This print-out should have 18 questions. Multiple-choice questions may continue on the next column or page – find all choices before answering.

001 4.0 points

The rate of formation of $NO_2(g)$ in the reaction

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

is 5.78 (mol NO_2)/L/s. What is the rate at which N_2O_5 decomposes?

1. 5.78 (mol N_2O_5)/L/s

2. 2.89 (mol N_2O_5)/L/s

3. 0.723 (mol N_2O_5)/L/s

4. 11.6 (mol N_2O_5)/L/s

5. 1.45 (mol N_2O_5)/L/s

002 4.0 points

Which naturally occurring type of radiation has the greatest penetrating power?

1. alpha

2. neutron

3. gamma

4. beta

003 4.0 points

One Becquerel is equal to ___ and one Curie is equal to ___.

1. one Neutron emission per second; 1 disintegration per second

2. 60 disintegrations per second; one beta particle emission per second

3. one Neutron emission per second; 60 disintegrations per second

4. one alpha particle emission per second; one beta particle emission per second

5. 1 disintegration per second; 3.7×10^{10} disintegrations per second

6. one Curie; one Neutron emission per second

7. one Curie; 3.7×10^{10} disintegrations per second

8. one Curie; one beta particle emission per second

004 4.0 points

A sample of carbon from the Lascaux cave in France contained 12% of the original fraction carbon-14. Estimate the age of this sample. The half-life of carbon-14 is 5.73×10^3 year.

1. 100,000 years

2. 50,000 years

3. 25,000 years

4. 17,500 years

5. 75,000 years

005 4.0 points

The overall reaction:

$$NO_2(g) + CO(g) \longrightarrow CO_2(g) + NO(g)$$

has an empirically determined rate law with a single bimolecular collision that doesn't involve CO. If $k = 2.0 \times 10^2\ M^{-1} \cdot s^{-1}$, $[NO_2] = 0.3$ M and $[CO] = 0.1$ M, what is the observed rate?

1. $6\ M \cdot s^{-1}$

2. $60\ M \cdot s^{-1}$

3. $1.8\ M \cdot s^{-1}$

4. $18\ M \cdot s^{-1}$

006 4.0 points

The following data were collected for the net reaction

$$A + B_2 + 2\,C \rightarrow D.$$

	Initial [A] M	Initial [B_2] M	Initial [C] M	Initial rate M/s
1	0.01	0.01	0.10	1.20×10^3
2	0.02	0.01	0.10	4.80×10^3
3	0.03	0.01	0.20	2.16×10^4
4	0.04	0.02	0.10	3.84×10^4

Which of the following is the rate law for this reaction? (Note that the units for the rate constant are omitted in the following answers.)

1. Rate $= (1.2 \times 10^{11})\,[A]^2\,[B_2]^2$

2. Rate $= (1.2 \times 10^{9})\,[A]\,[B_2]^2$

3. Rate $= (1.2 \times 10^{10})\,[A]^2\,[B_2]\,[C]$

4. Rate $= (1.2 \times 10^{10})\,[A]\,[B_2]^2$

5. Rate $= (1.2 \times 10^{12})\,[A]^2\,[B_2]\,[C]$

6. Rate $= (1.2 \times 10^{6})\,[B_2]\,[C]$

007 4.0 points

Consider the elementary reaction:

$$CaCO_3(s) \longrightarrow CO_2(g) + CaO(s)$$

If $k = 1.03 \times 10^{-2}\ \mathrm{M \cdot s^{-1}}$, and there is initially 0 M CO_2 , what is the [CO_2] after 10 minutes have passed?

1. 0.62 M

2. 1.03 M

3. 0.10 M

4. 6.18 M

008 4.0 points

Consider the reaction

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

rate $= k\,[N_2O_5]$.

If the initial concentration of N_2O_5 is 0.80 M, what is the concentration after 5 half-lives?

1. 0.032 M

2. 0.11 M

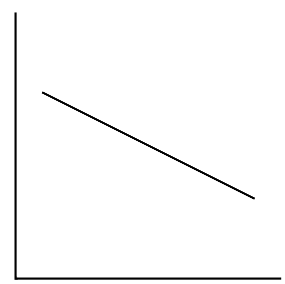
3. 0.050 M

4. 0.16 M

5. 0.025 M

009 4.0 points

The following graph is for a first order reaction.



Which are the appropriate units for the axes?

1. x-axis: time; y-axis: $[A]_0$

2. x-axis: time; y-axis: E_a

3. x-axis: $\dfrac{1}{\text{temperature}}$; y-axis: E_a

4. x-axis: time; y-axis: ln[A]

5. x-axis: temperature; y-axis: E_a

6. x-axis: time; y-axis: k

7. x-axis: $\dfrac{1}{\text{temperature}}$; y-axis: $\dfrac{1}{k}$

8. x-axis: $\dfrac{1}{\text{time}}$; y-axis: ln[A]

9. x-axis: time; y-axis: $\dfrac{1}{[\mathrm{A}]}$

10. x-axis: $\dfrac{1}{\text{time}}$; y-axis: [A]

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010 4.0 points

Based on the molecular model of chemical reactions discussed in class, which of the following is not required for a reaction to occur?

1. A certain minimum amount of energy.

2. A collision between the molecules which appear in the net chemical equation.

3. A collision between the species involved in the mechanism.

4. The proper orientation between reacting species.

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011 4.0 points

According to transition state theory and the potential energy curves used to explain it, which of the following is incorrect?

1. The change in internal energy for a reaction, differs from ΔE for the reverse reaction only by a change in sign.

2. Reactants pass through a short-lived intermediate state before forming products.

3. The energy of activation for the forward reaction is always less than that for the reverse reaction.

4. Free energy of activation is always positive.

5. Reactants pass through a high-energy transition state before forming products.

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012 4.0 points

If a certain reaction has an activation energy E_a of 0.5 $\mathrm{kJ \cdot mol^{-1}}$, at approximately what temperature would the reaction take place twice as fast as it does at 50 K?

1. 500 K

2. -110 K

3. 25 K

4. 125 K

5. 373 K

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013 4.0 points

The mechanism proposed for the oxidation of the iodide ion by the hypochlorite ion in aqueous solution is as follows:

1: $ClO^- + H_2O \rightleftharpoons HClO + OH^-$ (fast)

2: $I^- + HClO \rightarrow HIO + Cl^-$ (slow)

3: $HIO + OH^- \rightarrow IO^- + H_2O$ (fast)

How many intermediates are there in this mechanism?

1. 1

2. 0

3. 2

4. 3

5. 4

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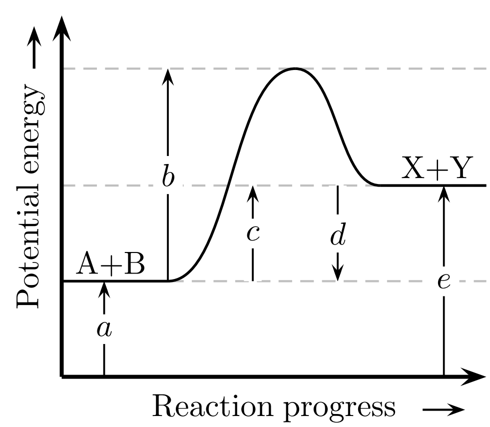
014 4.0 points

Consider the following potential energy diagram.



If a catalyst were added, which arrow would change, and how?

1. the length of arrow a would be larger.

2. the length of arrow b would be larger.

3. the length of arrow c would be larger.

4. the length of arrow d would be larger.

5. the length of arrow a would be smaller.

6. the length of arrow e would be smaller.

7. the length of arrow b would be smaller.

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015 4.0 points

In a catalytic converter, one of the general sets of reactions is a reduction. It is ________.

1. carbon monoxide being converted to carbon dioxide.

2. carbon dioxide being converted into methane.

3. nitrogen oxides being converted to nitrogen gas.

4. incomplete combustion products being converted to carbon dioxide.

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016 4.0 points

What type of particle is emitted in the transformation

$$^{201}\mathrm{Pt} \rightarrow {}^{201}\mathrm{Au}\,?$$

1. β particle

2. No particle is emitted because electron capture occurs.

3. positron

4. α particle

5. γ particle

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017 4.0 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. 2.3 months

2. 4.6 months

3. 0.090 months

4. 5.2 months

5. 10 months

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018 4.0 points

The following reaction

$\mathrm{A + B \rightarrow C}$

is found to follow the rate law

rate $=\mathrm{k[A][B]}$

when will a plot of ln[A] vs time yield a straight line?

1. when [B] = [A]

2. when the $[B] >> [A]$

3. never

4. always

5. when the $[B] << [A]$