117
version

last name

first name

signature

McCord CH302
50375 / 50380

Exam 3

Spring 2017

Reminder: Be sure and correctly bubble in your name, uteid, and version number on your bubblesheet.

The Periodic Table plus conversion factors and data should be provided on a separate sheet.

NOTE: Please keep your Exam copy intact (all pages still stapled). You must turn in your exam copy, bubble sheet, handouts, and scratch paper.

This print-out should have 26 questions. Multiple-choice questions may continue on the next column or page – find all choices before answering.

001 4.0 points

For a zero order reaction, the half life:

1. increases with increasing concentration of the reactant.

2. is independent of concentration of the reactant.

3. decreases with increasing concentration of the reactant.

002 4.0 points

Does the complex ion, $[Mn(CO)_2(OH_2)_4]^{2+}$, obey the 18-electron rule? If not, how many total electrons are there?

1. No, the complex has a total of 16 electrons.

2. No, the complex has a total of 15 electrons.

3. Yes, the complex has a total of 18 electrons.

4. No, the complex has a total of 19 electrons.

5. No, the complex has a total of 17 electrons.

003 4.0 points

The following data were collected for the reaction

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

	Initial [A] (M)	Initial [B_2] (M)	Initial [C] (M)	Initial rate (M/s)
1	0.01	0.01	0.01	1.250×10^3
2	0.02	0.01	0.01	5.000×10^3
3	0.03	0.01	0.05	1.125×10^4
4	0.04	0.02	0.01	8.000×10^4

Find the rate law.

1. Rate = $(1.25 \times 10^9)\ [A]^2\ [B_2]$

2. Rate = $(1.25 \times 10^7)\ [A]\ [B_2]\ [C]^2$

3. Rate = $(1.25 \times 10^9)\ [A]\ [B_2]^2$

4. Rate = $(1.25 \times 10^{11})\ [A]^2\ [B_2]^2$

5. Rate = $(1.25 \times 10^7)\ [A]^2\ [B_2]^2$

004 3.0 points

Following a nuclear reaction that releases energy, the total particle mass is

1. twice as much as the original.

2. slightly less than the original.

3. slightly more than the original.

4. the same as the original.

5. zero, since it was completely consumed.

005 4.0 points

O-15 decays by positron emission. What is the product of this decay?

1. $^{11}_{6}C$

2. None of these

3. $^{15}_{10}Ne$

4. $^{15}_{9}F$

5. $^{15}_{7}\mathrm{N}$

6. $^{14}_{8}\mathrm{O}$

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006 4.0 points

If Substance A is a catalyst, which equation best represents what happens in a chemical reaction?

1. $\mathrm{X} + \mathrm{YZ_2} + \mathrm{A} \rightarrow \mathrm{XY} + \mathrm{Z_2} + 2\mathrm{A}$

2. $\mathrm{X} + \mathrm{YZ_2} + \mathrm{A} \rightarrow \mathrm{XY} + \mathrm{Z_2} + \mathrm{A}$

3. $\mathrm{X} + \mathrm{YZ_2} + 2\mathrm{A} \rightarrow \mathrm{XY} + \mathrm{Z_2} + \mathrm{A}$

4. $\mathrm{X} + \mathrm{YZ_2} + \mathrm{A} \rightarrow \mathrm{XY} + \mathrm{Z_2}$

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007 4.0 points

Calculate the time required for the activity of a 9.0 mCi sodium-25 source to decay to 7.0 mCi. The half-life of sodium-25 is 60.0 s.

1. 22 s

2. 19 s

3. 0.029 s

4. 44 s

5. 9.4 s

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008 4.0 points

The reaction

$$2\,\mathrm{HI} \rightarrow \mathrm{H_2} + \mathrm{I_2}$$

has rate constants $k_1 = 9.7 \times 10^{-6}\ \mathrm{M^{-1}s^{-1}}$ and $k_2 = 0.097\ \mathrm{M^{-1}s^{-1}}$ at $T_1 = 326.85°\mathrm{C}$ and $T_2 = 526.85°\mathrm{C}$. What is the activation energy of this reaction?

1. 7.16×10^7 J

2. 6.59×10^4 J

3. 7.93×10^3 J

4. 1.84×10^5 J

5. 2.86×10^4 J

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009 4.0 points

$^{123}\mathrm{I}$ is a radioisotope used to diagnose the function of the thyroid gland. It has a half-life of 13.3 hours. What fraction of the diagnostic dose of $^{123}\mathrm{I}$ would be present in a patient 79.8 hours after it was administered?

1. $\frac{1}{8}$

2. $\frac{1}{64}$

3. $\frac{1}{16}$

4. $\frac{1}{32}$

5. $\frac{1}{6}$

6. You need to know how much was given to the patient.

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010 4.0 points

The nuclear binding energy for lithium-7 is the energy released in the nuclear reaction

1. $7\,^1\mathrm{H} \rightarrow ^7\mathrm{Li}$

2. $3\,^1\mathrm{H} + 4\,\beta \rightarrow ^7\mathrm{Li}$

3. $3\,^1\mathrm{H} + 7\,n \rightarrow ^7\mathrm{Li}$

4. $3\,^1\mathrm{H} + 4\,n \rightarrow ^7\mathrm{Li}$

5. $^6\mathrm{Li} + n \rightarrow ^7\mathrm{Li}$

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011 3.0 points

What is the neutron : proton ratio for the nucleus $^{134}_{50}\mathrm{Sn}$?

1. 1.68 : 1

2. 1 : 2

3. 1 : 1.68

4. None of these

5. 2.68 : 1

6. 2 : 1

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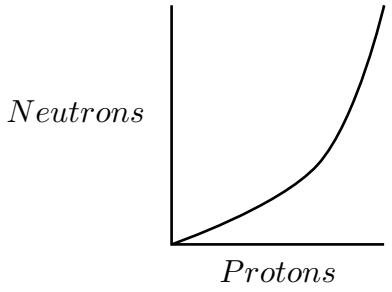
012 4.0 points

Below is a graph representing the band of stability for different isotopes. Nuclides that lie below the band of stability would be likely to decay by



1. Beta emission, to decrease their neutron: proton ratio

2. Positron emission, to increase their neutron: proton ratio

3. Beta emission, to increase their neutron: proton ratio

4. Positron emission, to decrease their neutron: proton ratio

5. Alpha emission, to decrease their neutron: proton ratio

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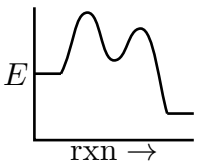
013 4.0 points

The reaction $2\,\mathrm{A} + \mathrm{B} \rightarrow 2\,\mathrm{C}$ is endothermic. A proposed mechanism for this reaction is

(1) $2\,\mathrm{A} \rightleftharpoons \mathrm{D}$ fast
(2) $\mathrm{D} + \mathrm{B} \rightarrow 2\,\mathrm{C}$ slow

Which of the following reaction profiles best fit this data?

1.


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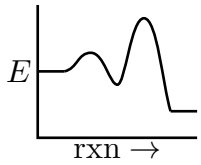

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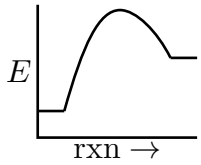

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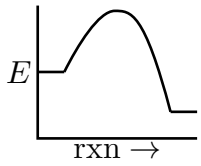

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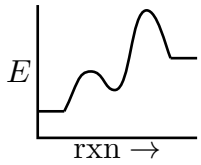
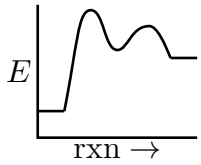


6.


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014 4.0 points

Consider the multistep reaction that has the overall reaction

$$2\,\mathrm{A} + 2\,\mathrm{B} \rightarrow \mathrm{C} + \mathrm{D}.$$

What is the rate law expression that would correspond to the following proposed mechanism?

$$\begin{array}{ll} \mathrm{A} + \mathrm{B} \rightleftharpoons \mathrm{I} & \text{(fast)} \\ \mathrm{I} + \mathrm{B} \rightleftharpoons \mathrm{X} & \text{(fast)} \\ \mathrm{X} + \mathrm{A} \rightarrow \mathrm{D} + \mathrm{C} & \text{(slow)} \end{array}$$

1. Rate $= k\,[\mathrm{A}]^2$

2. Rate $= k\,[\mathrm{I}]\,[\mathrm{B}]$

3. Rate $= k\,[\mathrm{A}]\,[\mathrm{B}]$

4. Rate $= k\,[\mathrm{A}]\,[\mathrm{I}]\,[\mathrm{B}]$

5. Rate $= k\,[\mathrm{B}]$

6. Rate $= k\,[\mathrm{A}]\,[\mathrm{B}]^2$

7. Rate $= k\,[\mathrm{A}]^2\,[\mathrm{B}]^2$

8. Rate $= k\,[\mathrm{A}]^2\,[\mathrm{B}]$

9. Rate $= k\,[\mathrm{A}]$

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015 3.0 points

Consider the reaction

$4\,Fe^{2+}(aq) + O_2(aq) + 2\,H_2O(\ell) \rightarrow 4\,Fe^{3+}(aq) + 4\,OH^-(aq)$

$\text{rate} = k[Fe^{2+}][OH^-]^2[O_2]\,.$

What is the overall order of the reaction and the order with respect to O_2?

1. 4 and 1

2. 5 and 1

3. 3 and 1

4. 7 and 1

5. 4 and 2

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016 4.0 points

The reaction

$$N_2 + 3\,H_2 \rightarrow 2\,NH_3$$

is proceeding under conditions that 0.150 moles of NH_3 are being formed every 20 seconds. What is the rate of disappearance of H_2?

1. 7.5×10^{-3} moles/sec

2. The question cannot be answered from the information given; we need to know the volume of the container.

3. The question cannot be answered from the information given; we need to know the rate law for the reaction.

4. 1.125×10^{-2} moles/sec

5. 2.25×10^{-1} moles/sec

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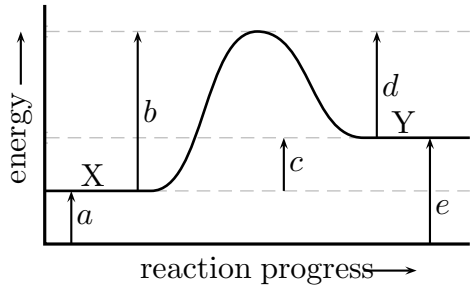
017 3.0 points

Consider the energy diagram for the reaction of X → Y.



Which arrow(s) are affected (value changes) when a catalyst is added to this reaction ?

1. b

2. b and d

3. c, d, and e

4. d

5. a, b, and c

6. c

7. a

8. e

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018 4.0 points

Which of the following species could form a dative bond with Co^{2+}?

1. CH_4

2. Ag^+

3. Cr^{2+}

4. H_2O

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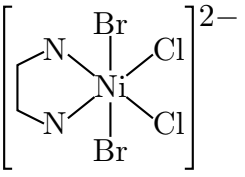
019 4.0 points

Consider the following inorganic complex shown below. What is the charge of the Ni in the center of the complex?



1. +1

2. +2

3. 0

4. −2

5. +3

6. −1

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020 4.0 points

The reaction

$$NO_2 + CO_2 \rightarrow CO + NO_3$$

has a rate law that is second order in NO_2. Which of these statements describes the mechanism that explains this unexpected rate law?

1. A single-step reaction mechanism in which a first unimolecular decomposition of NO_2 is the rate determining step.

2. A multi-step reaction mechanism in which a first unimolecular decomposition of NO_2 is the rate determining step.

3. A multi-step reaction mechanism in which a first bimolecular collision between NO_2 molecules is the rate determining step.

4. A single-step reaction mechanism in which a bimolecular collision between NO_2 molecules is the rate determining step.

5. A single-step reaction mechanism in which a bimolecular collision between NO_2 and CO_2 is the rate determining step.

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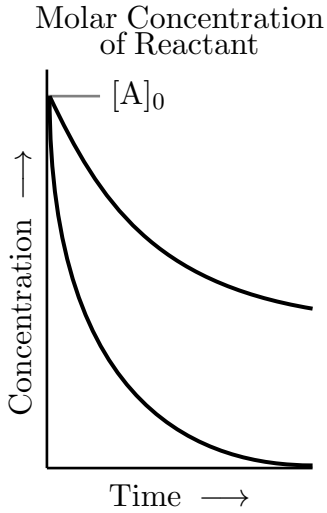
021 4.0 points

Consider the concentration-time dependence graph for two first-order reactions.



Which reaction has the larger rate constant?

1. the reaction represented by the upper curve

2. the reaction represented by the lower curve

3. Unable to determine

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022 4.0 points

Which of the following complexes contain coordination bonds?

I) HCl

II) $CHCl_3$

III) $[Cr(OH_2)_6]^{2+}$

IV) CO

1. I and II only

2. IV only

3. I and IV only

4. I, II, and IV only

5. III only

6. II and IV only

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023 4.0 points

The rate law for a reaction has been shown to be dependent only on reactant W. A graph of $1/[\mathrm{W}]$ vs t gives a straight line. This reaction is _____ order with respect to W. How would you determine the rate constant, k?

1. first; $k = -\text{slope}$

2. zero; $k = \text{slope}$

3. second; $k = \text{slope}$

4. second; $k = -\text{slope}$

5. first; $k = \text{slope}$

6. zero; $k = -\text{slope}$

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024 4.0 points

Complete the nuclear equation

$$^{253}_{99}\mathrm{Es} + {}^{4}_{2}\mathrm{He} \longrightarrow {}^{1}_{0}n + \underline{?}.$$

1. $? = {}^{252}_{103}\mathrm{Md}$

2. $? = {}^{256}_{101}\mathrm{Md}$

3. None of these

4. $? = {}^{257}_{101}\mathrm{Es}$

5. $? = {}^{249}_{97}\mathrm{Bk}$

6. $? = {}^{254}_{102}\mathrm{Bk}$

7. $? = {}^{248}_{105}\mathrm{Es}$

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025 4.0 points

Reaction mechanisms usually involve only unimolecular and/or bimolecular elementary steps. Is this generally true or false and give a statement as to why?

1. False, because the rate-determining step for most reactions is termolecular.

2. False, because mechanisms can have any molecularity.

3. True, because collisions of higher molecularity are statistically very rare.

4. True, because the activation energy for collisions of higher molecularity would be too great.

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026 4.0 points

Terpyridine is a ligand that forms an octahedral complex ion with ruthenium(II) that has the formula, $[\mathrm{Ru(tpy)_2}]^{2+}$. What is the denticity of terpyridine?

1. monodentate

2. pentadentate

3. tridentate

4. tetradentate

5. hexadentate

6. bidentate