

Exam 4 practice test, Fall 2005, Williams, 12/9, chapter 14 questions added. 12/12, some comments and revisions to chapter 14 questions. 12/14 some more comments and revisions, to chapter 13 questions.

### Chapter 13

1. Electrical work is given by

- a.  $w_{\text{elec}} = Q\mathcal{E}$
- b.  $w_{\text{elec}} = -Q\Delta\mathcal{E}$
- c.  $w_{\text{elec}} = -Q/\Delta\mathcal{E}$
- d.  $w_{\text{elec}} = -\Delta\mathcal{E}/Q$
- e. none of these

Answer: b

2. One joule per coulomb is

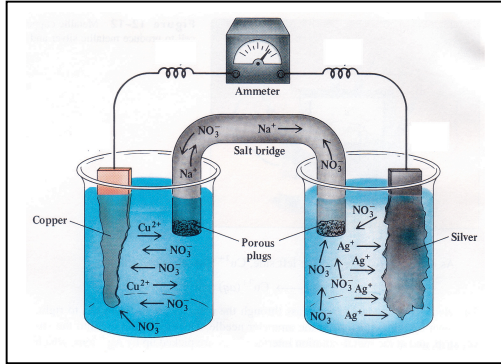
- a. one faraday
- b. one ampere
- c. one volt
- d. one watt
- e. one mole

Answer: c

3. One kilowatt-hour is

- a. 60 J
- b. 1000 J
- c. 3600 C
- d. 3.6106 C
- e. none of these

Answer: e



4. For the galvanic cell above use information from the standard reduction tables to predict the direction of electron flow if the reactants and products are in their standard states.

- a. left to right
- b. right to left
- c. no electron flow
- d. cannot be determined.

Answer: a

5. The standard cell voltage of a galvanic cell is related to the standard half-cell reduction potentials ( $\epsilon^\circ$ ) by  $\Delta\epsilon^\circ =$

- a.  $\epsilon^\circ(\text{anode}) - \epsilon^\circ(\text{cathode})$
- b.  $\epsilon^\circ(\text{cathode}) - \epsilon^\circ(\text{anode})$
- c.  $\epsilon^\circ(\text{anode}) + \epsilon^\circ(\text{cathode})$
- d.  $\epsilon^\circ(\text{anode})\epsilon^\circ(\text{cathode})$
- e. none of these

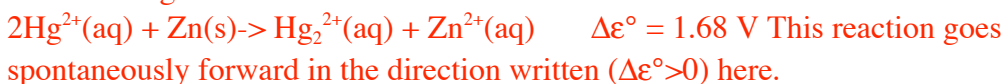
Answer: b

6. From tabulated  $\epsilon^\circ$  values, the electrochemical cell,  $\text{Pt}|\text{Hg}_2^{2+}, \text{Hg}_2^+||\text{Zn}^{2+}|\text{Zn}$ , with all substances in their standard states at  $25^\circ\text{C}$ , will operate spontaneously

- a. as written
- b. in the reverse direction
- c. not at all
- d. This cannot be determined without additional information.



add these together



The single/double line notation will not be on the test.

Answer: b

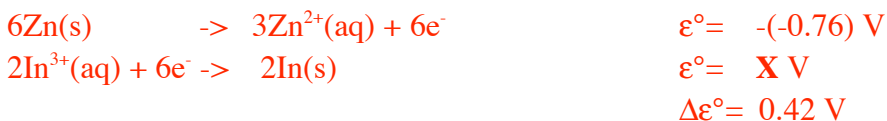
7. From tabulated  $\epsilon^\circ$  values, which of the following species has the greatest tendency to be reduced?

- a.  $\text{Cu}^{2+}$
- b.  $\text{Zn}^{2+}$
- c.  $\text{Sn}^{2+}$
- d.  $\text{Fe}^{3+}$
- e.  $\text{Ag}^+$

Answer: e

8. A galvanic cell is constructed from the two half-cells,  $(\text{Zn}^{2+}|\text{Zn})$  and  $(\text{In}^{3+}|\text{In})$ , [ $(\text{Zn}^{2+} + 2\text{e}^- \rightarrow \text{Zn})$  and  $(\text{In}^{3+} + 3\text{e}^- \rightarrow \text{In})$ ] with the electrolytes  $\text{Zn}(\text{NO}_3)_2$  and  $\text{In}(\text{NO}_3)_3$  in the two half-cells both being 1.00 M in concentration. At  $25^\circ\text{C}$  this cell gives a voltage of 0.424 V. It is observed that In metal plates out on the In electrode as time passes. Determine the standard reduction potential for the  $(\text{In}^{3+}|\text{In})$  half-cell. [See tabulated  $\epsilon^\circ$  values for the  $(\text{Zn}^{2+}|\text{Zn})$  half-cell.]

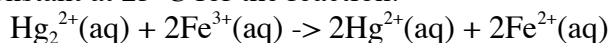
- a. -0.338 V
- b. 0.338 V
- c. -1.186 V
- d. 1.186 V
- e. none of these



$$0.76 + \text{X} = 0.42 \Rightarrow \text{X} = -0.34$$

Answer: a

9. Using tabulated  $\epsilon^\circ$  values [ $2\text{Hg}_2^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Hg}_2^{2+}(\text{aq})$   $\epsilon^\circ = 0.92 \text{ V}$ ], calculate the equilibrium constant at  $25^\circ\text{C}$  for the reaction:



- a. 1.11
- b. 11.7
- c.  $3.0 \times 10^{-3}$
- d.  $9.2 \times 10^{-6}$
- e. none of these

$$\Delta\epsilon^\circ = 0.77 - 0.92 = -0.15 \text{ V}$$

$$K = \exp[(nF)(\Delta\epsilon^\circ)(RT)^{-1}] = \exp[(2 \cdot 96458)(-0.15)(8.314)^{-1}]$$

$$K = \exp(-11.6)$$

(I don't have a calculator that takes exponentials, is this right?)

Answer: d

## Chaper 14

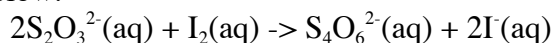
1. A rate constant can change with
  - a. temperature.
  - b. addition of a catalyst or enzyme.
  - c. reactant concentrations.
  - d. a and b.
  - e. none of these

Answer: d

2. Which of the following is the correct set of units for the reaction rate if concentrations are measured in molarity and the time in seconds?
  - a.  $\text{mol L}^{-1} \text{s}^{-1}$
  - b.  $\text{mol L s}$
  - c.  $\text{mol}^{-1} \text{L}^{-1} \text{s}^{-1}$
  - d.  $\text{s L mol}^{-1}$
  - e. none of these

Answer: a

3. Aqueous thiosulfate (colorless) reacts with an aqueous solution of iodine (yellow) to form aqueous iodide ion (colorless) and aqueous tetrathionate ion (colorless) as shown in the reaction below.



What parameter of the system could one observe to follow the progress of this reaction?

- a. the increase in the intensity of the yellow color as a function of time.
- b. the decrease in the intensity of the yellow color as a function of time.
- c. the amount of solid formed as a function of time.
- d. the amount of gas formed as a function of time.
- e. none of these

Answer: b

4. At constant T, rate constants generally
  - a. are greatest at the beginning of a reaction and decrease with time.
  - b. are smallest at the beginning and increase with time.
  - c. are constant throughout a reaction.
  - d. increase and decrease alternately as the reaction proceeds.
  - e. No such generalizations can be made.

Answer: c

5. On a plot of concentration versus time for a reaction, the average rate of a reaction over a given time interval is the
  - a. slope of the tangent to the curve at the point where the rate is half the original rate.
  - b. slope of the tangent to the curve at the point where a reactant concentration is half its original value.
  - c. slope of the straight line connecting the concentrations at the limits of the time interval.
  - d. All of these should yield equivalent results.

e. none of these.

Answer: c

6. Enzymes increase

a. forward rate constants

b. reverse rate constants

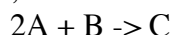
c. equilibrium constants

d. a and b.

e. none of these.

Answer: d

7. The reaction,



is studied by monitoring the concentration of A. Over the first 3.2 minutes of observation, [A] decreases from  $6.68 \times 10^{-2} \text{ mol L}^{-1}$  to  $6.23 \times 10^{-2} \text{ mol L}^{-1}$ . Thus the average rate of this reaction over this time period is

a.  $-4.5 \times 10^{-3} \text{ mol L}^{-1} \text{ s}^{-1}$

b.  $1.41 \times 10^{-3} \text{ mol L}^{-1} \text{ s}^{-1}$

c.  $4.69 \times 10^{-5} \text{ mol L}^{-1} \text{ s}^{-1}$

d.  $2.34 \times 10^{-5} \text{ mol L}^{-1} \text{ s}^{-1}$

e.  $1.17 \times 10^{-5} \text{ mol L}^{-1} \text{ s}^{-1}$

Answer: e

8. The rate law relates the rate of a chemical reaction to

a. the concentrations of reactants.

b. the reaction mechanism.

c. the activation energy.

d. the temperature.

e. all of these

Answer: a

9. Which of the following is the rate law for a reaction that is first order in oxygen?

a.  $\text{rate} = k [\text{NO}_2]$

b.  $\text{rate} = k [\text{NO}_2] [\text{O}_2]$

c.  $\text{rate} = k [\text{NO}_2]^2 [\text{O}_2]$

d.  $\text{rate} = k [\text{NO}_2]^2 [\text{O}_2] [\text{N}_2]$

e. none of these

Answer: b (the exponents have been corrected, but there is still a mistake here, because c and d are also 1<sup>st</sup> order in O<sub>2</sub>, so there is no correct answer).

10. Which of the following is the rate law for a reaction that is 2nd order in NO<sub>2</sub> and 3rd order overall?

a.  $\text{rate} = k [\text{NO}_2]$

b.  $\text{rate} = k [\text{NO}_2] [\text{O}_2]$

c.  $\text{rate} = k [\text{NO}_2]^2 [\text{O}_2]$

d.  $\text{rate} = k [\text{NO}_2]^2 [\text{O}_2] [\text{N}_2]$

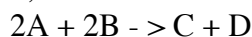
e. none of these

Answer: c

11. The powers in the rate law are determined by
- the coefficients in the balanced chemical reaction.
  - the physical states of the reactants and products.
  - the principle of detailed balance.
  - concentration versus time experiments.
  - More than one of these are correct.

Answer: d

12. The reaction,



has a rate constant of  $6.0 \times 10^{-3} \text{ L}^2 \text{ mol}^{-2} \text{ s}^{-1}$  at  $0^\circ\text{C}$ . The order of this reaction is

- 1
- 2
- 3
- indeterminate without additional information.
- none of these

The idea here is to use the units of the rate constant to figure out the order. Write out both sides of the rate law and it will fall out.

For example:  $d[A]/dt (\text{mol L}^{-1} \text{ s}^{-1}) = k (\text{L}^2 \text{ mol}^{-2} \text{ s}^{-1}) [A]^3 (\text{mol L}^{-1})^3$

Answer: c

13. For a certain reaction, a plot of  $\ln [A]$  versus  $t$  gives a straight line with a slope of  $-1.46 \text{ s}^{-1}$ . The order of the reaction in A is

- 0
- 1
- 2
- 3
- none of these

Answer: b

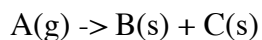
14. For a certain reaction, a plot of  $\ln [A]$  versus  $t$  gives a straight line with a slope of  $-1.46 \text{ s}^{-1}$  and a y- intercept of 4.30. The rate constant for this reaction is

- 0.68 s
- $-1.46 \text{ s}^{-1}$
- $1.46 \text{ s}^{-1}$
- $4.30 \text{ s}^{-1}$
- This cannot be determined without additional information.

For a reaction that is first order in A, a plot of  $\ln[A]$  versus  $t$  gives a straight line, with a slope of  $-k$  and an intercept of  $\ln[A]_0$ . See graph on page 619 OFB.

Answer: c

15. Determine the order of the decomposition process,



using the following data for the dependence of the pressure of A on the time:

time (s)	PA (torr)
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0.0	1420
20.0	1004
40.0	710
60.0	502

- a. 0<sup>th</sup> order
- b. 1<sup>st</sup> order
- c. 2<sup>nd</sup> order
- d. 3<sup>rd</sup> order
- e. This cannot be determined without additional information.

Use partial pressures instead of concentrations. Graph  $1/P$  versus  $t$ , and  $\ln P$  versus  $t$ , to see which one is linear.

Answer: b

16. Calculate the rate constant for the decomposition process above.

- a.  $0.017 \text{ s}^{-1}$
- b.  $0.025 \text{ s}^{-1}$
- c.  $0.056 \text{ s}^{-1}$
- d.  $58 \text{ s}^{-1}$
- e. This cannot be determined without additional information.

Answer: a

17. If a reaction is known to be an elementary reaction, the powers to which the concentrations are raised in the rate law

- a. are the same as the coefficients in the balanced reaction.
- b. are always one.
- c. are all equal to each other.
- d. can be determined from experiment alone.
- e. none of these

Answer: a