Question #49802, Chemistry, Other

Calculate activation energy, a constant A of the Arrenius equation , Vant-Goff's coefficient and reaction constant at T3. Use formula of Vant-Hoff's law.

CO+H2O=CO2+H2,
k2, min^-1 mole^-1= 8.15·10^-3,
T2,K= 310,
k1, min^-1 mole^-1= 3.1·10^-4,
T1,K= 290,
T3,K= 300

Answer:

the Arrenius equation:

$$k=Ae^{-E/RT}$$

Vant-Hoff's law:

$$\gamma=(V_2/V_1)^{10/(T2-T1)}$$

in single mole concentration V=k

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

$$\gamma=((8.15\cdot10^{-3})/3.1\cdot10^{-4})^{10/(310-290)}=5.127$$

$$k_3=k1\cdot\gamma^{(T3-T1)/10}=3.1\cdot10^{-4}\cdot5.127^{(300-290)/10}=15.89\cdot10^{-4}$$

Energy of activation:

$$E_a=8.31\cdot\ln((8.15\cdot10\text{^-}3)/(3.1\cdot10\text{^-}4))/(1/310-1/290)=-122115.933\ J$$

$$A=e^{-E/RT3}/k_3$$

$$A=\exp(122115.933/(8.31\cdot300))/(15.89\cdot10\text{^-}4)=\mathbf{1.18\cdot10^{24}}$$