

Kinetics Study Guide – Multiple Choice

$\therefore 12.5\%$ remains after 24 days

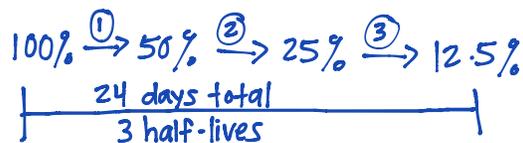
1. If 87.5 percent of a sample of pure ^{131}I decays in 24 days, what is the half-life of ^{131}I ?

(A) 6 days

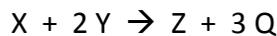
(B) 8 days

(C) 12 days

(D) 24 days



$$\therefore t_{1/2} = \frac{24 \text{ days}}{3} = 8 \text{ days}$$



2. For the reaction represented above, the initial rate of decrease in [X] was $2.8 \times 10^{-3} \text{ mol L}^{-1} \text{ s}^{-1}$.

What was the initial rate of decrease in [Y]?

(A) $7.0 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$

(B) $1.4 \times 10^{-3} \text{ mol L}^{-1} \text{ s}^{-1}$

(C) $2.8 \times 10^{-3} \text{ mol L}^{-1} \text{ s}^{-1}$

(D) $5.6 \times 10^{-3} \text{ mol L}^{-1} \text{ s}^{-1}$

X : Y

1 : 2

rate Y is twice that of X = $(2.8 \times 10^{-3})(2) = 5.6 \times 10^{-3}$

3. Which of the following statements best explains why an increase in temperature of 5-10 Celsius degrees can substantially increase the rate of a chemical reaction?

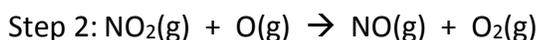
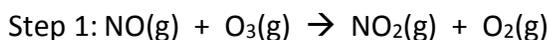
~~(A)~~ The activation energy for the reaction is lowered. *catalysts lower E_a*

(B) The number of effective collisions between particles is increased. *greater # of particles w/ sufficient E*

~~(C)~~ ΔH for the reaction is lowered.

~~(D)~~ ΔG for the reaction becomes more positive.

> Thermodynamics does not predict speed of rxn



4. A reaction mechanism for the destruction of ozone, $\text{O}_3(\text{g})$, is represented above. In the overall reaction, $\text{NO}(\text{g})$ is best described as

(A) a catalyst - *reactant then product; doesn't appear in overall eqn.*

(B) a reactant - *doesn't cancel; will appear in overall eqn.*

(C) an intermediate - *product then reactant*

(D) a product - *doesn't cancel; will appear in overall eqn.*

5. The rate law for the reaction of nitrogen dioxide and chlorine is found to be $\text{rate} = k [\text{NO}_2]^2 [\text{Cl}_2]$. By what factor does the rate of the reaction change when the concentrations of both NO_2 and Cl_2 are doubled?

(A) 2

(B) 3

(C) 6

(D) 8

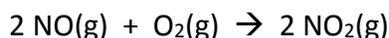
$$\text{rate} = k [\text{NO}_2]^2 [\text{Cl}_2]$$

$$\text{rate} = k (2)^2 (2) = 8$$

6. A kinetics experiment is set up to collect the gas that is generated when a sample of chalk, consisting primarily of solid CaCO_3 , is added to a solution of ethanoic acid, CH_3COOH . The rate of reaction between CaCO_3 and CH_3COOH is determined by measuring the volume of gas generated at 25°C and 1 atm as a function of time. Which of the following experimental conditions is most likely to increase the rate of gas production?

- (A) Decreasing the volume of ethanoic acid solution used in the experiment.
- (B) Decreasing the concentration of the ethanoic acid solution used in the experiment.
- (C) Decreasing the temperature at which the experiment is performed.
- (D) Decreasing the particle size of the CaCO_3 by grinding it into a fine powder.

smaller particles
= incr. surface area
= faster rxn rate

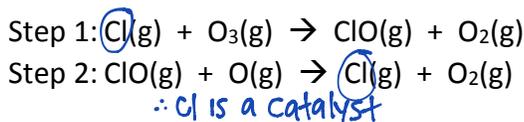


7. Consider the following reaction mechanism for the reaction represented above.



Which of the following statements is true?

- (A) Step 1 represents a unimolecular reaction. *step 1 is bimolecular*
- (B) Increasing the concentration of NO will decrease the overall rate of the reaction. *rate would increase*
- (C) Raising the temperature will have no effect on the numerical value of the rate constant. *rate constant, k, changes w/T*
- (D) The rate law that is consistent with the mechanism is $\text{rate} = k[\text{NO}]^2[\text{O}_2]$.
Add up to and include slow step, use coefficients of remaining reactants for orders



8. A proposed mechanism for destruction of ozone gas in the stratosphere is represented above. Which of the following is evidence that the mechanism is occurring?

- (A) The presence of $\text{Cl}(\text{g})$ increases the rate of the overall reaction.
- (B) The presence of $\text{Cl}(\text{g})$ decreases the rate of the overall reaction.
- (C) The presence of $\text{Cl}(\text{g})$ increases the equilibrium constant of the overall reaction.
- (D) The presence of $\text{Cl}(\text{g})$ decreases the equilibrium constant of the overall reaction. *> catalysts do not affect K_{eq}*

9. If the carbon isotope ^{11}C has a half-life of 20 ^{$t_{1/2}$} minutes, what fraction of a sample of pure ^{11}C remains after 1 hour?

(A) $\frac{1}{4}$

Half-lives = $\frac{\text{total time}}{t_{1/2}} = \frac{60 \text{ min}}{20 \text{ min}} = 3$

(B) $\frac{7}{30}$

1 $\xrightarrow{\text{① Divide By 2}}$ $\frac{1}{2}$ $\xrightarrow{\text{②}}$ $\frac{1}{4}$ $\xrightarrow{\text{③}}$ $\frac{1}{8}$

(C) $\frac{1}{8}$

(D) $\frac{1}{16}$



10. The rate law for the reaction shown above is as follows: $\text{rate} = k[A]$. Which of the following changes to the system will increase the rate of the reaction?

- I. An increase in the concentration of A. *A is in the rate law, thus $\uparrow [A]$ causes \uparrow rate*
- ~~II.~~ An increase in the concentration of B. *B is not in rate law, thus [B] doesn't affect rate*
- III. An increase in the temperature. *causes k to increase \therefore rate increases*

- (A) I only
- (B) I and II only
- (C) I and III only
- (D) I, II and III



11. A sample of N_2O_5 was placed in an evacuated container, and the reaction represented above occurred. The value of $P_{\text{N}_2\text{O}_5}$, the partial pressure of $\text{N}_2\text{O}_5(\text{g})$, was measured during the reaction and recorded in the table below.

Time (min)	$P_{\text{N}_2\text{O}_5}$ (atm)	$\ln(P_{\text{N}_2\text{O}_5})$	$\frac{1}{P_{\text{N}_2\text{O}_5}}$ (atm^{-1})
0	150	5.0	0.0067
100	75	4.3	0.013
200	38	3.6	0.027
300	19	2.9	0.053

Which of the following correctly describes the reaction?

- (A) The decomposition of N_2O_5 is zero-order reaction.
- (B) The decomposition of N_2O_5 is a first-order reaction. *$\ln(P_{\text{N}_2\text{O}_5})$ vs. time is linear*
- (C) The decomposition of N_2O_5 is a second-order reaction.
- (D) The overall reaction order is 3.

Use the reaction below to answer questions 12-16.



12. Which of the following best represents the ratio of the initial rate of appearance of C with the initial rate of disappearance of B?

- (A) 1 : 2
 - (B) 2 : 3
 - (C) 3 : 1
 - (D) 3 : 2
- C : B*
3 : 2

13. Which of the following is a correct expression for the rate of the reaction above?

- (A) $\frac{-\Delta[A]}{2\Delta t}$ $-\frac{1}{1} \frac{\Delta[A]}{\Delta t} = -\frac{1}{2} \frac{\Delta[B]}{\Delta t} = \frac{1}{3} \frac{\Delta[C]}{\Delta t} = \frac{1}{1} \frac{\Delta[D]}{\Delta t}$
- (B) $\frac{-\Delta[B]}{\Delta t}$
- (C) $\frac{\Delta[C]}{3\Delta t}$
- (D) $\frac{\Delta[D]}{3\Delta t}$

14. Five trials for the reaction above were carried out at 30°C. The following data were obtained.

Experiment	[A] ₀ (mol/L)	[B] ₀ (mol/L)	Initial Rate of Reaction (mol/L · hr)
1	0.240	0.480	8.00
2	0.240	0.120	2.00
3	0.360	0.240	9.00
4	0.120	0.120	0.500
5	0.240	0.0600	1.00

Which of the following is the correct rate expression for the reaction?

- (A) Rate = k [A][B]²
- (B) Rate = k [A][B]
- (C) Rate = k [A]²[B]
- (D) Rate = k [A]

15. What is the overall reaction order?

- (A) 1
- (B) 2
- (C) 3
- (D) 4

16. If the concentration of A was tripled and B was doubled, then how would the rate of reaction change?

- (A) Rate would increase by a factor of 6.
- (B) Rate would increase by a factor of 9.
- (C) Rate would increase by a factor of 12.
- (D) Rate would increase by a factor of 18.

$$[A]^2[B]$$

$$(3)^2(2) = 18$$