Kinetics Practice Test Questions

Question 1

Higher temperatures result in higher rates of reaction. Which of the following helps explain this phenomenon?

a) An increased temperature lowers the activation energy for molecules
b) An increased temperature raises the activation energy for molecules
c) An increased temperature allows a greater fraction of the reactant molecules to have the minimum energy needed to result in a successful collision.
d) An increased temperature allows all collisions to result in a successful reaction.

Question 2

When the reactant concentration increases, the rate of reaction increases. This can be explained by

a) an increase in the average kinetic energy of molecules as the reactant concentration increases.
b) an increase in the order of the reaction as the reactant concentration increases.
c) an increase in the frequency of collisions as the reactant concentration increases.
d) an increase in the rate constant which is proportional to reactant concentrations.
e) a decrease in the activation energy as the reactant concentration increases.

Question 3

When a catalyst is added to a reaction, the rate of reaction increases. This can be explained by:

a) an increase in the average kinetic energy of molecules.
b) an increase in the order of the reaction.
c) an increase in the frequency of collisions.
d)a decrease in the rate constant.
e) a decrease in the activation energy.

Question 4

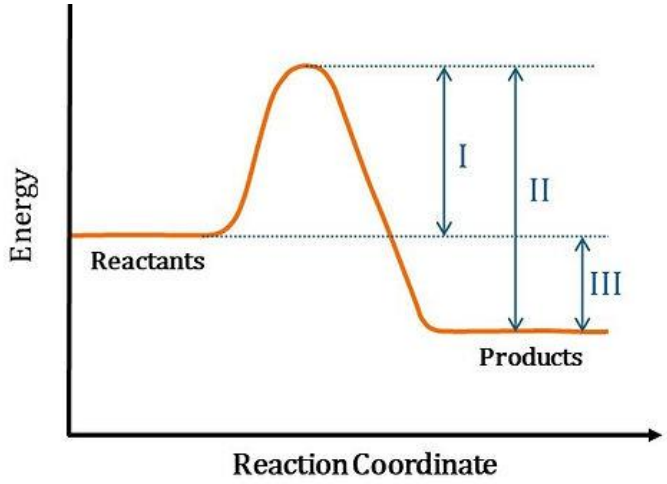
Which of the following factors affect the rate of a chemical reaction?

I. The kinetic energy of the colliding reactant particles
II. The frequency with which reactant particles collide
III. The orientation of the colliding reactant particles

a) I and II only
b) I and III only
c) II and III only
d) I, II, and III

Question 5

Consider the energy diagram for a reaction (shown). Adding a catalyst to this reaction would cause a change to which of the energy differences (I, II, III)?



a) I only
b II only
c) I and II only
d) I and III only
e) I, II, and III

Question 6

Slower rates of chemical reactions can be attributed to:

a) Higher concentration of reactants
b) The presence of a catalyst
c) Lower activation energy
d) Stronger bonds in reactant molecules

Question 7

Which of the following is true regarding the speed of a chemical reaction?

a) It is independent of the temperature
b) It is independent of the surface area of a solid involved.
c) Reactions between gasses should be relatively fast due to the large average kinetic energy of the molecules.
d) Reactions between ions in aqueous solution should be relatively fast because there are no bonds that need to be broken.
e) It varies inversely with the absolute temperature.

Question 8

Consider the combustion of butane (C_2H_{10}):

$$2C_4H_{10}(g) + 13O_2(g) \rightarrow 8CO_2(g) + 10H_2O(l)$$

Which of the following are true?

a) the rate of consumption of C_4H_{10} is 2 times faster than the rate of consumption of oxygen.
b) the rate of formation of CO_2 is equal to the rate of formation of H_2O.
c) water is formed at a rate equal to 4/5 the rate of formation of CO_2.
d) the rate of consumption of O_2 is equal to the rate of consumption of H_2O.
e) The rate of formation of CO_2 is 4 times faster than the rate of consumption of C_4H_{10}.

Question 9

For the reaction, $2A(g) + B(g) \rightarrow 2C(s) + 2D(l)$, which one of the following statements must be true?

a) The reaction is first order with respect to A and second order with respect to B.
b) The reaction is fourth order overall.
c) The rate law is: rate $= k[A]^2[B]$.
d) The rate law is: rate $= k[A][B]$.
e) The rate law cannot be determined from the information given.

Question 10

The rate law for the reaction $2A + B \rightarrow 2C$ is: Rate $= k[A]^2[B]$

Which of the following is true?

a) the order in A is 1 and the overall order is 1.
b) the order in A is 2 and the overall order is 2.
c) the order in A is 2 and overall order is 3.
d) the order in B is 2 and the overall order is 2.
e) the order in B is 2 and the overall order is 3.

Question 11

Experimental rate data was collected for the reaction between ammonium and nitrite ions as shown in the table.

Trial	$[NH_4^+]$ (M)	$[NO_2^-]$ (M)	Rate (M/s)
1	0.020	0.040	0.040
2	0.030	0.040	0.060
3	0.020	0.020	0.010

According to the data the rate law for the reaction is:

a) Rate = $k[NH_4^+][NO_2^-]$

b) Rate = $k[NH_4^+]^2[NO_2^-]^2$

c) Rate = $k[NH_4^+]^2[NO_2^-]$

d) Rate = $k[NH_4^+][NO_2^-]^2$

e) none of the above

Question 12

What are the units of k for the rate law: Rate = k[A]2[B], when the concentration unit is mol/L?

a) s^{-1}
b) s
c) L mol^{-1} s^{-1}
d) L^2 mol^{-2} s^{-1}
e) L^2 s^2 mol^{-2}

Question 13

Given: $A + 3B \rightarrow 2C + D$

This reaction is first order with respect to reactant A and second order with respect to reactant B. If the concentration of A is halved and the concentration of B is tripled, how would the rate of the reaction change?

a) the reaction rate would increase by 1.5 times.
b) the reaction rate would decrease by 1.5 times.
c) the reaction rate would increase by 3 times.
d) the reaction rate would decrease by 3 times.
e) the reaction rate would increase by 4.5 times.

Question 14

Rate = $k[A][B]^2$

The rate of a chemical reaction between substances A and B follows the rate law given above. If the concentrations of both A and B are doubled, the reaction rate will increase by a factor of

a) 2
b) 4
c) 6
d) 8

Question 15

$2\ NO\ (g) + O_2\ (g) \rightarrow NO_2\ (g)$

Initial rates of reaction for the reaction between nitrogen monoxide and oxygen were measured for various concentrations of reactants as shown in the table. Determine the experimental rate law for the reaction.

Trial	Initial Concentration NO (M)	Initial Concentration O_2 (M)	Rate (M/s)
1	0.10	0.10	3.0×10^{-4}
2	0.20	0.10	6.0×10^{-4}
3	0.20	0.40	9.6×10^{-3}

a) Rate = $k\ [NO][O_2]$
b) Rate = $k\ [NO]^2[O_2]$
c) Rate = $k\ [NO][O_2]^2$
d) Rate = $k\ [NO]^2[O_2]^2$

Question 16

$A\ (g) + B\ (g) \rightarrow B\ (g)$

Initial rates of reaction for the reaction between A and B were measured for various concentrations of reactants as shown in the table below. Determine the reaction rate for trial 4.

Trial	Initial Concentration A (M)	Initial Concentration B (M)	Rate (M/s)
1	0.10	0.10	1.0×10^{-4}
2	0.20	0.10	4.0×10^{-4}
3	0.20	0.40	1.6×10^{-3}
4	0.30	0.30	?

a) 3.0×10^{-4} M/s
b) 6.0×10^{-4} M/s
c) 2.7×10^{-3} M/s
d) 8.1×10^{-3} M/s

Question 17

The following rate data was attained at 25°C for the reaction between generic chemicals A and B.

Experiment Number	Initial [A] (M)	Initial [B] (M)	Initial Rate (M/s)
1	0.24	0.060	0.360
2	0.24	0.24	1.44
3	0.12	0.12	0.090

What is the rate law for this reaction?

$2\ A(g) + B\ (g) \rightarrow 3\ C\ (g)$

a) Rate = $k\ [A][B]$

b) Rate = $k\ [A]^2$

c) Rate = $k\ [A]^2[B]$

d) Rate = $k\ [A]^3[B]$

Question 18

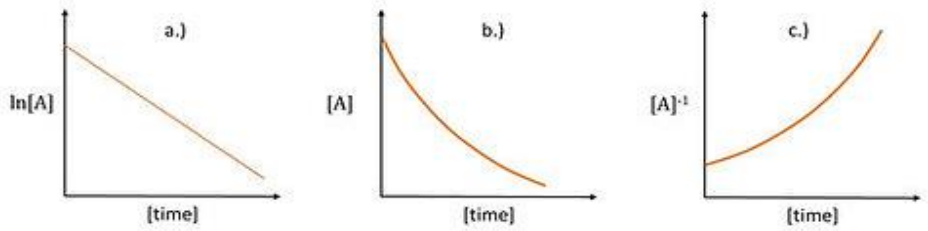
The following rate data was attained at 25°C for the reaction between C_2H_4 and O_3. Determine the rate constant for this reaction.

Experiment Number	Initial $[C_2H_4]$ (M)	Initial $[O_3]$ (M)	Initial Rate (M/s)
1	0.50	1.00	1.00
2	1.50	1.00	3.00
3	1.00	2.00	8.00

a) $0.50\ s^{-1}\ M^{-2}$
b) $1.0\ s^{-1}\ M^{-2}$
c) $2.0\ s^{-1}\ M^{-2}$
d) $4.0\ s^{-1}\ M^{-2}$

Question 19

Which of the curves shown gives support to an argument that a reaction occurs through first order kinetics?



Question 20

N_2O_5 decomposes according to the reaction shown below. A sample of N_2O_5 was placed in a rigid container at constant temperature and allowed to decompose. The partial pressure of N_2O_5 was monitored as a function of time as shown in the data table.

$2\ N_2O_5\ (g) \rightarrow 4\ NO_2\ (g) + O_2\ (g)$

Time (minutes)	$P_{N_2O_5}$ (atm)	$\ln(P_{N_2O_5})$	Delta	$P_{N_2O_5}$ (atm^{-1})
0	100.0	4.61		0.0100
			0.7x	
100	50.0	3.91		0.0200
			0.69 x	
200	25.0	3.22		0.0400
			0.69 x	
300	12.5	2.53		0.0800

Which of the following correctly describes the reaction?

a) The decomposition of N_2O_5 is a zero-order process.
b) The decomposition of N_2O_5 is a first-order process.
c) The decomposition of N_2O_5 is a second-order process.
d) The overall reaction order is 3.

Question 21

A chemical decomposes according to first order kinetics with a rate constant of $4.00 \times 10^{-2}\ s^{-1}$ at 500 ^{0}C.

How long will it take for 96% of the compound to decompose?

a) 1.02 sec
b) 58.6 sec
c) 80.5 sec
d) 114 sec

Question 22

The decomposition of HI (g) is shown below:

$HI\ (g) \rightarrow \frac{1}{2}\ H_2\ (g) + \frac{1}{2}\ I_2\ (g)$

The rate is given by: $\text{Rate} = k\,[HI]^2$
If $k = 30.\ M^{-1}min^{-1}$ at 443°C, how much time does it take for the concentration of HI to drop from 0.020 M to 0.010 M at 443°C?

a) 0.00033 min
b) 0.023 min
c) 0.30 min
d) 1.7 min

Question 23

A rapidly reacting reactant was monitored for the first 10 seconds of a reaction and the percentage of the reactant remaining was monitored over this time frame as shown in the table above. Use this data to determine the reaction order with respect to the chemical monitored and the half-life of the reaction.

Time (s)	0	1	2	3	4	5	6	7	8	9	10
% Remaining	100	84	71	59	50	42	35	30	25	21	18

a) The reaction is 1st order with respect to the reactant and the half-life is 4 seconds.
b) The reaction is 1st order with respect to the reactant and the half-life is 10 seconds.
c) The reaction is 2nd order with respect to the reactant and the half-life is 4 seconds.
d) The reaction is 2nd order with respect to the reactant and the half-life is 10 seconds.

Question 24

A reaction follows first order kinetics with a half-life of 19 minutes at 450 ^{0}C. How much time is required for the pressure to decrease from 1.00 atmospheres to 0.125 atmospheres at the same temperature?

a) 19 minutes
b) 38 minutes
c) 57 minutes
d) 76 minutes
e) 152 minutes

Question 25

Cyclobutene reacts to form butadiene through first order kinetics. In one experiment, the partial pressure of cyclobutene drops to ¼ its original pressure in 82.6 seconds. What is the half-life for this reaction at this temperature?

a) 15.5 sec
b) 31.0 sec
c) 41.3 sec
d) 62.0 sec

Question 26

If 87.5 percent of a radioactive substance decays in 24 days, what is the half-life of this substance?

a) 6 days
b) 8 days
c) 12 days

d) 14 days

Question 27

A reactant follows first order kinetics with a rate constant $k = 2.8 \times 10^{-7}\ s^{-1}$ at 1000 ^{0}C. What is the half-life of this reaction at 1000 ^{0}C?

a) 5.0×10^{7} s
b) 4.7×10^{-6} s
c) 3.8×10^{5} s
d) 6.1×10^{4} s
e) 2.5×10^{6} s

Question 28

A reaction follows first order kinetics with a half-life of 32 s. A reaction is started and after 2.0 minutes, the reactant concentration is 0.124 M. What was the original concentration of the reactant?

a) 1.67 M
b) 0.138 M
c) 0.182 M
d) 0.161 M
e) 0.260 M

Question 29

The activation energy of a reaction is 250 kJ/mol.
How many times faster is the reaction at 320 K than at 300 K?

a) 3×10^{-29}
b) 0.067
c) 15.0
d) 525
e) 3×10^{-28}

Question 30

What is the activation energy (in kJ) of a reaction whose rate constant increases by a factor of 100 by increasing the temperature from 200 K to 225 K?

a) 27
b) 35
c) 42
d) 53
e) 69

Question 31
Reaction rates increase as reaction temperatures increase. This can be explained by:

(I) an increase in the activation energy as temperature is increased.
(II) an increase in the rate constant as temperature is increased.
(III) an increase in the percentage of "high energy" collisions as temperature is increased.

a) only I
b) only II
c) only III
d) only I and II
e) only II and III

Question 32
A catalyst can act in a chemical reaction to:

(I) increase the rate constant.
(II) changes the equilibrium concentration of the products.
(III) decrease the change in energy for the overall reaction.
(IV) provide a new path for the reaction.

a) only I & II
b) only II & III
c) only III & IV
d) only I & IV
e) only I, II & IV

Question 33
Consider the reaction:

$2NO(g) + O_2(g) \rightarrow N_2O_2(g)$

Possible mechanisms for the overall reaction are:

$NO(g) + NO(g) \rightarrow N_2O_2(g)$ slow
$N_2O_2(g) + O_2(g) \rightarrow 2NO_2(g)$ fast

Which rate law fits best with this mechanism?

a) Rate$= k\,[NO]^2[O_2]$

b) Rate=k $[N_2O_2][O_2]$

c) Rate=k $[NO]^2$

d) Rate=k $[NO]^2[O_2]^{-1}$

Question 34

Consider the following reaction:

Overall: $A + 2B \rightarrow AB_2$
Step 1: $A + B \rightarrow AB$ (Slow)
Step 2: $AB + B \rightarrow AB_2$ (Fast)

What is the rate law for this reaction?

a) Rate = k[A]
b) Rate = k[B]
c) Rate = k[A][B]
d) Rate = $k[B]^2$
e) Rate = $k[A][B]^2$

Question 35

Consider the following reaction:

$2A + B \rightarrow C + D$

Step 1: $A + A \rightleftharpoons A_2$ (Fast, Equilibrium)
Step 2: $A_2 + A \rightarrow A_2$ (Slow)
Step 3: $A_2 + B \rightarrow A + C + D$ (Fast)

What is the rate law for this reaction?

a) Rate = $k[A]^2$
b) Rate = k[A][B]
c) Rate = $k[A]^2[B]$
d) Rate = k[A]
e) Rate = $k[A]^3$