1. Combine $3\ln(x) + \frac{1}{2}\ln(x^2) - 7\ln\left(\frac{1}{x}\right)$

2. Expand $\ln\left(\frac{\sqrt{7-x}\,(3x-4)}{(x+1)\sqrt{7}}\right)$

3. Expand $3\ln(x^3y) + 2\ln(yz^2)$

4. Collect $3\ln(x^3y) + 2\ln(yz^2)$

5. Write $k = Ae^{-E_a/RT}$ as a linear relationship between $\ln k$ and $\frac{1}{T}$

(1) Combine $3\ln(x) + \frac{1}{2}\ln(x^2) - 7\ln\left(\frac{1}{x}\right)$ into a single logarithm.

$$3\ln(x) + \frac{1}{2}\ln(x^2) - 7\ln\left(\frac{1}{x}\right) = \ln(x^3) + \ln\left((x^2)^{1/2}\right) + \ln\left(\left(\frac{1}{x}\right)^{-7}\right)$$

$$= \ln(x^3) + \ln(x) + \ln(x^7)$$

$$= \ln(x^3 \cdot x \cdot x^7)$$

$$= \ln(x^{11})$$

(2) Expand $\ln\left(\frac{\sqrt{7-x}\,(3x-4)}{(x+1)\sqrt{7}}\right) = \ln\left(\sqrt{7-x}\,(3x-4)\right) - \ln\left((x+1)\sqrt{7}\right)$

$$= \ln\left(\sqrt{7-x}\right) + \ln(3x-4) - \ln(x+1) - \ln(7^{1/2})$$

$$= \frac{1}{2}\ln(7-x) + \ln(3x-4) - \ln(x+1) - \frac{1}{2}\ln 7.$$

(3) Expand $3\ln(x^3y) + 2\ln(yz^2) = 3\ln(x^3) + 3\ln(y) + 2\ln(y) + 2\ln(z^2)$

$$= 9\ln(x) + 5\ln(y) + 4\ln(z)$$

(4) Collect $3\ln(x^3y) + 2\ln(yz^2) = \ln\left((x^3y)^3\right) + \ln\left((yz^2)^2\right)$

$$= \ln(x^9y^3) + \ln(y^2z^4)$$

$$= \ln(x^9y^5z^4)$$

(5) write as a linear relationship between $\ln k$ and $\frac{1}{T}$: $k = Ae^{-E_a/RT}$

This is the Arrhenius Equation from Chemistry.

$$\ln k = \ln\left(Ae^{-E_a/RT}\right)$$

$$= \ln A + \ln e^{-E_a/RT}$$

$$= \ln A + \left(-\frac{E_a}{RT}\right)$$

$$\ln k = \left(\frac{-E_a}{R}\right)\left(\frac{1}{T}\right) + \ln A$$

If we plot $\ln k$ vs $\frac{1}{T}$ the slope of the line would be $\frac{-E_a}{R}$