1. Urbium (Ur) is an upscale element found in big cities. Its oxide (UrO$_2$) is not very stable and decomposes readily at temperatures exceeding 666°C. The figure below shows how the rate of reaction varies with the concentration of UrO$_2$ at 777°C. The rate, $r$, is in units of M/s and the concentration of UrO$_2$, $c$, is in units of M (mole/L). The slope has a value of 1.77 and the intercept has a value of 1.46.

(a) What is the order of reaction? The order is the slope: 1.77

(b) Calculate the value of the rate constant. Pay strict attention to the units.

$$r = kc^n \rightarrow \log r = \log k + n \log c; \text{ when } c = 1, \ r = k = 10^{1.46} = 28.8$$

Units of $k = r/c^n = (\text{M/s})/(\text{M}^{1.77}) = \text{M}^{-0.77}/\text{s} \rightarrow k = 28.8 \ \text{M}^{-0.77}/\text{s}$

(c) On the graph above, draw the line showing how the rate of reaction varies with the concentration of UrO$_2$ at 888°C. No calculation necessary. Pay attention to relative values and slopes.

The upper line on the graph represents the isotherm at 888°C. Note same slope as 777°C but greater value of $r$-intercept.

2. Show by a calculation that the diffusion length of boron (B) in germanium (Ge) is less than 1.0 μm at a temperature of 1200 K for a diffusion time of 30 minutes. The diffusion coefficient of B in Ge at 1200 K, $D_B$, has the value of $2.0 \times 10^{-17} \text{ m}^2/\text{s}$.

The diffusion length is approximated by the relationship $x = \sqrt{Dt}$ or $x = 2\sqrt{Dt}$

$$\therefore \sqrt{Dt} = \sqrt{2.0 \times 10^{-17} \text{ m}^2/\text{s} \cdot 30 \text{ min} \cdot 60 \frac{\text{ s}}{\text{ min}}} = 1.90 \times 10^{-3} \text{ m} < 1.0 \mu\text{m}$$