Chemistry 6C: General Chemistry III | University of California, San Diego
C. Hoeger | *Sequence Number* | Spring 2007

6C Exam 1
120 pts

Name (Print): _____ **UCSD ID: _____**

TA: _____

INSTRUCTIONS

➔ RECORD THE "A" IN YOUR ID NUMBER AS "1" ON THE SCANTRON

➔ MARK TEST VERSION IN "TEST FORM" FIELD ON SCANTRON
****PUT NOTHING IN THE EXAM NUMBER FIELD!****

➔ ALL MULTIPLE CHOICE ANSWERS MUST BE ON THE SCANTRON SHEET PROVIDED.

➔ PLACE YOUR SCANTRON INSIDE YOUR EXAM BOOK WHEN DONE

➔ TURN IN BOTH YOUR SCANTRON SHEET AND THIS TEST BOOKLET AT THE END OF THE EXAM PERIOD.

➔ KEEP YOUR EXAM COVERED AT ALL TIMES.

➔ SCRATCH PAPER AND A PERIODIC TABLE/EQUATION SHEET ARE PROVIDED

➔ NON-GRAPHING, NON-PROGRAMMABLE CALCULATORS ARE ALLOWED BUT MAY NOT BE SHARED.

➔ PAY ATTENTION TO THE MAGNITUDE OF YOUR UNITS *AND YOUR SIGNS!!!*

SCANTRONS WILL NOT BE RETURNED

The Sequence Number AT THE TOP OF THIS PAGE is to be written on your Scantron on the "HOUR/DAY" line at the TOP of the Scantron:

FYI:
mM = millimolar = mmol/L
ug/dL = micrograms per deciliter (a common concentration used in pharmacology)

Part 1. Calculation/Short Answer Problems (Values as shown). All work for the following must be done in THIS TEST BOOKLET. For calculation problems: Answers with no work will receive zero points. Your work must be clear and logical AND SHOWN to receive maximum (OR ANY) credit.

1. As discussed in class, standard reduction potential diagrams ("Latimer Diagrams") are a convenient way to summarize the redox characteristics of a particular element. Below is a Latimer diagram for manganese in acidic solution at 25°C:

$$MnO_4^- \xrightarrow{0.56} MnO_4^{2-} \xrightarrow{0.27} MnO_4^{3-} \xrightarrow{4.27} MnO_2 \xrightarrow{0.95} Mn^{3+} \xrightarrow{1.50} Mn^{2+} \xrightarrow{-1.18} Mn$$

a) **(5 pts)** Write the cell diagram for the ***galvanic*** cell one would obtain if a half cell of Mn^{3+}/Mn^{2+} were connected to a half cell of MnO_4^-/MnO_4^{2-}

b) **(4 pts)** Calculate E°_{cell} for the cell from part (a):

c) **(7 pts)** Recalculate $E_{half-cell}$ for : MnO_4^{3-}/MnO_2 at pH = 4.50. Do not include electrons in any *K* or *Q* expressions you might use

d) **(10 pts)** Write a balanced half reaction and determine the voltage for reduction half-reaction $MnO_4^{3-} \longrightarrow Mn^{2+}$. ***YOUR WORK MUST BE CLEAR FOR FULL CREDIT.***

e) **(10 pts)** Calculate the equilibrium constant for the hypothetical disproportionation of Mn^{3+} at 35°C

2. You have just taken a job as the lead pharmaceutical chemist for DrugCo. The company president has taken you aside and charged you with a most important task: answer two very important questions regarding their new antineoplastic agent CHNG-3232. A typical dose gives a t_0 serum concentration of 295 μg/dL. It is known that: (I) CHNG-3232's ***biological*** activity follows first order kinetics, but (II) is is unclear whether its ***elimination*** from the body is first order, second order or higher. *NOTE: Anytime you calculate k, be sure you have the correct units!*

a) **(8 pts)** If one-third of the biologcal activity of CHNG-3232 is gone in 92 minutes, calculate the half-life of CHNG-3232 (in minutes).

b) **(8 pts)** How many hours must pass after initially dosing a patient before CHNG-3232 is no longer biologically active, given a serum level of 48.5 μg/dL is the point at which no more bioactivity is seen?

c) **(8 pts)** Assume that it takes 15 hours for half of the initial dose to be eliminated from the body. If the elimination is second order, calculate how long will it take until only 12.5% of the CHNG-3232 remains.

Part 2. 6 Point Multiple Choice Problems*. Select the best answer from the choices given and mark your answer on your scantron. *ASSUME 25°C UNLESS TOLD OTHERWISE

Problems 1-3 concern the hypothetical reaction,

$$4\ A + 7\ B \rightarrow 4\ C + 6\ D$$

for which the following initial rate data have been obtained:

Run	[A] (M)	[B] (M)	Rate
1	0.050	0.050	1.04
2	0.050	0.150	3.1
3	0.250	0.050	26

1. The order of the reaction in A is

a. 1 b. 2 c. 3 d. 5 e. none of these

2. The order of the reaction in B is

a. 1 b. 2 c. 3 d. 5 e. none of these

3. The numerical value of the rate constant for this reaction (same units as implied by tabulated data) is

a. 1.3×10^{-4} b. 2.6×10^{-3} c. 4.2×10^{2} d. 8.3×10^{3} e. none of these

4. A galvanic cell is constructed from the two half-cells, (Zn^{2+}| Zn) and (In^{3+}| In), with the electrolytes $Zn(NO_3)_2$ and $In(NO_3)_3$ in the two half-cells both being 1.00 M in concentration. At 25°C this cell gives a voltage of 0.424 V, and it is observed that In metal is plating out on the In electrode as time passes. Determine the standard reduction potential for the (In^{3+}| In) half-cell. For the (Zn^{2+}| Zn) half-cell E° = -0.762 V

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

5. The first-order decomposition of thionyl chloride has a half-life of 938 seconds. What is the rate constant for this reaction?

a. $5.33 \times 10^{-4}\ s^{-1}$ b. $7.39 \times 10^{-4}\ s^{-1}$ c. $1.066 \times 10^{-3}\ s^{-1}$
d. 1876 s e. none of these

6. Butadiene, C_4H_6 (used to make synthetic rubber and latex paints) dimerizes to C_8H_{12} with a rate law of rate = 0.014 L/(mol·s) $[C_4H_6]^2$. What will be the concentration of C_4H_6 after 3.0 hours if the initial concentration is 0.025 *M*?

a. 0.0052 *M* b. 0.024 *M* c. 43 *M* d. 190 *M* e. 0.0000 *M*

7. An electrochemical cell is constructed to to study the reaction,

$$3\ Hg(l) + Cr_2O_7^{2-}(aq) + 14\ H^+(aq) \rightarrow 2\ Cr^{3+}(aq) + 3\ Hg^{2+}(aq) + 7\ H_2O(l),$$

If ΔE° = 0.48 V, which of the following changes will result in an increase in ΔE for the cell?

1. increasing the dichromate concentration
2. increasing the pH
3. increasing the mercury ion concentration
4. increasing the amount of mercury

a. 1 only b. 2 only c. 3 only d. 1 and 4 e. 2 and 4

8. Write the cell diagram for the reaction

$$2Ag(s) + 2H^+(aq) + 2Cl^-(aq) \rightarrow 2AgCl(s) + H_2(g)$$

A) Pt | $Cl^-(aq)|H^+(aq)$ || $H_2(g)$ | AgCl(s) | Ag(s)
B) Ag(s) | AgCl(s) | $Cl^-(aq)$ || $H^+(aq)$ | $H_2(g)$ | Pt
C) Pt | $H_2(g)$ | $H^+(aq)$ || $Cl^-(aq)$ | AgCl(s) | Ag(s)
D) Pt | $H_2(g)$ | $H^+(aq)$ || $Cl^-(aq)$ | Ag(s) | Pt
E) Ag(s) | AgCl(s) | $H^+(aq)$ || $Cl^-(aq)$ | $H_2(g)$ | Pt

9. The galvanic cell, Ag | Ag^+ (saturated Ag_2SO_4) || Ag^+(0.125 M) | Ag, displays a ΔE of 0.032 V at 25°C. Calculate K_{sp} for Ag_2SO_4.

a. 3.5 b. 0.54 c. 1.9×10^{-4} d. 4.7×10^{-4} e. 2.3×10^{-5}

10. A current of 250. A flows for 24.0 hours at an anode where $Mn^{2+}(aq)$ is being converted to $MnO_2(s)$. What mass of MnO_2 is deposited at this anode?

a. 19.5 kg b. 12.9 kg c. 4.87 kg
d. 2.43 kg e. none of the above

11. Consider the following reaction:

$$S_2O_8^{2-}(aq) + 3I^-(aq) \rightarrow 2SO_4^{2-}(aq) + I_3{-}(aq) \qquad \text{rate} = k[S_2O_8^{2-}][I^-]$$

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

A) $1.21 \times 10^3\ M^{-1}{\cdot}s^{-1}$. B) $6.07 \times 10^3\ M^{-1}{\cdot}s^{-1}$. C) $1.37 \times 10^{-2}\ M^{-1}{\cdot}s^{-1}$.
D) 9.10 $M^{-1}{\cdot}s^{-1}$. E) 1.82 $M^{-1}{\cdot}s^{-1}$.

12. PLEASE MARK ONE OF THE FOLLOWING TWO CHOICES (this will be your only chance this quarter):

A) I Wish to have my scores and grade in this class posted on the course web page by the LAST 5 DIGITS of my UCSD ID number
B) I do NOT want my scores posted.

13. This is Version A. Mark "A" as the answer to this question ***<u>and</u>*** in the "TEST FORM" box on your scantron (below ID number): (3 points if you do ***<u>BOTH</u>***)

VERSION A = a