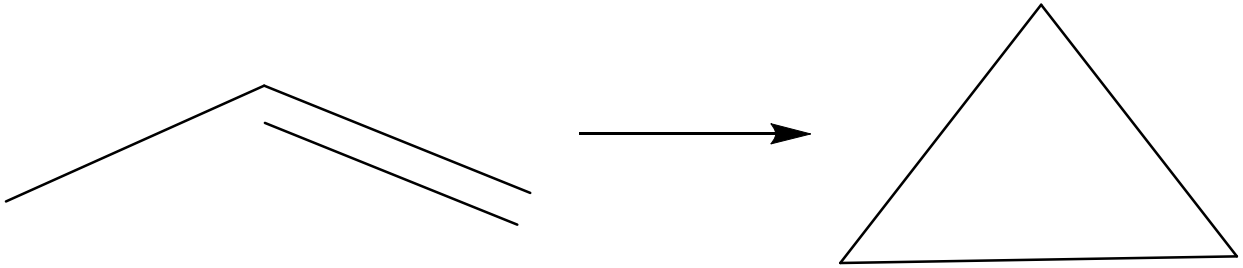
Activation energy

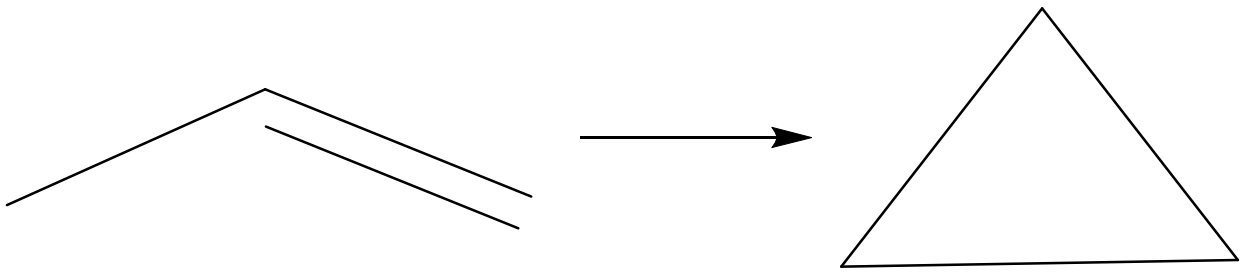
The following data were obtained by observation of the kinetics for the isomerization of propene.



T, K	477	523	577	623
k, s^{-1}	0.00018	0.0027	0.030	0.26

Determine the activation energy and prefactor for the Arrhenius rate constant. HINT: You may use any two of the data points for this determination.

Activation energy

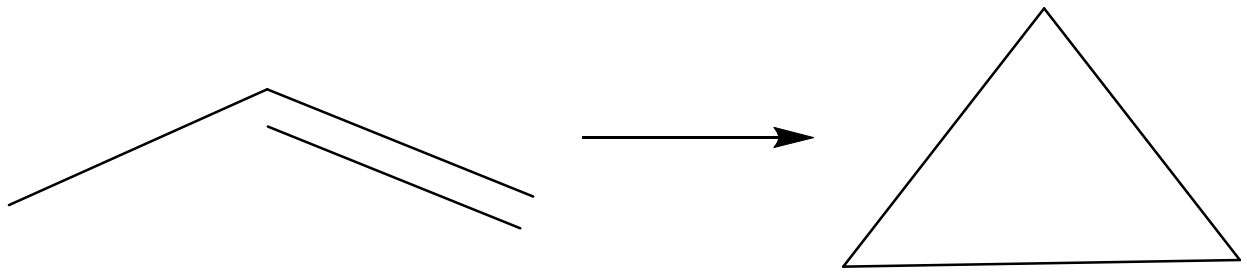


T, K	477	523	577	623
k, s^{-1}	0.00018	0.0027	0.030	0.26

Solution: To calculate Ea use the equation

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

Activation energy



T, K	477	523	577	623
k, s^{-1}	0.00018	0.0027	0.030	0.26

Solution: Use the equation

$$E_a = \frac{-8.31 \ln \frac{0.0027}{0.00018}}{\left(\frac{1}{523} - \frac{1}{477}\right)} = 122{,}000\ J/mol$$

Activation energy

Solution: We can obtain the prefactor from the Arrhenius equation

$$k = Aexp\{-E_a/RT\}$$

Therefore,

$$A = \frac{k}{exp\{-E_a/RT\}}$$

$$A = \frac{0.00018}{exp\{-122000/(8.31)(477)\}}$$

$$A = 4.18\ x\ 10^9\ s^{-1}$$