

The first-order reaction $\text{SO}_2\text{Cl}_2 \rightarrow \text{SO}_2 + \text{Cl}_2$ is 10% complete in 80. min.

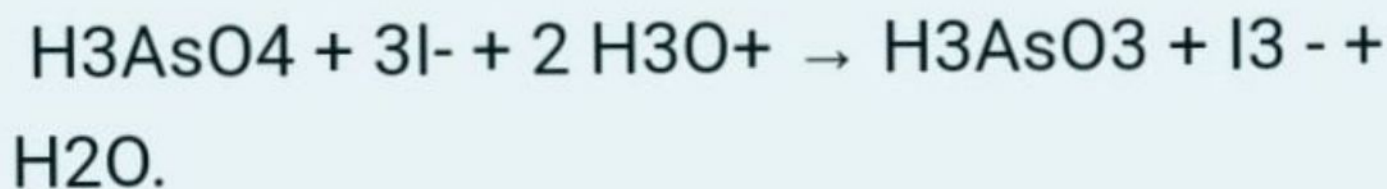
How long would it take for the reaction to be 95% complete?

- 1.8 min .a ☐
- 104 min .b ☐
- 530 min .c ☐
- ✓ 2300 min .d ☒

الإجابة الصحيحة هي:

2300 min

The oxidation of iodide ions by arsenic acid in acidic aqueous solution occurs according to the net reaction



The experimental rate law for this reaction is $\text{Rate} = k[\text{H}_3\text{AsO}_4][\text{I}^-][\text{H}_3\text{O}^+]$

What is the order of the reaction with respect to I^- ?

second .a ☐

✓ first .b ☒

third .c ☐

zero .d ☐

The rate law predicted by the following two-step mechanism is $\text{Rate} = k[\text{A}][\text{B}]$.



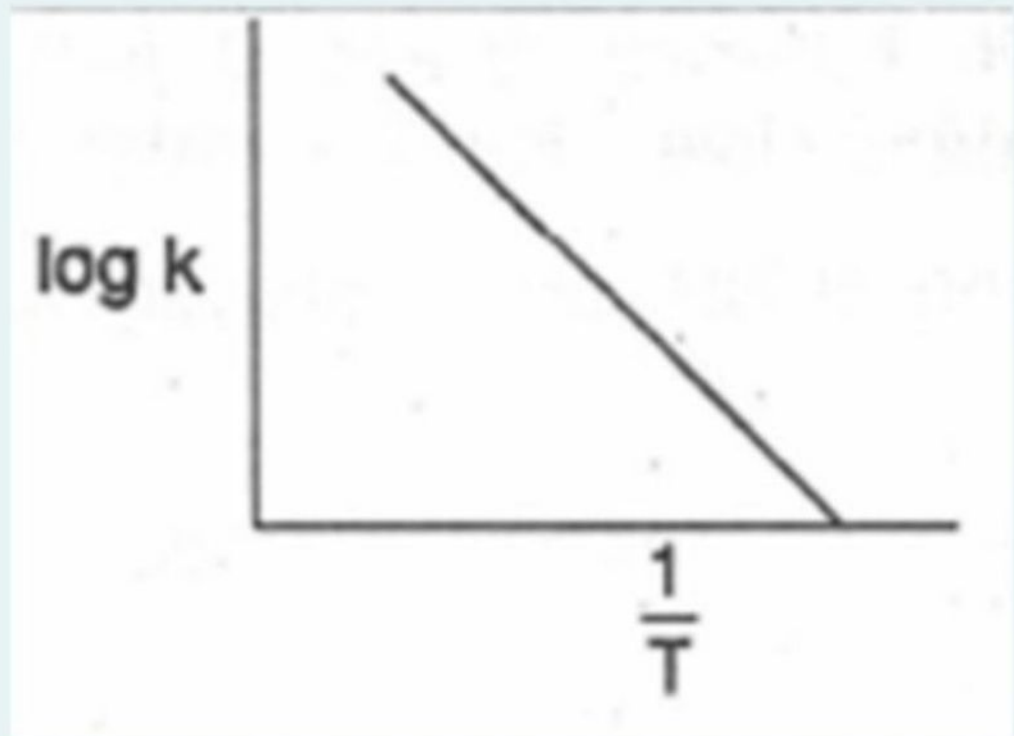
✓ False .a ☒

True .b ☐

الإجابة الصحيحة هي:

False

In the Arrhenius equation $k = Ae^{-E_a/RT}$, the plot of $\log k$ against $1/T$ gives a graph as shown, and the slope is $\text{slop} = E_a/2.303R$



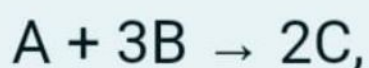
true .a ☐

✓ false .b ☒

الإجابة الصحيحة هي:

false

For the hypothetical reaction



the rate should be expressed as

rate = $-\Delta[C]/\Delta t$.a ☐

rate = $-3(\Delta[B]/\Delta t)$.b ☐

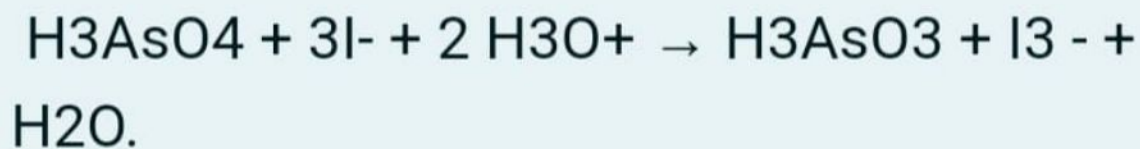
rate = $\Delta[A]/\Delta t$.c ☐

✓ rate = $(1/2)(\Delta[C]/\Delta t)$.d ☒

الإجابة الصحيحة هي:

$$\text{rate} = (1/2)(\Delta[C]/\Delta t)$$

The oxidation of iodide ions by arsenic acid in acidic aqueous solution occurs according to the net reaction



The experimental rate law for this reaction is

$$\text{Rate} = k[\text{H}_3\text{AsO}_4][\text{I}^-][\text{H}_3\text{O}^+].$$

According to the rate law for the reaction, an increase in the concentration of hydronium ion has what effect on this reaction?

The rate of reaction decreases .a ☐

no effect .b ☐

✓ The rate of reaction increases .c ☒

الإجابة الصحيحة هي:

The rate of reaction increases

The decomposition of dimethylether at 504°C is first order with a half-life of 1570 seconds. What fraction of an initial amount of dimethylether remains after 4710 seconds?

- ☐ a. $1/6$
- ☒ b. $1/8$
- ☐ c. $1/16$
- ☐ d. $1/3$

الإجابة الصحيحة هي:

$1/8$

Molecularity of a reaction is independent of pressure and temperature

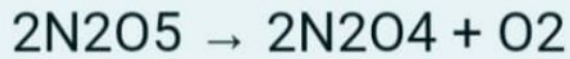
false .a ☐

✓ true .b ☒

الإجابة الصحيحة هي:

true

Nitrogen pentoxide decomposes by a first-order process yielding N_2O_4 and oxygen.



At a given temperature, the half-life of N_2O_5 is 0.90 hr. What is the first-order rate constant for N_2O_5 decomposition?

✓ $\text{hr}^{-1} 0.77$.a ☒

$\text{hr}^{-1} 7.7$.b ☐

$\text{hr}^{-1} 77$.c ☐

$\text{hr}^{-1} 0.2$.d ☐

الإجابة الصحيحة هي:

0.77 hr^{-1}

The rate law for the reaction

$\text{H}_2\text{O}_2 + \text{I}^- \rightarrow \text{I}_2 + 2\text{H}_2\text{O}$ is $\text{rate} = k[\text{H}_2\text{O}_2][\text{I}^-]$.

The following mechanism has been suggested.



Identify all intermediates included in this mechanism.

a. H^+ and I^- ☐

b. H^+ and HOI ☐

c. ☒ HOI and OH^-

d. H_2O and OH^- ☐

الإجابة الصحيحة هي:

HOI and OH^-

Which items correctly complete the following statement
:A catalyst can act in a chemical reaction to
.increase the equilibrium constant (I)
.lower the activation energy (II)
.provide a new path for the reaction (III)

only I & III .a ☐

only I & II .b ☐

✓ only II & III .c ☒

الإجابة الصحيحة هي:

only II & III

The activation energy for the reaction $\text{CH}_3\text{CO} \rightarrow \text{CH}_3 + \text{CO}$ is 71 kJ/mol. How many times greater is the rate constant for this reaction at 170°C than at 150°C?

1.1 .a ☐

4 .b ☐

✓ 2.5 .c ☒

0.40 .d ☐

الإجابة الصحيحة هي:

2.5

:Given the following data for this reaction



	RATE	$[\text{NO}_2^-]$	$[\text{NH}_4^+]$	EXPT
M/s	0.020M	0.020M	0.010	1
M/s	0.030M	0.020M	0.015	2
M/s	0.005M	0.010M	0.010	3

:The rate law for the reaction is

- ✓ Rate = $k[\text{NH}_4^+][\text{NO}_2^-]^2$.a ☒
- Rate = $k[\text{NH}_4^+]^2[\text{NO}_2^-]^2$.b ☐
- Rate = $k[\text{NH}_4^+]^2[\text{NO}_2^-]$.c ☐
- Rate = $k[\text{NH}_4^+][\text{NO}_2^-]$.d ☐

الإجابة الصحيحة هي:

$$\text{Rate} = k[\text{NH}_4^+][\text{NO}_2^-]^2$$

?Which statement is **false**

✓ If a reaction is thermodynamically spontaneous, it must have a low activation energy. .a ☒

If a reaction is thermodynamically nonspontaneous, it will not occur spontaneously. .b ☐

If a reaction is thermodynamically spontaneous it may occur rapidly. .c ☐

If a reaction is thermodynamically spontaneous it may occur slowly. .d ☐

الإجابة الصحيحة هي:

If a reaction is thermodynamically spontaneous, it must have a low activation energy.

When the concentration of reactant molecules is increased, the rate of reaction increases. The best explanation is: As the ,reactant concentration increases

- a ☐ the activation energy increases.
- b ☐ the average kinetic energy of molecules increases.
- c ☒ the frequency of molecular collisions increases.
- d ☐ the rate constant increases.

الإجابة الصحيحة هي:

the frequency of molecular collisions increases.

The speed of a chemical reaction

is independent of the amount of contact surface of a solid involved. .a ☐

is constant no matter what the temperature is. .b ☐

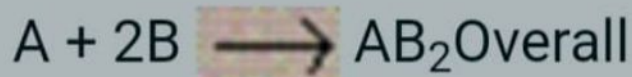
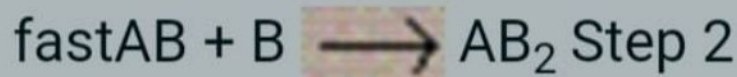
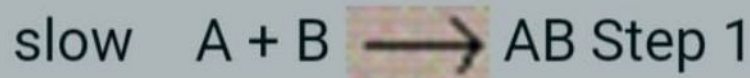
between gases should in all cases be extremely rapid because the average kinetic energy of the molecules is great. .c ☐

✓ between ions in aqueous solution is extremely rapid because there are no bonds that need to be broken. .d ☒

الإجابة الصحيحة هي:

between ions in aqueous solution is extremely rapid because there are no bonds that need to be broken.

Suppose the reaction: $A + 2B \longrightarrow AB_2$ occurs by the following mechanism



= The rate law expression must be Rate

$k[A]$.a ☐

$k[A][B]^2$.b ☐

✓ $k[A][B]$.c ☒

$k[B]$.d ☐

$k[B]^2$.e ☐

الإجابة الصحيحة هي:



For what order reaction does the half-life get longer as the initial concentration increases?

✓ zeroth order .a ☒

first order .b ☐

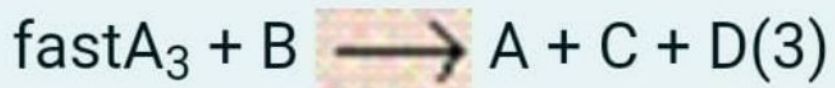
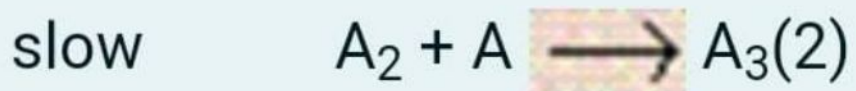
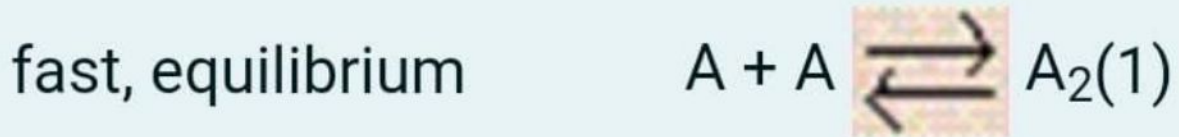
none of them because half-life is
always independent of the initial
concentration .c ☐

second order .d ☐

الإجابة الصحيحة هي:

zeroth order

A possible mechanism for the reaction, $2A + B \rightarrow C + D$, is



According to the mechanism, the rate law will be

Rate = $k[A][B]$.a ☐

✓ Rate = $k[A]^3$.b ☒

Rate = $k[A]^2$.c ☐

Rate = $k[A][B]$.d ☐

الإجابة الصحيحة هي:

Rate = $k[A]^3$

In the reaction, $2\text{N}_2\text{O} \rightarrow 2\text{N}_2 + \text{O}_2$, oxygen and nitrogen gases are formed at the same rate (mol/L·s) .

✓ False .a ☒

True .b ☐

الإجابة الصحيحة هي:

False

A correct reaction mechanism for a given
:reaction usually is

the same as its balanced chemical
equation. .a ☐

obvious if its reaction order is known. .b ☐

✓ **the sequence of elementary steps
by which a chemical reaction
occurs** .c ☒

obvious if its heat of reaction is known. .d ☐

الإجابة الصحيحة هي:

**the sequence of elementary steps by which a
chemical reaction occurs**

For the chemical reaction $A \rightarrow C$, a plot of $1/[A]$ versus time was found to give a straight line with a positive slope. What is the order of reaction?

- first .a ☐
- zeroth .b ☐
- third .c ☐
- ✓ second .d ☒

الإجابة الصحيحة هي:

second

The activation energy of a certain uncatalyzed reaction is 64 kJ/mol. In the presence of a catalyst, the E_a is 55 kJ/mol. How many times faster is the catalyzed than the uncatalyzed reaction at 400°C? Assume that the frequency factor remains the same.

- a ☐ 15.0 times
- b ☐ 1.16 times
- c ☒ 5.0 times
- d ☐ 2.0 times

الإجابة الصحيحة هي:

5.0 times

If reaction A has an activation energy of 250 kJ and reaction B has an activation energy of 100 kJ, which of the following statements **must** be correct?

If reaction A is exothermic and reaction B is endothermic then reaction A is favored kinetically. .a ☐

✓ At the same temperature the rate of reaction B is greater than the rate of reaction A. .b ☒

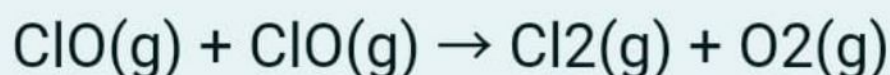
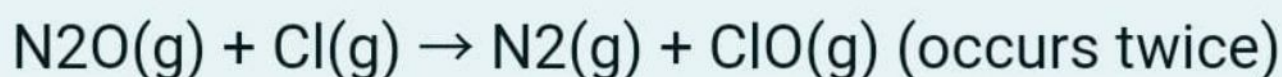
The energy of reaction A must be greater than the energy of reaction B. .c ☐

The energy of reaction B must be greater than the energy of reaction A. .d ☐

Nitrous oxide (N₂O) decomposes at 600°C according to the balanced equation



A reaction mechanism involving three steps is shown below. Identify all of the catalysts in the following mechanism.



Cl .a ☐

ClO .b ☐

✓ Cl₂ .c ☒

ClO and Cl .d ☐

الإجابة الصحيحة هي:

Cl₂

If E_a for a certain biological reaction is 50. kJ/mol, by what factor (how many times will the rate of this reaction increase when body temperature increases from 37°C (normal) to 40°C (fever)?

1.0002 .a ☐

✓ 1.20 .b ☒

1.15 .c ☐

2.0 .d ☐

الإجابة الصحيحة هي:

1.20

The half-life of a reaction is half the time required for the reaction to go to completion

✓ false .a ☒

true .b ☐

The Arrhenius equation is $k = A e^{-(E_a/RT)}$.

The slope of a plot of $\ln k$ vs. $1/T$ is
equal to

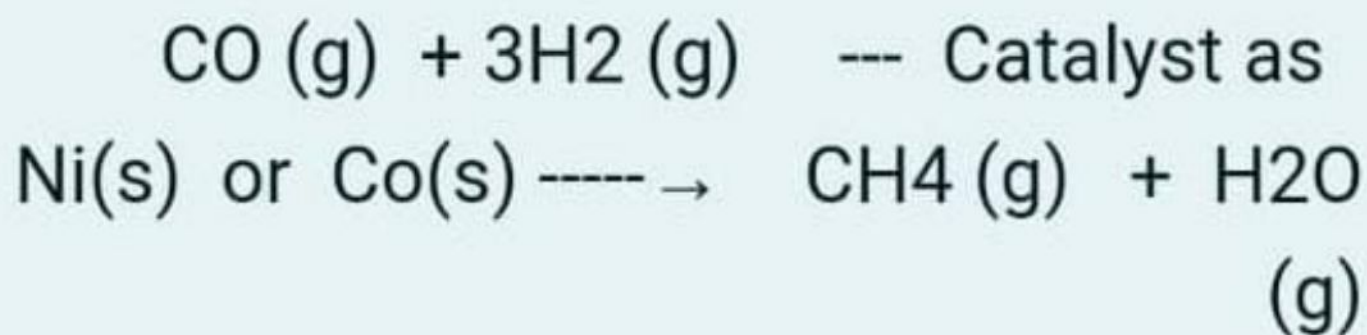
-k .a ☐

A .b ☐

k .c ☐

✓ -E_a /R .d ☒

Substitute natural gas can be synthesized by passing carbon monoxide and hydrogen over Ni or Co at 400°C.



This process is an example of homogeneous catalysis.

☒ False .a ☐

True .b ☐

:A catalyst

- changes the equilibrium concentration of the products. .a ☐
- always increases the activation energy for a reaction. .b ☐
- ✓ actually participates in the reaction. .c ☒
- always decreases the rate for a reaction. .d ☐

How many times will the rate of the elementary reaction $3X + Y \rightarrow X_2Y$ change if the concentration of the substance X is doubled and that of Y is halved?

$r_2 = 4.5r_1$.a ☐

$r_2 = 5r_1$.b ☐

✓ $r_2 = 4r_1$.c ☒

$r_2 = 2r_1$.d ☐

Which one of the following changes would alter the rate constant (k) for the reaction $2A + B \rightarrow \text{products}$

- a ☐ increasing the concentration of A
- b ☒ increasing the temperature
- c ☐ increasing the concentration of B
- d ☐ measuring k again after the reaction has run for a while

الإجابة الصحيحة هي:

increasing the temperature

Given that E_a for a certain biological reaction is 48 kJ/mol and that the rate constant is $2.5 \times 10^{-2} \text{ s}^{-1}$ at 15°C , what is the rate constant at 37°C ?

✓ ☒ a. $1.0 \times 10^{-1} \text{ s}^{-1}$

☐ b. $2.5 \times 10^{-1} \text{ s}^{-1}$

☐ c. $6.0 \times 10^{-3} \text{ s}^{-1}$

☐ d. $2.7 \times 10^{-2} \text{ s}^{-1}$

الإجابة الصحيحة هي:

$1.0 \times 10^{-1} \text{ s}^{-1}$

For the reaction $\text{NO}_2 + \text{CO} \rightarrow \text{CO}_2 + \text{NO}$
the experimental rate expression is $-\text{dc} / \text{dt} = k [\text{NO}_2]^2$ the number of molecules of CO
:involves in the slowest step will be

3 .a ☐

1 .b ☐

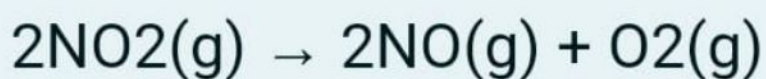
2 .c ☐

✓ 0 .d ☒

الإجابة الصحيحة هي:

0

The reaction



is suspected to be second order in NO_2 .

Which of the following kinetic plots would be the most useful to confirm whether or not the reaction is second order?

- a plot of $[\text{NO}_2]$ vs. t .a ☐
- a plot of $\ln [\text{NO}_2]^{-1}$ vs. t .b ☐
- a plot of $\ln [\text{NO}_2]$ vs. t .c ☐
- ✓ a plot of $[\text{NO}_2]^{-1}$ vs. t .d ☒

الإجابة الصحيحة هي:

a plot of $[\text{NO}_2]^{-1}$ vs. t

For a first order reaction, the half-life is independent of concentration

false .a ☐

✓ true .b ☒

الإجابة الصحيحة هي:

true

Complete the following statement: A catalyst

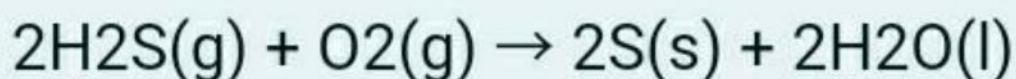
increases the concentration of reactants. .a ☐

✓ changes the reaction mechanism. .b ☒

increases the activation energy. .c ☐

increases the average kinetic energy of the reactants. .d ☐

For the overall chemical reaction shown below, which one of the following statements can be rightly assumed?



The reaction is second-order overall .a ☐

The reaction is third-order overall. .b ☐

The rate law is, $\text{rate} = k[\text{H}_2\text{S}]^2[\text{O}_2]$.c ☐

✓ The rate law cannot be determined from the information given. .d ☒

For the first-order reaction, $A \rightarrow$ products, if half of the initial concentration of A reacts in 20 min, then the remaining half will completely react in the next 20 min

True .a ☐

✓ False .b ☒



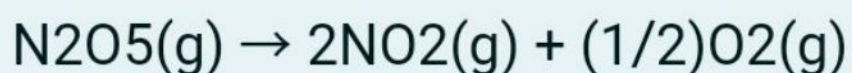
This reaction is first order with respect to reactant A and second order with respect to reactant B. If the concentration of A is doubled and the concentration of B is halved, the rate of _____ the reaction would _____ by a factor of _____.

- ☒ a. decrease, 2
- ☐ b. decrease, 4
- ☐ c. increase, 4
- ☐ d. increase, 2

الإجابة الصحيحة هي:

decrease, 2

The activation energy for the following first-order reaction is 102 kJ/mol.



The value of the rate constant (k) is $1.35 \times 10^{-4} \text{ s}^{-1}$ at 35°C . What is the value of k at 0°C ?

$2.2 \times 10^{-2} \text{ s}^{-1}$.a ☐

✓ $8.2 \times 10^{-7} \text{ s}^{-1}$.b ☒

$4.2 \times 10^{-5} \text{ s}^{-1}$.c ☐

$1.9 \times 10^{-5} \text{ s}^{-1}$.d ☐

الإجابة الصحيحة هي:

$8.2 \times 10^{-7} \text{ s}^{-1}$

What are the units of k for the rate law: $\text{Rate} = k[A][B]^2$, when the concentration unit is mol/L

✓ $\text{L}^2 \text{mol}^{-2} \text{s}^{-1}$.a ☒

s^{-1} .b ☐

s .c ☐

$\text{L mol}^{-1} \text{s}^{-1}$.d ☐

الإجابة الصحيحة هي:

$\text{L}^2 \text{mol}^{-2} \text{s}^{-1}$

Benzoyl chloride, $\text{C}_6\text{H}_5\text{COCl}$, reacts with water to form benzoic acid, $\text{C}_6\text{H}_5\text{COOH}$, and hydrochloric acid.

This first-order reaction is 25% complete after 26 s.

How much longer would one have to wait in order to obtain 99% conversion of benzoyl chloride to benzoic acid?

✓ 390 s .a ☒

420 s .b ☐

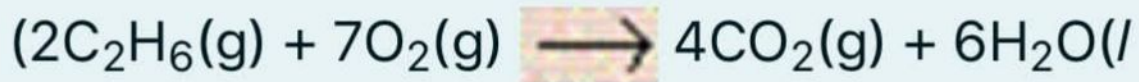
180 s .c ☐

290 s .d ☐

الإجابة الصحيحة هي:

390 s

The combustion of ethane (C_2H_6) is represented
by the equation



In this reaction

a ☐ the rate of formation of CO_2 equals the rate of formation of water.

b ☐ water is formed at a rate equal to two-thirds the rate of formation of CO_2 .

c ☒ CO_2 is formed twice as fast as ethane is consumed.

d ☐ the rate of consumption of ethane is seven times faster than the rate of consumption of oxygen.

The isomerization of methyl isocyanide, $\text{CH}_3\text{NC} \rightarrow \text{CH}_3\text{CN}$, follows first-order kinetics. The half-lives were found to be 161 min at 199°C and 12.5 min at 230°C . Calculate the activation energy for this reaction.

- 78.2 kJ/mol .a ☐
- ✓ 163 kJ/mol .b ☒
- 31.4 kJ/mol .c ☐
- 124 kJ/mol .d ☐

الإجابة الصحيحة هي:

163 kJ/mol

For the reaction, $2\text{H}_2\text{S}(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{S}(\text{s}) + 2\text{H}_2\text{O}(\text{l})$, which one of the following statements is **absolutely** true

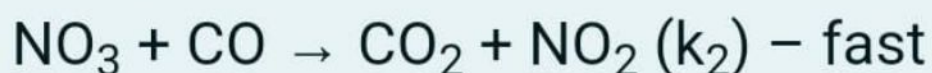
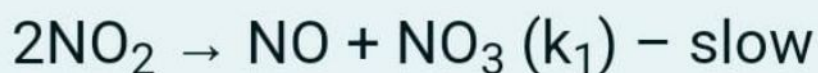
✓ The rate law cannot be determined from the information given. .a ☒

The reaction is fourth order overall. .b ☐

The rate law is: $\text{rate} = k[\text{H}_2\text{S}]^2[\text{O}_2]$. .c ☐

The reaction is first order with respect to H_2S and second order with respect to O_2 . .d ☐

The reaction $\text{NO}_2 + \text{CO} \rightarrow \text{NO} + \text{CO}_2$ takes place in two steps. Find the rate law.



✓ $R = k_1 [\text{NO}_2]^2$.a ☒

$R = k_1 [\text{NO}_2]$.b ☐

$R = k_1 [\text{NO}_2]^3$.c ☐

$R = k_2 [\text{NO}_3] [\text{CO}]$.d ☐

الإجابة الصحيحة هي:

$$R = k_1 [\text{NO}_2]^2$$

For the chemical reaction $A \rightarrow B + C$,
a plot of $[A]_t$ versus time is found to give a
straight line with a negative slope. What is
the order of reaction with respect to A?

- third .a ☐
- second .b ☐
- first .c ☐
- ✓ zeroth .d ☒

الإجابة الصحيحة هي:

zeroth

For a reaction $2A + B \longrightarrow 2C$, with the
:rate equation

$$\text{Rate} = k[A]^2[B]$$

- ✓ .a ☒ the order with respect to A is 2
and the order overall is 3.
- .b ☐ the order with respect to A is 1 and
the order overall is 1.
- .c ☐ the order with respect to B is 2 and
the order overall is 2.
- .d ☐ the order with respect to A is 2 and
the order overall is 2.

الإجابة الصحيحة هي:

the order with respect to A is 2 and the
order overall is 3.

The activation energy for a certain reaction is 113 kJ/mol. By what factor (how many times) will the rate constant increase when the temperature is raised from 310 K to 325 K?

6.7 .a ☐

3 .b ☐

7.9 .c ☐

✓ 7.6 .d ☒

الإجابة الصحيحة هي:

7.6

The rate constant of a first-order reaction, $A \rightarrow \text{products}$, can be determined from a graph of $\ln[A]$ versus t .

False .a ☐

✓ True .b ☒

الإجابة الصحيحة هي:

True

A fast reaction has a large rate constant and short half-life

false .a ☐

✓ true .b ☒

الإجابة الصحيحة هي:

true

What is the concentration of the reactant in a first order reaction when the rate of the reaction is 0.6 s^{-1} and the rate constant is 0.035?

✓ 17.143 M .a ☒

26.667 M .b ☐

17.667 M .c ☐

26.183 M .d ☐

الإجابة الصحيحة هي:

17.143 M

Appropriate units for a first-order rate constant are

$M^2 \cdot s/1$.a ☐

$1/M \cdot s$.b ☐

✓ $1/s$.c ☒

M/s .d ☐

الإجابة الصحيحة هي:

$1/s$

Appropriate units for a first-order rate constant are

✓ 1/s .a ☒

M/s .b ☐

$M^2 \cdot s/1$.c ☐

$1/M \cdot s$.d ☐

الإجابة الصحيحة هي:

1/s

The activation energy for the following reaction is 60. kJ/mol.



By what factor (how many times) will the rate constant increase when the temperature is raised from 10°C to 28°C?

- 5.6 .a ☐
- ✓ 4.6 .b ☒
- 2.8 .c ☐
- 1.002 .d ☐

الإجابة الصحيحة هي:

4.6

Half life depends on concentration of
.reactants for first order reaction

✓ false .a ☒

true .b ☐

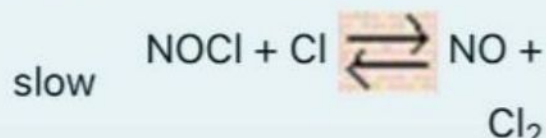
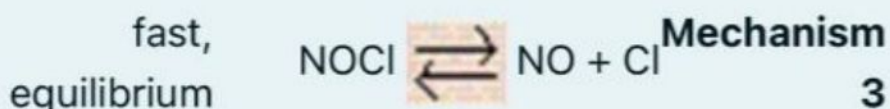
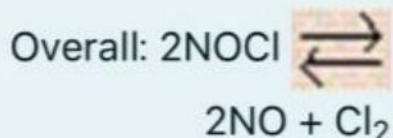
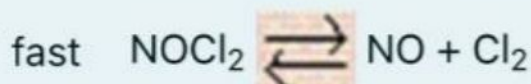
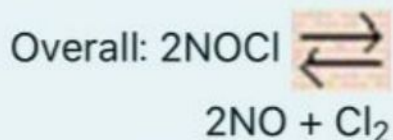
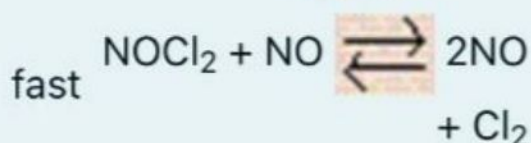
الإجابة الصحيحة هي:

false

At 300 K, the following reaction is found to obey
the rate law: $\text{Rate} = k[\text{NOCl}]^2$



Consider the three postulated mechanisms
given below. Then choose the response that lists
all those that are possibly correct and no others



3 .a ☐

✓ 2 .b ☒

1 .c ☐

2, 3 .d ☐

The activation energy for a reaction does not change significantly as temperature changes.

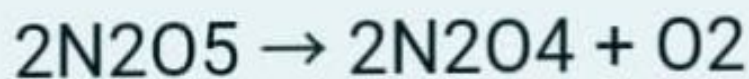
false .a ☐

✓ true .b ☒

الإجابة الصحيحة هي:

true

For the first-order reaction



at a particular temperature, the half-life of N_2O_5 is 0.90 hr. What fraction of the initial concentration of N_2O_5 will remain after 2.4 hours?

0.15 .a ☐

0.17 .b ☐

0.12 .c ☐

✓ 0.16 .d ☒

الإجابة الصحيحة هي:

0.16

The decomposition of carbon disulfide, CS_2 , to carbon monosulfide, CS , and sulfur is first order with $k = 2.8 \times 10^{-7} \text{ s}^{-1}$ at 1000°C



What is the half-life of this reaction at 1000°C

$6.1 \times 10^4 \text{ s}$.a ☐

✓ $2.5 \times 10^6 \text{ s}$.b ☒

$5.0 \times 10^7 \text{ s}$.c ☐

$3.8 \times 10^5 \text{ s}$.d ☐

$4.7 \times 10^{-6} \text{ s}$.e ☐

الإجابة الصحيحة هي:

$2.5 \times 10^6 \text{ s}$

For a second order reaction, the half-life is equal to

$t_{1/2} = 0.693/k$.a ☐

$t_{1/2} = k/0.693$.b ☐

$t_{1/2} = k$.c ☐

✓ $t_{1/2} = 1/k[A]_0$.d ☒

الإجابة الصحيحة هي:

$$t_{1/2} = 1/k[A]_0$$