CONCEPT: ARRHENIUS EQUATION

- The **Arrhenius Equation** investigates the _____ dependence of chemical reaction rates.

Arrhenius Equation

Arrhenius Equation Formula

$$k = A \cdot e^{\frac{-E_a}{RT}}$$

- ☐ **k** = Rate Constant
- ☐ **A** = Frequency or _____ Factor
- ☐ **E_a** = Activation Energy
- ☐ **R** = Gas Constant as _____ $\frac{J}{mole \cdot K}$

☐ This value for the R constant is used whenever _____, _____, or _____ are mentioned.

EXAMPLE: The gas-phase reaction of NO with Cl_2 to form NOCl and Cl has an activation energy of 7.2 kJ/mol and a frequency factor of 8.9×10^9 M^{-1} s^{-1}. Calculate the rate constant at 110ºC.

Arrhenius Equation (Two Point Form)

- The two point form of the Arrhenius Equation shows how changing the temperature can impact the _____ (k).
  - ☐ _____ the reaction temperature causes an _____ in the rate constant k.
  - ☐ Used when dealing with _____ rate constants and _____ temperatures for a given reaction.

Arrhenius Equation (Two Point Form)

$$\ln\frac{\_\_\_}{\_\_\_} = \frac{-E_a}{R}\left(\frac{1}{\_\_\_} - \frac{1}{\_\_\_}\right)$$

- ☐ _____ = Initial Rate Constant
- ☐ _____ = Final Rate Constant
- ☐ _____ = Initial Temperature
- ☐ _____ = Final Temperature

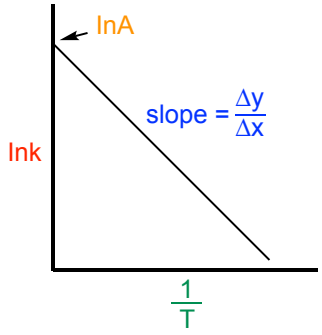
EXAMPLE: A chemical reaction has rate constants of 4.6×10^{-2} s^{-1} and 8.1×10^{-2} s^{-1} at 0ºC and 20ºC, respectively. What is the value of the activation energy?

CONCEPT: ARRHENIUS EQUATION

Linear Form of Arrhenius Equation

- We use the linear form of the equation when a plot of _____ vs _____ temperature is given.
  - □ Used to determine the _____ of the reaction.
    - Recall that the equation for a straight line is _____.

Arrhenius Equation (Linear Form)



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

$$\underline{\quad} = \underline{\quad}\left(\underline{\quad}\right) + \underline{\quad}$$

slope

starting point

- □ ___ = Rate Constant
- □ ___ = Frequency or Pre-exponential Factor
- □ ___ = Activation Energy
- □ ___ = Gas Constant as _____ $\frac{J}{mole \cdot K}$

EXAMPLE: A plot of lnk vs. 1/T has a slope of – 8313. What is the activation energy for this reaction?

PRACTICE: The rate constant of a reaction at 32ºC is 0.060/s. If the frequency factor is $3.1 \times 10^{15}\ s^{-1}$, what is the activation barrier?

CONCEPT: ARRHENIUS EQUATION

PRACTICE: A reaction with an activation energy E_a = 55.00 kJ/mol is run at temperature of 30ºC. Determine the temperature required to increase the rate constant 3 times.

PRACTICE: The following data shows the rate constant of a reaction measured at numerous temperatures. Use the Arrhenius plot to determine the frequency factor for the reaction.

Temperature (K)	Rate Constant (1/s)
300.0	3.37×10^{-3}
310.0	1.08×10^{-2}
320.0	3.21×10^{-2}
330.0	8.96×10^{-2}
340.0	2.35×10^{-1}