This print-out should have 25 questions. Multiple-choice questions may continue on the next column or page – find all choices before answering.

001 10.0 points

If the average rate of formation of $H_2(g)$ is 3.90 (mol H_2)/L/s for the reaction

$$2\,PH_3(g) \rightarrow 2\,P(g) + 3\,H_2(g)\,,$$

what is the unique average reaction rate?

1. 1.30 mol/L/s

2. 2.60 mol/L/s

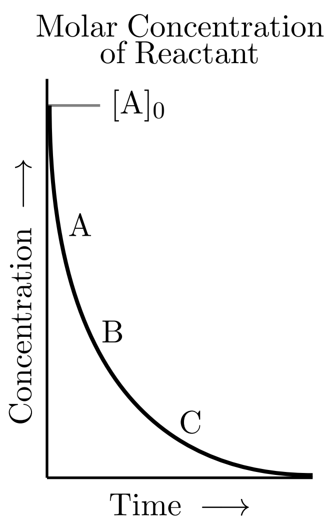
3. 3.90 mol/L/s

4. 7.80 mol/L/s

5. 11.7 mol/L/s

002 10.0 points

Consider the concentration-time dependence graph for a first-order reaction.



At which point on the curve is the reaction fastest?

1. A

2. The rates are the same at all points.

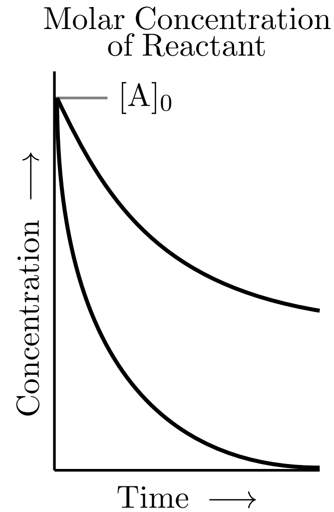
3. A + $t_{1/2}$

4. C

5. B

003 10.0 points

Consider the concentration-time dependence as shown below for two first order reactions.



Which reaction has the greatest $t_{1/2}$?

1. the reaction represented by the lower curve

2. Unable to determine

3. the reaction represented by the upper curve

004 10.0 points

When the reaction

$$3\,NO(g) \rightarrow N_2O(g) + NO_2(g)$$

is proceeding under conditions such that 0.015 mol/L of N_2O is being formed each second, the rate of the overall reaction is __?__ and the rate of change for NO is __?__ .

1. 0.015 $M{\cdot}s^{-1}$; -0.005 $M{\cdot}s^{-1}$

2. 0.015 $M{\cdot}s^{-1}$; -0.045 $M{\cdot}s^{-1}$

3. none of the other answers is correct

4. 0.030 $M{\cdot}s^{-1}$; -0.005 $M{\cdot}s^{-1}$

5. 0.015 $M{\cdot}s^{-1}$; $+0.045$ $M{\cdot}s^{-1}$

005 10.0 points

What is the rate law for the reaction

$$A + B + C \rightarrow D$$

if the following data were collected?

Exp	$[A]_0$	$[B]_0$	$[C]_0$	Initial Rate
1	0.4	1.2	0.7	2.32×10^{-3}
2	1.3	1.2	0.9	7.54×10^{-3}
3	0.4	4.1	0.8	9.25×10^{-2}
4	1.3	1.2	0.2	7.54×10^{-3}

1. rate $= 3.36 \times 10^{-3}\,[A]^1\,[B]^3\,[C]^0$

2. rate $= 5.37 \times 10^{-3}\,[A]^1\,[B]^3\,[C]^0$

3. rate $= 1.49 \times 10^{-3}\,[A]^0\,[B]^3\,[C]^1$

4. rate $= 4.48 \times 10^{-3}\,[A]^1\,[B]^2\,[C]^1$

5. rate $= 1.79 \times 10^{-3}\,[A]^0\,[B]^2\,[C]^1$

006 10.0 points

Consider the reaction

$$2\,O_3(g) \rightarrow 3\,O_2(g) \qquad \text{rate} = k[O_3]^2[O_2]^{-1}$$

What is the overall order of the reaction and the order with respect to $[O_3]$?

1. 0 and 1

2. 3 and 2

3. −1 and 3

4. 2 and 2

5. 1 and 2

007 10.0 points

For a given reaction, the rate-law is

1. an equation in which reaction rate is equal to a mathematical expression involving concentrations of reactants.

2. a constant of proportionality between reaction rate and the concentrations of reactants.

3. the sum of the powers to which reactant concentrations appear.

008 10.0 points

Consider the reaction

$$2\,A(g) + B(g) \rightarrow C(g) + D(g)\,.$$

When [A] = [B] = 0.10 M, the rate is 2.0 M/s; for [A] = [B] = 0.20 M, the rate is 8.0 M/s; and for [A] = 0.10 M, [B] = 0.20 M, the rate is 2.0 M/s. What is the rate law?

1. rate $= k\,[A]\,[B]$

2. rate $= k\,[A]^2$

3. rate $= k\,[A]$

4. rate $= k\,[A]\,[B]^0$

5. rate $= k\,[B]^2$

009 10.0 points

For the reaction

$$S_2O_8^{2-}(aq) + 3\,I^-(aq) \rightarrow 2\,SO_4^{2-}(aq) + I_3^-(aq)\,,$$

rate $= k\,[S_2O_8^{2-}][I^-]$. When the reaction is followed under pseudo-first-order conditions with $[S_2O_8^{2-}] = 200$ mM and $[I^-] = 1.5$ mM, the rate constant was 1.82 s^{-1}. What is the second order rate constant k for the reaction?

1. $6.07 \times 10^3\ M^{-1}s^{-1}$

2. $1.37 \times 10^{-2}\ M^{-1}s^{-1}$

3. $9.10\ M^{-1}s^{-1}$

4. $1.21 \times 10^3\ M^{-1}s^{-1}$

5. $1.82\ M^{-1}s^{-1}$

010 (part 1 of 3) 10.0 points

A chemical reaction is expressed by the balanced chemical equation

$$A + 2\,B \longrightarrow C$$

Consider the data

	Initial [A] M	Initial [B] M	Initial rate M/min
1	0.16	0.16	0.00146227
2	0.16	0.32	0.00584909
3	0.32	0.32	0.0116982

Find the rate law for the reaction.

1. $R = k[A]\,[B]$

2. $R = k[A]\,[B]^2$

3. $R = k[A]^2\,[B]$

011 (part 2 of 3) 10.0 points

Calculate the value of the specific rate constant.

1. 0.352
2. 0.234
3. 0.25
4. 0.427
5. 0.336
6. 0.208
7. 0.225
8. 0.379
9. 0.371
10. 0.357

012 (part 3 of 3) 10.0 points

If the initial concentrations of both A and B are 0.29 M, at what initial rate is C formed?

1. 0.0279865
2. 0.0256851
3. 0.0249589
4. 0.00870687
5. 0.0190222
6. 0.0200586
7. 0.0336315
8. 0.016192
9. 0.0118528
10. 0.0135992

Answer in units of M/min.

013 10.0 points

We know that the rate expression for the reaction

$$2\,NO + O_2 \rightarrow 2\,NO_2$$

at a certain temperature is Rate $= k\,[NO]^2\,[O_2]$. We carry out two experiments involving this reaction at the same temperature, but in the second experiment the initial concentration of NO is doubled while the initial concentration of O_2 is halved. The initial rate in the second experiment will be how many times that of the first?

1. 8

2. 1

3. 4

4. 2

014 10.0 points

Consider the data collected for a chemical reaction between compounds A and B that is first order in A and first order in B:

	[A] M	[B] M	rate M/s
1	0.2	0.05	0.1
2	?	0.05	0.4
3	0.4	?	0.8

From the information above for 3 experiments, determine the missing concentrations of A and B. Answers should be in the order of [A] then [B].

1. 0.80 M; 0.20 M

2. 0.40 M; 0.20 M

3. 0.40 M; 0.10 M

4. 0.80 M; 0.10 M

5. 0.20 M; 0.80 M

6. 1.60 M; 0.40 M

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015 10.0 points

For a reaction that is zero-order overall,

1. the rate constant is zero.

2. the activation energy is zero.

3. the reactant concentration does not change with time.

4. the rate does not change during the reaction.

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016 10.0 points

Consider the reaction: $A + B \longrightarrow C$

If it is 1^{st} order in A and 0^{th} order in B, a plot of $\ln[A]$ vs time will have a slope that is

1. slowly decreasing

2. constant

3. decreasing exponentially

4. slowly increasing

5. increasing exponentially

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017 10.0 points

Consider the reaction:

$$H_2CO_3(aq) \longrightarrow CO_2(aq) + H_2O(\ell)$$

If it has a half-life of 1.6 s, how long will it take a system with an initial $[H_2CO_3]$ of 2 M to reach a $[H_2CO_3]$ of 125 mM?

1. 6.4 s

2. 0.8 s

3. 3.2 s

4. Not enough information is given.

5. 0.4 s

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018 10.0 points

At a certain fixed temperature, the reaction

$$A(g) + 2\,B(g) \rightarrow AB_2(g)$$

is found to be first order in the concentration of A and zero order in the concentration of B. The reaction rate constant is 0.05 s^{-1}. If 2.00 moles of A and 4.00 moles of B are placed in a 1.00 liter container, how many seconds will elapse before the concentration of A has fallen to 0.30 mole/liter?

1. 34.06

2. 0.05

3. 56.67

4. 37.94

5. Not enough information to answer.

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019 10.0 points

A reaction

$$A \rightarrow \text{products}$$

is observed to obey first-order kinetics. Which of the following plots should give a straight line?

1. $\ln[A]$ *vs* t

2. $[A]$ *vs* t

3. $[A]$ *vs* $\dfrac{1}{t}$

4. $\ln[A]$ *vs* $\dfrac{1}{t}$

5. $\ln[A]$ *vs* $\dfrac{1}{k}$

6. $[A]$ *vs* k

7. $[A]$ *vs* $\dfrac{1}{k}$

8. $\ln[A]$ *vs* k

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020 10.0 points

The order of a reaction

Z1) is the product of the powers to which the reactant concentrations are raised in the rate law.

Z2) can't be greater than two since a rate-determining step involving the collision of three or more reactants would practically never occur.

Z3) is the sum of the powers to which the reactant concentrations are raised in the rate law.

Z4) is not related to events on an atomic or molecular scale.

1. Z3 only

2. Z4 only

3. Z1 only

4. Z3 and Z4 only

5. Z2 only

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021 10.0 points

A compound decomposes with a half-life of 8.0 s and the half-life is independent of the concentration. How long does it take for the concentration to decrease to one-ninth of its initial value?

1. 32 s

2. 3.6 s

3. 25 s

4. 72 s

5. 64 s

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022 10.0 points

For the reaction

$$\text{cyclobutane(g)} \rightarrow 2\,\text{ethylene(g)}$$

at 800 K, a plot of ln[cyclobutane] *vs* t gives a straight line with a slope of $-1.6\ \text{s}^{-1}$. Calculate the time needed for the concentration of cyclobutane to fall to $\dfrac{1}{16}$ of its initial value.

1. 1.3 s

2. 0.63 s

3. 1.6 s

4. 2.3 s

5. 1.7 s

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023 10.0 points

The initial concentration of the reactant A in a first-order reaction is 1.2 M. After 69.3 s, the concentration has fallen to 0.3 M. What is the rate constant k? ($\ln 2 = 0.693$)

1. $0.2\ \text{s}^{-1}$

2. not enough information

3. $0.02\ \text{s}^{-1}$

4. $0.01\ \text{s}^{-1}$

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024 10.0 points

A reaction is found to be first order with respect to one of the reactant species, A. When might a plot of ln[A] vs time not yield a straight line?

1. if the reaction has any significant backward rate

2. all of the above

3. if the reaction comes to equilibrium

4. when the rate also depends on the concentration of another reactant

025 10.0 points

Calculate the time required for the activity of a 9.0 mCi cobalt-60 source to decay to 8.5 mCi. The half-life of cobalt-60 is 5.26 years.

1. 4.6 months

2. 2.3 months

3. 0.090 months

4. 10 months

5. 5.2 months