$2NO_2 \rightarrow 2NO + O_2$

T independent

$A = 2\times10^9\ M^{-1}s^{-1}$

$E_a = 112.55\ kJ\ mol^{-1}$

$\Delta H^\circ = 114.1\ kJ\ mol^{-1}$

$\Delta S^\circ = 147\ J\ mol^{-1}K^{-1}$

$\Delta G^\circ = 70.4\ kJ\ mol^{-1}$

	(25) 298	(327) 600	(727) 1000
k	3.82×10^{-11}	0.3179	2.64×10^3
K	4.65×10^{-13}		2.1×10^{-4}
K_r	1.346×10^6		

⓪ show k vs. T plot ; ln k vs $\frac{1}{T}$ plot ; get E_a

⓪ Find E_a from k / T (600 K and 1000 K) Arrhenius Eqn. 2-pt form

$$\ln\frac{k_2}{k_1} = \frac{E_a}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

$$E_a = \frac{R\ln\frac{k_2}{k_1}}{\frac{1}{T_1}-\frac{1}{T_2}} = \frac{8.314\ J\ mol^{-1}K^{-1}\cdot\ln\frac{2.64\times10^3\ M^{-1}s^{-1}}{0.3179\ M^{-1}s^{-1}}}{\frac{1}{600K}-\frac{1}{1000\ K}}\left(\frac{kJ}{10^3\ J}\right) = 112.55\ kJ\ mol^{-1}$$

@ 298.15/1000K → 112.55 kJ mol⁻¹

② Find K @ 600 K

$$K = e^{-\frac{\Delta G^\circ}{RT}} = e^{\frac{-(70.4\ kJ\ mol^{-1})\left(\frac{10^3\ J}{kJ}\right)}{8.314\ J\ mol^{-1}K^{-1}(600\ K)}} = 7.43\times10^{-7}$$

Endothermic rxn → increasing T promotes product formation

③ Find K_{rev} @ 600 K

$$K_{rev} = e^{-\frac{\Delta G^\circ}{RT}} = e^{\frac{-(-70.4\ kJ\ mol^{-1})\left(\frac{10^3\ J}{kJ}\right)}{8.314\ J\ mol^{-1}K^{-1}(600\ K)}} = 1.346\times10^6$$

$$K_{rev} = \frac{1}{K} = \frac{1}{7.43\times10^{-7}} = 1.346\times10^6$$

@ 298 K 2.15×10^{12}

@ 1000 K ~~[illegible]~~ 4.76×10^3

$rate_f = k_1[NO_2]^2$

$rate_r = k_{-1}[NO]^2[O_2]$

equal @ equilibrium — equal @ equilibrium

since $rate_f = rate_r$, then $k_1[NO_2]^2 = k_{-1}[NO]^2[O_2]$

$$K = \frac{k_1}{k_{-1}} = \frac{[NO]^2[O_2]}{[NO_2]^2}$$ products over reactants

$$K_{rev} = \frac{1}{K} = \frac{[NO_2]^2}{[NO]^2[O_2]}$$