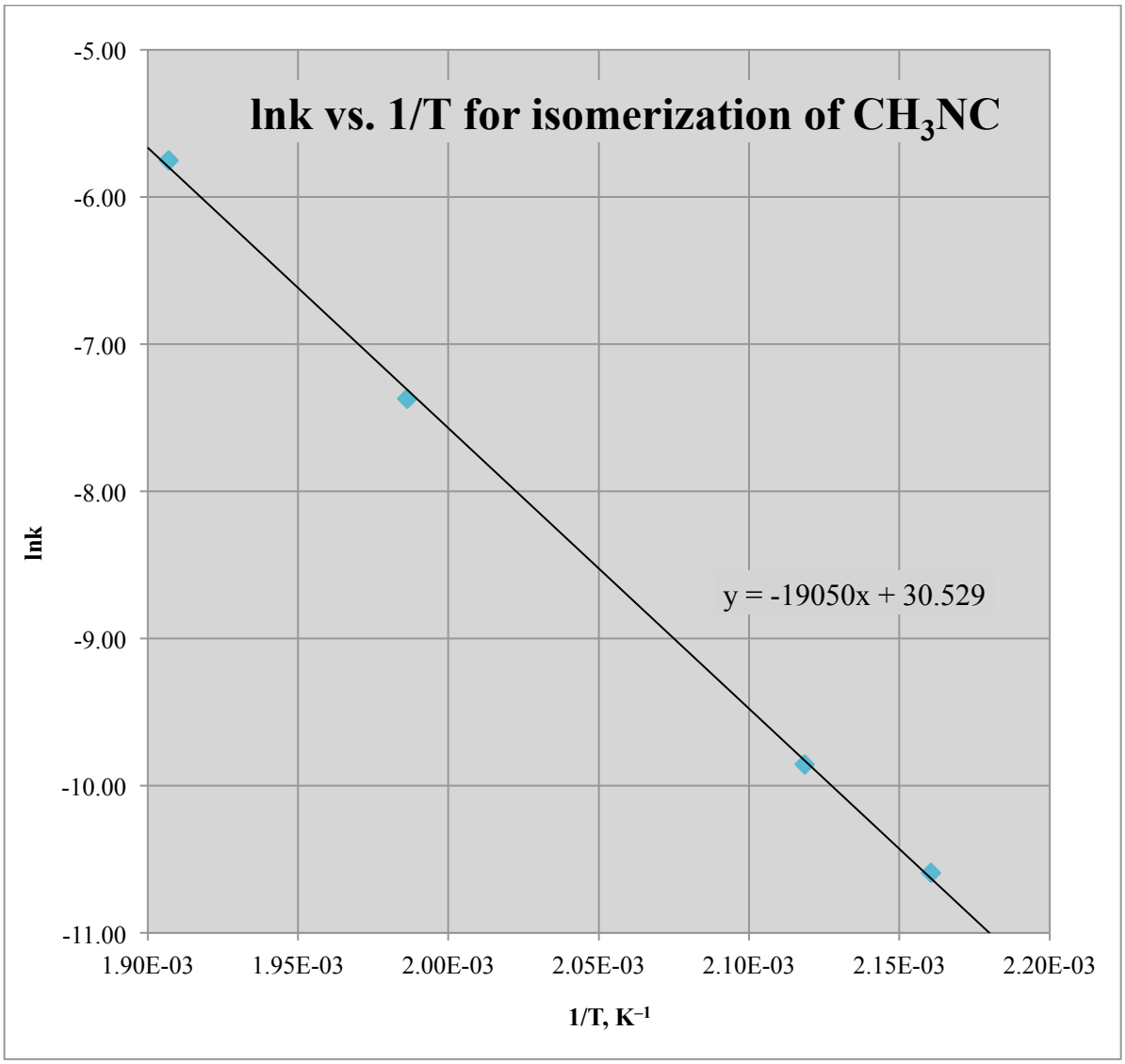
Arrhenius Equation Data Sets (Rate Constant as a function of Temperature)

- Determine the activation energy for the rearrangement of methylisonitrile, $CH_3NC \rightarrow CH_3CN$ from the following determinations of k at various temperatures:

Temperature, °C	k, s^{-1}	T, K	1/T, K^{-1}	ln$k$
189.7	2.52×10^{-5}	462.9	0.002161	–10.59
198.9	5.25×10^{-5}	472.1	0.002118	–9.85
230.3	6.30×10^{-4}	503.5	0.001986	–7.37
251.2	3.16×10^{-3}	524.4	0.001907	–5.76



$$E_a = -\text{slope} \times R = -(-1.9\times10^4\ \text{K})\left(\frac{8.314\ \text{J}}{\text{mol}\cdot\text{K}}\right)\left(\frac{1\ \text{kJ}}{1000\ \text{J}}\right) = 160\ \text{kJ/mol}$$

- For the same reaction, what is the value of k when the temperature is 430.0 K?

$$\ln\frac{k_2}{k_1} = -\frac{E_a}{R}\left(\frac{1}{T_2}-\frac{1}{T_1}\right):\ \ln\frac{k_2}{2.52\times10^{-5}\ \text{s}^{-1}} = -\frac{160\ \text{kJ/mol}}{8.314\ \text{J/mol}\cdot\text{K}}\left(\frac{1000\ \text{J}}{1\ \text{kJ}}\right)\left(\frac{1}{430.0\ \text{K}}-\frac{1}{462.9\ \text{K}}\right)$$

$$\ln k_2 = \ln(2.52\times10^{-5}\ \text{s}^{-1}) - 3.18,\ \text{so}\ k_2 = (2.52\times10^{-5}\ \text{s}^{-1})e^{-3.18} = 1.05\times10^{-5}\ \text{s}^{-1}$$