This print-out should have 31 questions. Multiple-choice questions may continue on the next column or page – find all choices before answering.

Msci 21 1208
001 10.0 points

Consider the following electrode reactions:

$Fe^{3+} + 1\,e^- \rightarrow Fe^{2+}$ $E^0 = +0.771$ V

$I_2 + 2\,e^- \rightarrow 2\,I^-$ $E^0 = 0.535$ V

What would be E^0_{cell} for the spontaneous reaction?

1. $+1.007$ V

2. $+0.236$ V

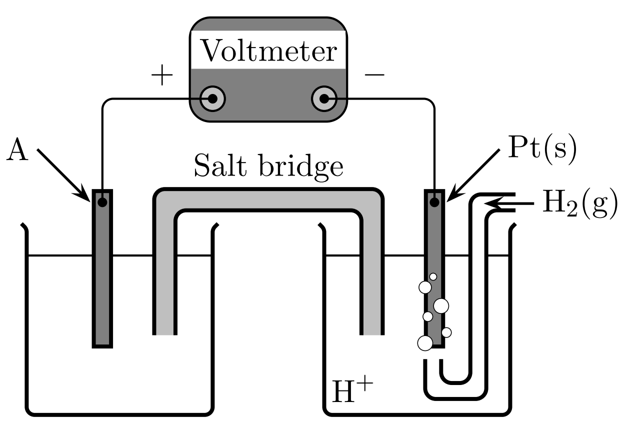
3. -1.306 V

4. -0.236 V

5. $+1.306$ V

ChemPrin3e T12 59
002 10.0 points

In the cell shown, A is a standard $Zn^{2+}\,|\,Zn$ electrode connected to a standard hydrogen electrode (SHE).



If the voltmeter reading is $+0.76$ V, which half-reaction occurs in the left-hand cell compartment?

1. $Zn(s) \rightarrow Zn^{2+}(aq) + 2\,e^-$

2. $Zn(s) + 2\,H^+(aq) \rightarrow Zn^{2+}(aq) + H_2(g)$

3. $Zn^{2+}(aq) + 2\,e^- \rightarrow Zn(s)$

4. $Zn^{2+}(aq) + H_2(g) \rightarrow Zn(s) + 2\,H^+(aq)$

Cell Type 02
003 10.0 points

What is the cathode in

$$Mg(s)\,|\,Mg^{2+}(aq)\,||\,Au^+(aq)\,|\,Au(s)$$

$Mg^{2+} + 2\,e^- \rightarrow Mg$ $\mathcal{E}^\circ_{\text{red}} = -2.36$

$Au^+ + e^- \rightarrow Au$ $\mathcal{E}^\circ_{\text{red}} = +1.69$

and what is the cell type?

1. $Au^+(aq)\,|\,Au(s)$; a battery

2. $Mg(s)\,|\,Mg^{2+}(aq)$; an electrolytic cell

3. $Mg(s)\,|\,Mg^{2+}(aq)$; a battery

4. Not enough information is provided.

5. $Au^+(aq)\,|\,Au(s)$; an electrolytic cell

EC Cell Nomenclature 006
004 10.0 points

If the two half reactions below were used to make an electrolytic cell, what species would be consumed at the cathode?

Half reaction	E°
$Cu^{2+}(aq) + 2\,e^- \longrightarrow Cu(s)$	$+0.34$
$Fe^{3+}(aq) + e^- \longrightarrow 2\,Fe^{2+}(aq)$	$+0.77$

1. $Fe^{2+}(aq)$

2. $Fe^{3+}(aq)$

3. $Cu(s)$

4. $Cu^{2+}(aq)$

ChemPrin3e T12 02
005 10.0 points

Consider the reaction

$$S_2O_4^{2-}(aq) \rightarrow SO_3^{2-}(aq)$$

in basic solution. How many electrons appear in the balanced half-reaction?

1. 6

2. 3

3. 1

4. 2

5. 4

ChemPrin3e T12 06
006 10.0 points

Consider the reaction
$$Zn(s) + OH^-(aq) + H_2O(\ell) + NO_3^-(aq) \rightarrow Zn(OH)_4^{2-}(aq) + NH_3(g)$$

If the coefficient of NO_3^- in the balanced equation is 1, how many electrons are transferred in the reaction?

1. 4

2. 2

3. 6

4. 10

5. 8

Msci 21 1204x
007 10.0 points

Given the following standard reduction potentials

$Fe^{3+} + e^- \rightleftharpoons Fe^{2+}$	+0.771 V
$Cu^{2+} + 2\,e^- \rightleftharpoons Cu$	+0.337 V
$Sn^{2+} + 2\,e^- \rightleftharpoons Sn$	−0.140 V

Which of the following species would be the strongest oxidizing agent?

1. Cu^{2+}

2. Cu

3. Sn

4. Fe^{2+}

5. Fe^{3+}

6. None of the species listed can act as an oxidizing agent.

7. Sn^{2+}

ChemPrin3e T12 46
008 10.0 points

The standard voltage of the cell

$$Ag(s)\,|\,AgBr(s)\,|\,Br^-(aq)\,||\,Ag^+(aq)\,|\,Ag(s)$$

is +0.73 V at 25°C. Calculate the equilibrium constant for the cell reaction.

1. 4.6×10^{-13}

2. 5.1×10^{14}

3. 2.0×10^{-15}

4. 2.2×10^{12}

5. 3.9×10^{-29}

LDE G from E Calc 001
009 10.0 points

What is ΔG° for the reaction below?

Reaction	E°
$ClO_3^- + 6\,H^+(aq) \longrightarrow \frac{1}{2}\,Cl_2(g) + 3\,H_2O(\ell)$	+1.47

1. $194,000\ kJ \cdot mol^{-1}$

2. $-1,418\ kJ \cdot mol^{-1}$

3. $-709\ kJ \cdot mol^{-1}$

4. $194\ kJ \cdot mol^{-1}$

Spontaneous Redox 002
010 10.0 points

Consider the half reactions

$Zn^{2+} + 2\,e^- \rightarrow Zn(s)$	$E^\circ = -0.76$
$Ag^{1+} + e^- \rightarrow Ag(s)$	$E^\circ = +0.80$

What will happen if you mix a solution that is 1M $Zn(NO_3)_2$, 1 M $AgNO_3$ and place into the solution a piece of solid Ag and a piece of solid Zn?

1. nothing will happen

2. Ag metal will form on the solid Ag

3. Zn metal will form on the solid Zn

4. Zn metal will form on the solid Ag

5. Ag metal will form on the solid Zn

Mlib 08 0086
011 10.0 points

A battery has two electrodes labeled anode and cathode. Electrons flow from the (anode, cathode) to the (anode, cathode) through the external circuit and (an oxidation, a reduction) reaction occurs at the cathode.

1. anode; cathode; reduction

2. cathode; anode; reduction

3. anode; cathode; oxidation

4. cathode; anode; oxidation

ChemPrin3e T12 69
012 10.0 points

If 8686 C of charge is passed through molten magnesium chloride, calculate the number of moles of Mg(ℓ) produced.

1. 2.00 mol

2. 0.0110 mol

3. 0.0225 mol

4. 0.0900 mol

5. 0.0450 mol

Cell Current
013 10.0 points

What is the average current generated in the

$$\text{Cu(s)} \,|\, \text{Cu}^{2+}\text{(aq)} \,||\, \text{Fe}^{3+}\text{(aq)} \,|\, \text{Fe(s)}$$

electrochemical cell if 50 g of Cu(s) are used up in a 24 hour period?

$Cu^{2+} + 2\,e^- \rightarrow Cu$ $\quad E^\circ_{red} = +0.22$ V
$Fe^{3+} + 3\,e^- \rightarrow Fe$ $\quad E^\circ_{red} = -0.04$ V

1. 13.00 amp

2. 1.76 amp

3. 2.64 amp

4. 111.85 amp

5. 42.17 amp

LDE Nernst Equation Calc 001
014 10.0 points

A battery formed from the two half reactions below dies (reaches equilibrium). If $[Fe^{2+}]$ was 0.24 M in the dead battery, what would $[Cd^{2+}]$ be in the dead battery?

Half reaction	E°
$Fe^{2+} \longrightarrow Fe$	−0.44
$Cd^{2+} \longrightarrow Cd$	−0.40

1. 120.3 M

2. 5.4 M

3. 0.0.0005 M

4. 0.01 M

Concentration Cell 001
015 10.0 points

Consider the following standard voltaic cell

$$\text{Zn} \,|\, \text{Zn}^{2+}\ (1\ \text{M}) \,||\, \text{Cu}^{2+}\ (1\ \text{M}) \,|\, \text{Cu}$$

What will happen if the concentration of the Cu^{2+} side of the cell is reduced to 10^{-2}M?

1. The voltage will decrease

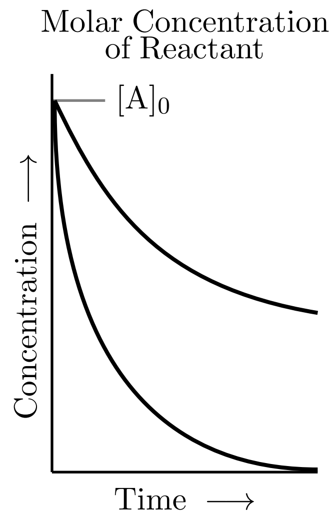
2. The voltage will stay the same

3. It depends on the value of E°

4. The voltage will increase

ChemPrin3e T13 19
016 10.0 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. Unable to determine

3. the reaction represented by the lower curve

LDE Assigning Rate Expressions 003
017 10.0 points

Consider the reaction below. Which of the following is a correct expression of the rate?

$$\frac{1}{2}\,S_8(s) + 3\,O_2(g) \longrightarrow 2\,SO_3(g)$$

1. $\dfrac{2 \cdot \Delta[SO_3]}{\Delta t}$

2. $-\dfrac{4 \cdot \Delta[S_8]}{\Delta t}$

3. $-\dfrac{\Delta[SO_3]}{2 \cdot \Delta t}$

4. $\dfrac{\Delta[O_2]}{3 \cdot \Delta t}$

5. $-\dfrac{\Delta[O_2]}{3 \cdot \Delta t}$

ChemPrin3e T13 04
018 10.0 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. 2.89 (mol N_2O_5)/L/s

2. 5.78 (mol N_2O_5)/L/s

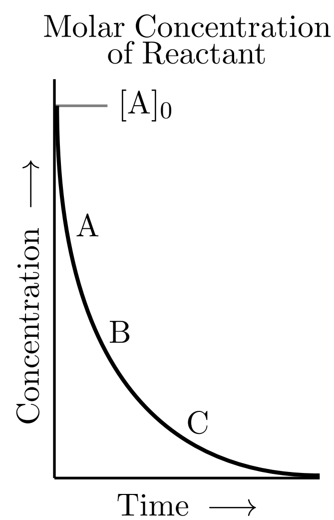
3. 0.723 (mol N_2O_5)/L/s

4. 1.45 (mol N_2O_5)/L/s

5. 11.6 (mol N_2O_5)/L/s

ChemPrin3e T13 18
019 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. The rates are the same at all points.

2. C

3. A

4. B

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

ChemPrin3e T13 17
020 10.0 points

For the reaction

$$2\,NO(g) + 2\,H_2(g) \rightarrow N_2(g) + 2\,H_2O(g)$$

the following data were collected.

[NO(g)]	[H_2(g)]	Rate, M/s
0.10	0.10	0.0050
0.10	0.20	0.010
0.10	0.30	0.015
0.20	0.10	0.020
0.20	0.20	0.040

What is the rate law for this reaction?

1. rate = $k\,[H_2]\,[NO]$

2. rate = $k\,[H_2]\,[NO]^2$

3. rate = $k\,\dfrac{[H_2]}{[NO]^2}$

4. rate = $k\,\dfrac{[H_2]}{[NO]}$

5. rate = $k\,[H_2]^2\,[NO]$

6. None of these

ChemPrin3e T13 40
021 10.0 points

For the reaction

$$\text{cyclopropane(g)} \rightarrow \text{propene(g)}$$

at 500°C, a plot of ln[cyclopropane] *vs* t gives a straight line with a slope of -0.00067 s^{-1}. What is the order of this reaction and what is the rate constant?

1. first order; 6.7×10^{-4} s^{-1}

2. first order; 6.7 s^{-1}

3. second order; 6.7×10^{-2} M$^{-1} \cdot$ s^{-1}

4. None of these

5. second order; 6.7×10^{-4} M$^{-1} \cdot$ s^{-1}

6. second order; 6.7 M$^{-1} \cdot$ s^{-1}

7. first order; 6.7×10^{-2} s^{-1}

Msci 16 0406
022 10.0 points

A first order elementary reaction

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

has a rate constant of 3.16×10^{8} sec^{-1}. At an instant in time, a concentration of 3.16×10^{-6} M of species A is created. How long does it take for the concentration to fall by a factor of 4?

1. 4.2×10^{-6} sec

2. 6.4×10^{-9} sec

3. 1.28×10^{-8}sec

4. 4.4×10^{-9} sec

5. 1.6×10^{-9} sec

Pseudo-First Order 001
023 10.0 points

The following reaction

A + B → C

is found to follow the rate law

rate =k[A][B]

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

1. when [B] = [A]

2. always

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

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

5. never

ChemPrin3e T13 48
024 10.0 points

Consider the dimerization reaction

$2\,\text{A} \rightarrow \text{A}_2$ $\qquad$ rate $= k\,[\text{A}]^2$.

When the initial concentration of A is 2.0 M, it requires 30 min for 60% of A to react. Calculate the rate constant.

1. $1.1 \times 10^{-3}\ \text{M}^{-1} \cdot \text{s}^{-1}$

2. $3.2 \times 10^{-4}\ \text{M}^{-1} \cdot \text{s}^{-1}$

3. $4.2 \times 10^{-4}\ \text{M}^{-1} \cdot \text{s}^{-1}$

4. $1.9 \times 10^{-4}\ \text{M}^{-1} \cdot \text{s}^{-1}$

5. $5.0 \times 10^{-4}\ \text{M}^{-1} \cdot \text{s}^{-1}$

Msci 16 0926
025 10.0 points

Consider the 2-step reaction mechanism

fast	$2\,\text{NO} + \text{H}_2 \leftrightarrow \text{N}_2\text{O}+\text{H}_2\text{O}$
slow	$\text{N}_2\text{O}+\text{H}_2 \rightarrow \text{N}_2+\text{H}_2\text{O}$
net	$2\,\text{NO} + 2\text{H}_2 \rightarrow \text{N}_2 + 2\,\text{H}_2\text{O}$

Which of the following rate laws is correct for the given mechanism? Note that the constant k may represent a combination of elementary reaction rate constants.

1. $\text{rate}_{\text{net}} = k\,\dfrac{[\text{N}_2]\,[\text{H}_2\text{O}]^2\,[\text{H}_2]^2}{[\text{NO}]^2}$

2. $\text{rate}_{\text{net}} = k\,\dfrac{[\text{H}_2]^2\,[\text{NO}]^2}{[\text{H}_2\text{O}]}$

3. $\text{rate}_{\text{net}} = k\,[\text{NO}]\,[\text{H}_2]$

4. $\text{rate}_{\text{net}} = k\,[\text{NO}]^2\,[\text{H}_2]$

5. $\text{rate}_{\text{net}} = k\,[\text{NO}]^2\,[\text{H}_2]^2$

Intermediates 001
026 10.0 points

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

1: $\text{ClO}^- + \text{H}_2\text{O} \rightleftharpoons \text{HClO} + \text{OH}^-$ (fast)
2: $\text{I}^- + \text{HClO} \rightarrow \text{HIO} + \text{Cl}^-$ (slow)
3: $\text{HIO} + \text{OH}^- \rightarrow \text{IO}^- + \text{H}_2\text{O}$ (fast)

How many intermediates are there in this mechanism?

1. 2

2. 3

3. 0

4. 4

5. 1

Arrhenius2
027 10.0 points

A given reaction has an activation energy of 14.5 kJ/mol. This reaction is normally run at room temperature (25°C) and takes about an hour to get to completion. At what temperature should the reaction be run so that it is running twice as fast as at room temperature?

1. 77°C

2. 65°C

3. 135°C

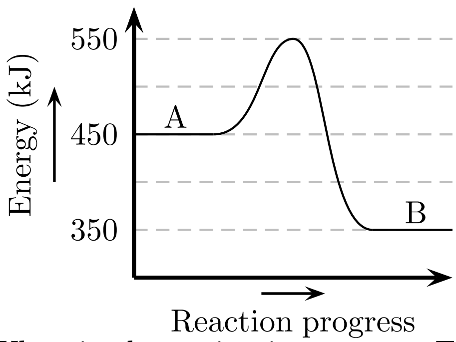
4. 31°C

5. 98°C

6. 50°C

Mlib 50 4023
028 10.0 points

Consider the potential energy diagram shown below.



What is the activation energy E_a for the reaction $A \to B$?

1. 200 kJ

2. 100 kJ

3. 550 kJ

4. −100 kJ

5. 450 kJ

ChemPrin3e T13 59
029 10.0 points

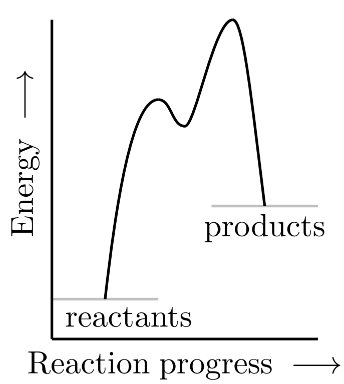
The reaction

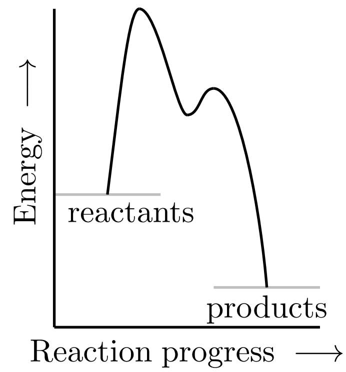
$$2\,A + B \to 2\,C$$

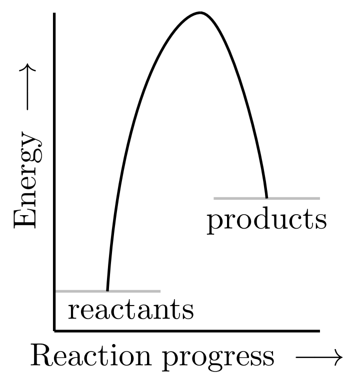
has a negative ΔH°_r; a possible mechanism for this reaction is

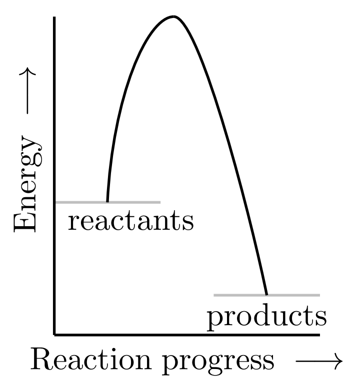
(1) $2\,A \rightleftharpoons D$ rapid equilibrium, K
(2) $D + B \to 2\,C$ slow, k

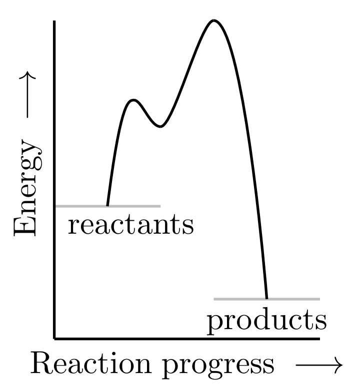
What is the reaction profile diagram for this reaction?

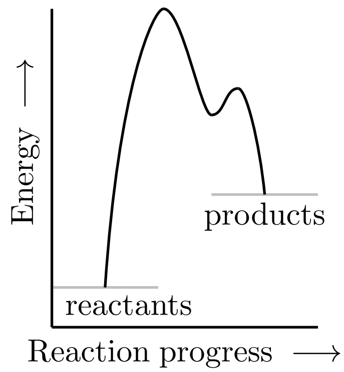
1. 

2. 

3. 

4. 

5. 

6. 

ChemPrin3e T13 57
030 10.0 points

A catalyst facilitates a reaction by

1. shifting the position of the equilibrium of the reaction.

2. lowering the activation energy of the reaction.

3. decreasing the temperature at which the reaction will proceed spontaneously.

4. increasing the activation energy for the reverse reaction.

5. making the reaction more exothermic.

Extra credit
031 10.0 points

If more points are awarded on this assignment, would you like them added to your score?

1. NO, leave my score alone, I prefer the lower score

2. YES, I would like the points and the higher score.