

1. Which of the following expressions would be equal to the rate of the reaction below?



1.  $-(\Delta[\text{KOH}] / 2 \cdot \Delta t)$
2.  $-(\Delta[\text{Na}_2\text{SO}_4] / \Delta t)$
3.  $(2 \cdot \Delta[\text{MnO}_2] / \Delta t)$
4.  $(\Delta[\text{H}_2\text{O}] / \Delta t)$
5.  $-(\Delta[\text{Na}_2\text{SO}_3] / 3 \cdot \Delta t)$
6.  $-(\Delta[\text{KMnO}_4] / \Delta t)$

2. Consider the data below:

Experiment number	[A] M	[B] M	[C] M	[D] M	initial rate $\text{M} \cdot \text{s}^{-1}$
1	0.025	0.03	0.04	0.056	$1.04 \times 10^{-6}$
2	0.025	0.12	0.04	0.056	$4.16 \times 10^{-6}$
3	0.025	0.015	0.08	0.056	$5.2 \times 10^{-7}$
4	0.075	0.03	0.01	0.056	$9.36 \times 10^{-6}$
5	0.025	0.06	0.07	0.112	$1.04 \times 10^{-6}$

What is the overall order of this reaction?

1. 1
2. 2
3. 3
4. 4
5. 5
6. 6

3. What would be the units of the rate constant (k) for the rate law below?

$$\text{rate} = k \cdot [\text{O}_2] \cdot [\text{CO}]^{-1} \cdot [\text{Cl}_2]^1$$

1.  $\text{s}^{-1}$
2.  $\text{M}^{-2} \cdot \text{s}^{-1}$
3.  $\text{M}^{-1} \cdot \text{s}^{-1}$
4.  $\text{M}^1 \cdot \text{s}^{-1}$

4. Consider two hypothetical zero-order reactions. If reaction 1 is faster than reaction 2 at room temperature, but slower than reaction 2 at much higher temperatures, then reaction 1 must have the (larger/smaller) activation energy and must have the (larger/smaller) pre-exponential factor. (Hint: consider both the Arrhenius equation and combined Arrhenius equation.)

1. larger, smaller
2. larger, larger
3. smaller, smaller
4. smaller, larger

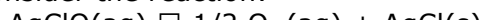
5. Consider the elementary reaction:



If  $k = 3.6 \times 10^2 \text{ s}^{-1}$ , and there is initially 0.781 M  $\text{H}_2\text{CO}_3$ , what is the  $[\text{H}_2\text{CO}_3]$  after 1.2 ms have passed?

1. 0.507 M
2. 0.349 M
3. 0.584 M
4. 1.203 M

6. Consider the reaction:



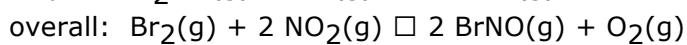
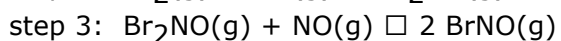
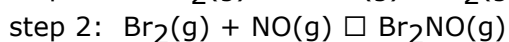
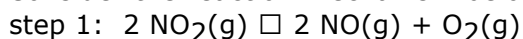
If an aqueous system initially has a  $[\text{AgClO}]$  of 112 mM and 3 minutes later has a  $[\text{AgClO}]$  of 7 mM, what is the half life of  $\text{H}_2\text{O}_2(\text{aq})$ ?

1. 90 seconds
2. 180 seconds
3. 60 seconds
4. 45 seconds
5. not enough information

7. To which of the following reactions would collision state theory not apply? (Note: consider the direction of the arrow in arriving at the correct answer).

1.  $\text{N}_2(\text{g}) + 3 \text{H}_2(\text{g}) \rightleftharpoons 2 \text{NH}_3(\text{g})$
2.  $\text{CH}_4(\text{g}) + 2 \text{O}_2(\text{g}) \rightleftharpoons \text{CO}_2(\text{g}) + 2 \text{H}_2\text{O}(\text{g})$
3.  $2 \text{H}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2 \text{H}_2\text{O}(\text{g})$
4.  $\text{CaCO}_3(\text{s}) \rightleftharpoons \text{CaO}(\text{s}) + \text{CO}_2(\text{g})$

8. Consider the reaction mechanism below:



If step 3 is the slow step, addition of which of the species below would slow down the observed rate of the reaction?

1.  $\text{NO}(\text{g})$
2.  $\text{BrNO}(\text{g})$
3.  $\text{Br}_2(\text{g})$
4.  $\text{O}_2(\text{g})$
5.  $\text{Br}_2\text{NO}(\text{g})$