Creation of a Rate Law

What can a rate law do?

It can determine the ***initial rate.***

How do I devise a rate law?

- Reaction mechanisms
- Concentration vs Initial Rate
- Graphically

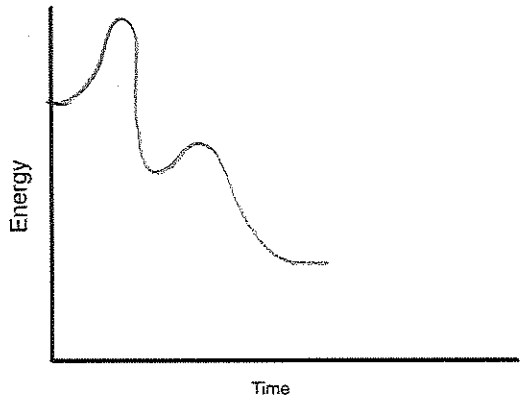
Video answer

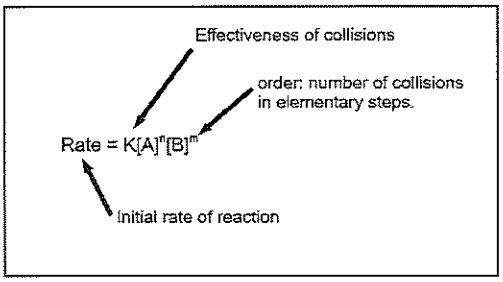
Reaction Mechanisms

$X + Y \rightarrow Z$ + energy (slow)

$Z \rightarrow Y + W$ + energy (fast)

1. Write the overall reaction. $X \rightarrow W$
2. Identify the catalyst. Y
3. Identify the reaction intermediate. Z
4. On the energy diagram provided, provide the energy pathway for this reaction.

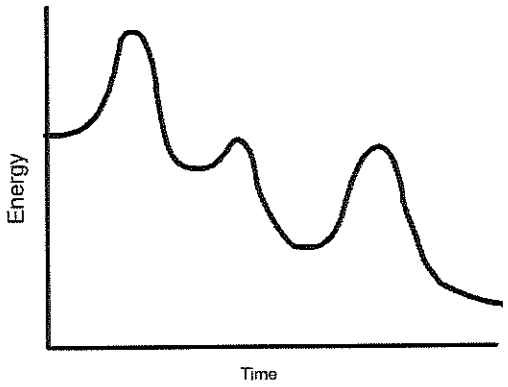




5. Determine the rate law for this reaction.

Rate = K[X][Y]

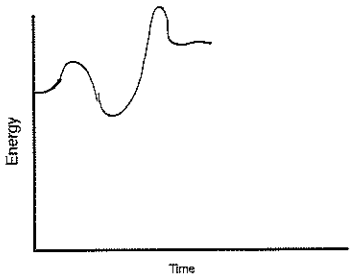
↳ catalyst is in Rate determining step...

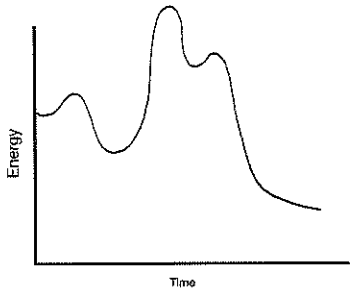


6. Which of the following reaction mechanisms could be responsible for this energy diagram?

$R_1 \rightarrow P_1$ + energy	$R_1 \rightarrow P_1$ + energy	$R_1 \rightarrow P_1$ + energy
Slow → R_2 + energy → P_2	$R_2 + \rightarrow P_2$ + energy	R_2 + energy → P_2 Slow
	R_3 + energy → P_3	$R_3 \rightarrow P_3$ + energy

7. For any reaction mechanism that did not match in #6 create an energy diagram that does match below.





Orders and the Rate Law

1. Given the rate law Rate = 0.05[A], what would be the rate if [A] = 1.5M?

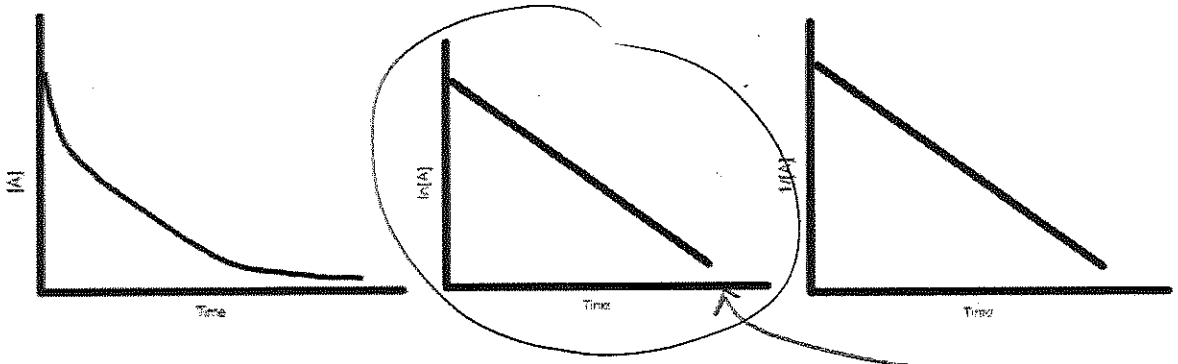
$.05(1.5M) = 0.075 M s^{-1}$

2. What would be the rate if we doubled the concentration of [A] to 3.0M? → x2 (0.15)

3. Regardless, if the concentration is doubled the rate will double?

4. If we tripled the concentration, then we would expect the rate to Triple?

f. Which of the following graphs would legitimately describe the reaction provided. Justify or nullify each graph.



2. What are the different ways you can calculate K?

$Rate = K[\ ]$ $\ln[\ ] = -K + \ln[\ ]$ Slope

3. How would I calculate an initial rate?

$Rate = K[\ ]$

4. How do I get the units of K?

$Rate = K[\ ]$

↑ solve

$$K = \frac{[\ ]}{Rate} = \frac{\frac{mol}{L}}{\frac{mol}{Ls}} = \frac{1}{s}$$