CHEM 1423 - Final Exam - May 9, 2017 The Street

Name	•

If you wish to have your final exam and course grade posted on the Web site, please provide me with a four (4) digit number which will be the ID number for your grade.

Four (4) digit number for posting

Please turn in:

- 1. Your Scantron with your name written in + bubbled answers. You don't have to bubble in your name.
- 2. This signature sheet. Please put your name on top. You are welcome to supply a 4 digit number of your choice if you would like your course results posted anonymously on the course web site.

You can keep the test (below) and use it to compare results with the answer key.

Conversions: 1 atm. = 760 torr

Constants: R = 0.082 L-atm/mol·K

R = 8.31 J/mol·K

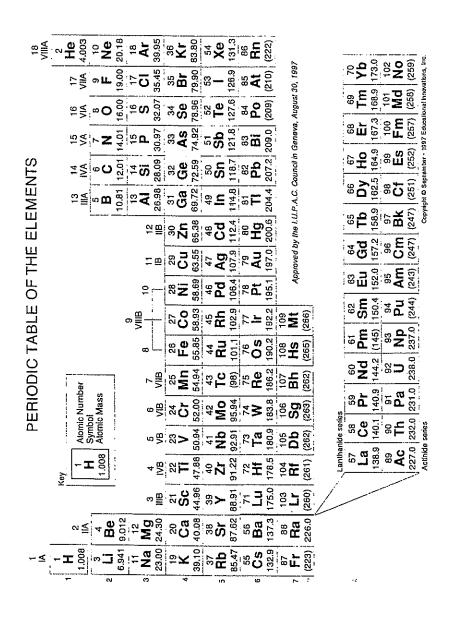
 $R = 8.31 \times 10^{-3} \text{ kJ/mol} \cdot \text{K}$

 $N_A = 6.02 \times 10^{23} \text{ mol}^{-1}$

 $F = 96,500 \text{ Coul/mol } e^{-}$

 $c = 3.00x10^8$ m/s (speed of light)

Molar Masses: Given with each question: [M=xx]



ELECTROCHEMISTRY INFORMATION

Table 1: Standard Reduction Potentials

Reduction Half-Reactions E° (V)

$F_2 + 2 e^- \rightarrow 2 F^-$	+2.87
$Au^{3+} + 3 e^{-} \rightarrow Au$	+1.50
$Cl_2 + 2 e^- \rightarrow 2 Cl^-$	+1.36
$Br_2 + 2 e^- \rightarrow 2 Br^-$	+1.07
$Hg^{2+} + 2 e^- \rightarrow Hg$	+0.86
$Ag^+ + 1 e^- \rightarrow Ag$	+0.80
$l_2 + 2 e^- \rightarrow 2 l^-$	+0.54
$Cu^{2+} + 2 e^- \rightarrow Cu$	+0.34
$Sn^{2+} + 2 e^- \rightarrow Sn$	-0.14
Fe ³⁺ + 3 e ⁻ Fe	-0.04
$Ni^{2+} + 2 e^- \rightarrow Ni$	-0.25
$Fe^{2+} + 2 e^{-} \rightarrow Fe$	-0.44
$Zn^{2+} + 2 e^- \rightarrow Zn$	-0.76
$Mn^{2+} + 2 e^- \rightarrow Mn$	-1.18
$Al^{3+} + 3 e^{-} \rightarrow Al$	-1.66
$Mg^{2+} + 2 e^- \rightarrow Mg$	-2.37
$K^+ + 1 e^- \rightarrow K$	-2.93
$Li^+ + 1e^- \rightarrow Li$	-3.05

Table 2: Some Reduction and Oxidation Potentials in Aqueous Solution

Reduction Potentials

$$2 H_2O + 2 e^- \rightarrow H_2 + 2 OH^ E^{\circ}_{red} = -0.83 V$$

$$Al^{3+} + 3e^{-} \rightarrow Al$$
 $E^{o}_{red} = -1.66 V$

$$Zn^{2+} + 2 e^{-} \rightarrow Zn$$
 $E^{\circ}_{red} = -0.76 \text{ V}$

$$Mg^{2+} + 2 e^{-} \parallel Mg$$
 $E^{o}_{red} = -2.37 \text{ V}$

$$Na^+ + 3 e^- Na$$
 $E^{\circ}_{red} = -2.71 V$

$$Fe^{2+} + 2e^{-}$$
 Fe $E^{\circ}_{red} = -0.44 \text{ V}$

Oxidation Potentials

$$2 H_2O \rightarrow O_2 + 4 H^+ + 4 e^ E^{\circ}_{oxid} = -1.23 V$$

$$2 I^{-} \rightarrow I_{2} + 2 e^{-}$$
 $E^{o}_{oxid} = -0.54 V$

$$2 Br_{\parallel} Br_2 + 2 e^{-}$$
 $E^{o}_{oxid} = -1.07 V$

$$2 F^{-} \rightarrow F_{2} + 2 e^{-}$$
 $E^{\circ}_{oxid} = -2.87 \text{ V}$

Some Electrochemical Equations

 $F = 96,500 \text{ C/mol e}^{-}$ (Coulombs per mole of electrons)

$$\Delta G^{\circ} = -nFE^{\circ}$$

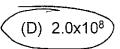
$$E = E^{\circ} - \frac{0.0592}{n} \cdot \log(Q)$$



(60)	60 QUESTIONS (Mark the one cor	rect answer to each question on
	your scantron)	

			r score will be con umber of correct a	verted to percent by: nswers)
1.	For the reaction, A	+ B \rightarrow Products, th	ne rate law is: <i>Rate</i> =	$k \frac{[C]^2}{[B]}$ The units of the
	rate constant are:			r 1
<	(A) s ⁻¹ (B) M ² s ⁻¹	(C) M ⁻² s ⁻¹	(D) M ⁻¹ s ⁻¹
2.	measured. It is four the B concentration first experiment). I	nd that if the initial on the same, the rate f the concentrations	e increases by a fact s of both A and B are	sed is tripled, keeping or of 9 (relative to the
	(A) $k[A]^2[B]^2$	(B) k[A][B]	(C) k[A] ² [B] ³	(D) k[A][B] ²
3.	Consider a reaction reaction, a plot of _		der; i.e. d[A]/dt = -k[raight line with a	A] ⁰ = -k.For this slope.
	(A) In([A]t), negati	ve	(B) [A]t , nega	tive
	(C) (A]t, positive		(D) 1/[A] _t , pos	sitive
4.	When the initial con	ncentration of A is (0.20 M, the initial rat	[A]; i.e. Rate = k[A] ⁿ . e is 1.5 Ms ⁻¹ . When the ⁄ls ⁻¹ . The order of this
	(A) -2	(B) +1	(C) +2	(D) +3
			action, $A \rightarrow Product$: centration of A is 0.7	s. The rate constant for 75 M
5.	Approximately how to 0.20 M?	/ long will it take for	the reactant concer	ntration to decrease
	(A) 45 s	(B) 100 s	(C) 180 s	(D) 80 s
6.	What will be the co	oncentration of A 60	s after the start of t	he reaction?
	(A) 0.39 M	(B) 0.23 M	(C) 0.47 M	(D) 0.56 M

- 7. For the reaction, $Sc^{3+}(aq) + 2 Ni^{+}(aq) \rightarrow Sc^{+}(aq) + 2 Ni^{2+}(aq)$, the reaction mechanism is: $2Ni^{+} \stackrel{K}{\longleftrightarrow} Ni + Ni^{2+} \quad \text{Fast equilibrium}$ $Ni + Sc^{3+} \stackrel{k}{\longleftrightarrow} Ni^{2+} + Sc^{+} \quad \text{Slow step}$ The overall rate equation for this reaction is: $(A) \quad Rate = k^{+} \frac{[Ni^{2+}][Sc^{3+}]}{[Ni^{+}]^{2}} \qquad (B) \quad Rate = k^{+} \frac{[Ni^{+}][Sc^{3+}]}{[Ni^{2+}]}$ $(C) \quad Rate = k^{+} \frac{[Ni^{+}]^{2}[Sc^{3+}]}{[Ni^{2+}]} \qquad (D) \quad Rate = k^{+} [Ni][Sc^{3+}]$
- 8. The gas phase equilibrium, $2 A(g) \leftrightharpoons 3 B(g) + C(g)$. The equilibrium constant is $K_c = 1 \times 10^{-4}$. If one puts an initial concentration of 2.0 M of A into a flask, what is the approximate concentration of B at equilibrium? [NOTE: You may assume that very little A reacts]
 - (A) 0.16 M (B) 0.19 M
- (C) 0.28 M
- (D) 0.06 M
- 9. Consider the gas phase equilibrium reaction, 2 A(g) = B(g). If one initially fills a container with A at a concentration of 3.0 M, and then allows it to come to equilibrium, it is found that the equilibrium concentration of B is 1.2 M. Therefore, the value of the equilibrium constant, K_c is approximately:
 - (A) 3.3
- (B) 2.0
- (C) 0.67
- (D) 0.37
- 10. The equilibrium constant for the reaction, $N_2(g) + O_2(g) = 2 \text{ NO}(g)$ is 1.7×10^{-3} (at 2300 K). What is the equilibrium constant for the reaction,
 - $6 \text{ NO(g)} = 3 \text{ N}_2(g) + 3 \text{ O}_2(g)$?
 - (A) 4.9x10⁻⁹
- (B) 8.4
- (C) 1.7x10³



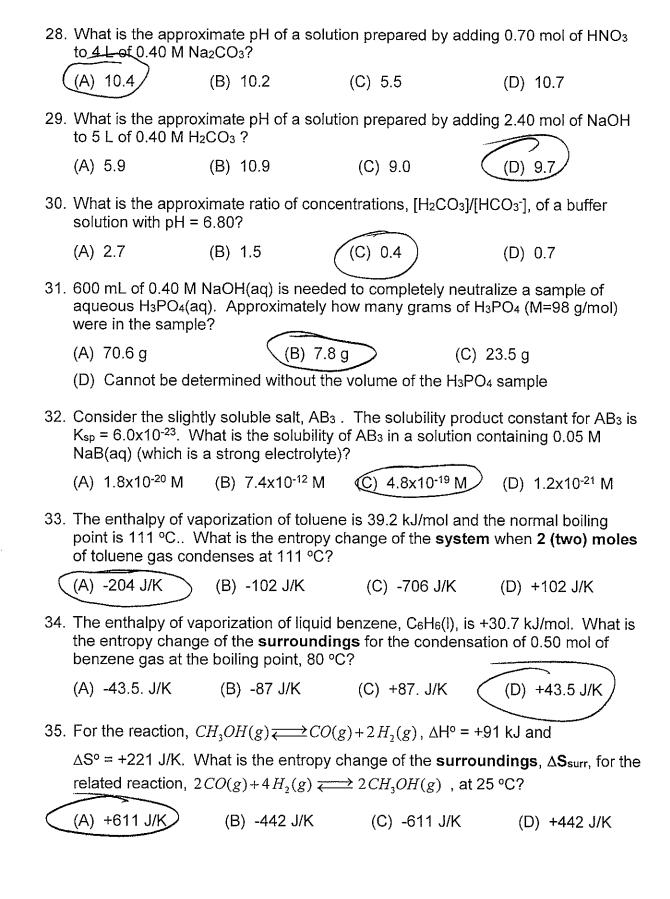
For #11 - #13: Consider the gas phase equilibrium, $4NO_2(g) + O_2(g) \implies 2N_2O_5(g)$. This is an Exothermic reaction.

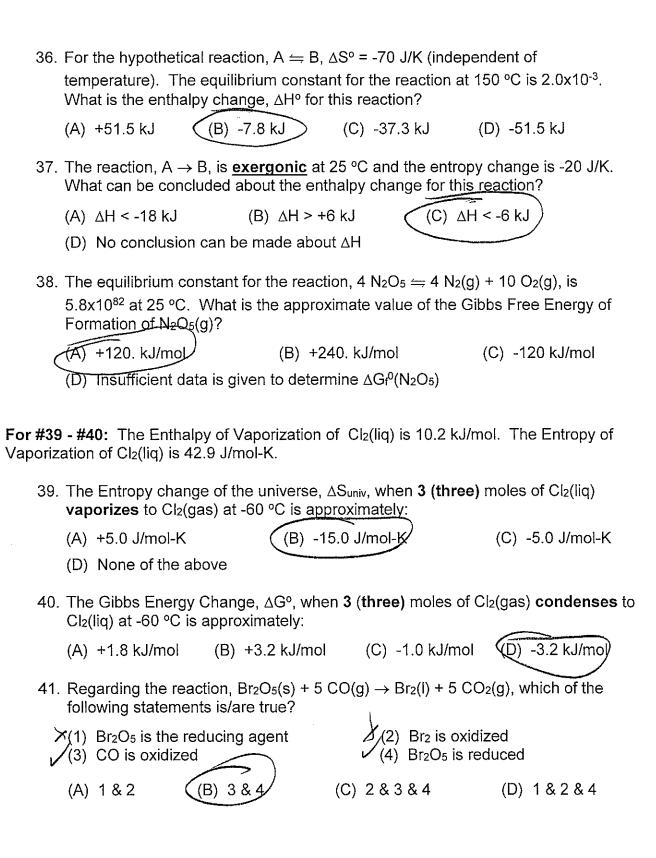
- 11. For the above reaction, if $O_2(g)$ is added to the mixture, then the ratio, $[NO_2]/[N_2O_5]$ will and K_c will
 - (A) decrease, Increase

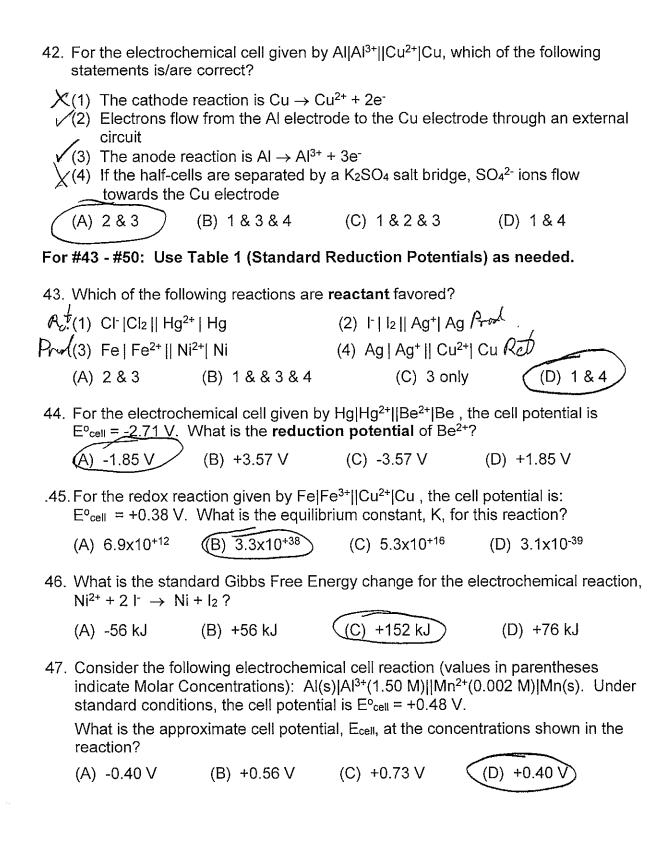
- (B) increase, decrease
- (C) decrease, remain constant
- (D) increase, remain constant

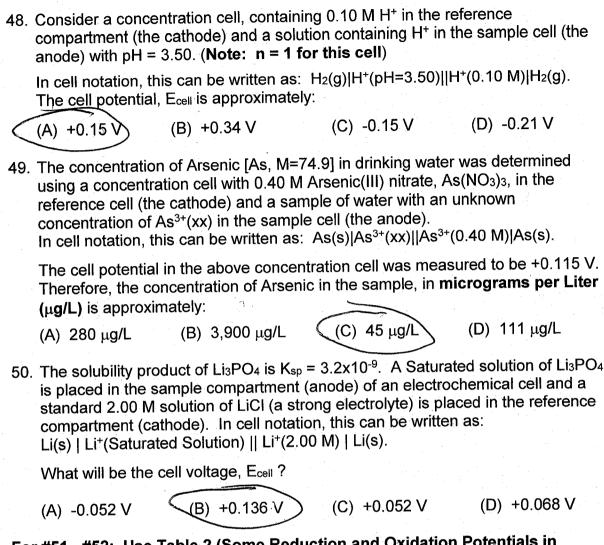
12. For the above reactotal pressure, the	· /		
Kc will			
(A) decrease, Incre (C) decrease, rema		(B) increase, d (D) increase, re	ecrease emain constant
13. For the above reac	tion, if the temperat	ure is decreased ,	
(A) the equilibrium (B) the equilibrium (C) the equilibrium (D) the equilibrium	will move to the rig will move to the lef	ht and K will increated and K will remain	ase I constant
14. The weight percent concentration of Th		•	10 ⁻¹¹ % . Therefore, the
(A) 0.30 ppt (B) 3x10 ⁻² ppt (C	3x10 ⁻⁴ ppt	(D) 3.0 ppt
15. What is the molality (C ₃ H ₈ O ₃ , M=92.) to	, ,		8 grams of Glycerol
(A) 2.033 molal	(B) 3.75	molal (C) 2.5 molal
(D) Determination	of the molality requ	ires the density of	the soluton
16. The density of a so (C₃H ₆ O₂, M=62) to Molarity of this solu	400 grams of water	• •	of Ethylene Glycol nat is the approximate
(A) 3.95 Molar	(B) 3.75 Molar	(C) 4.95 Molar	(D) 3.45 Molar
17. Which of the follow	ing aqueous solutio	ons has the lowes t	t boiling point?
(A) 0.20 m K ₃ PO ₄	(B) 0.	30 m Ca(NO ₃) ₂	
(C) 0.70 m C ₆ H ₁₂ C	O_6 O_0	.32 m NaBr	
18. When a sample of in 600 mL of aqueo Approximately how	ous solution, the osi	motic pressure at 2	
(A) 1.1x10 ⁻² mol	(B) 2.8x10 ⁻³ mol	(C) 7.9x10 ⁻³ mo	I (D) 3.9x10 ⁻³ mol
constant is 5.0 °C/r	n. When 80. grams boiling point of the	of an unknown co solution is 80.5 °C	ne boiling point elevation ompound is placed in 750. The Molar Mass of the
(A) 86 g/mol	(B) 69 g/mol	(C) 152 g/mol	(D) 114 g/mol

20. A 300. L sample of nitric acid (HNO ₃ , M=63) has a pOH of 11.5. Approximately how many grams of nitric acid are contained in the sample?
(A) 60. grams (B) 0.20 grams (C) 0.62 grams (D) 23. grams
21. Which of the following aqueous solutions is/are basic (pH > 7)?
(i) Potassium Lactate (KLac) ✗ (ii) Sodium Nitrate (NaNO₃) ≿(iii) Pyridinium Bromide (PyrHBr) √(iy) Sodium Propanoate (NaProp)
(A) i & iv (B) ii & iii (C) i & ii & iv (D) iv only
22. The pH of a 0.10 M solution of hydrocyanic acid, HCN, is 5.10. Therefore, the acid dissociation constant, K _a , for this acid is:
(A) 6.8×10^{-12} (B) 7.9×10^{-5} (C) 6.3×10^{-10} (D) 4.8×10^{-7}
23. For the weak acid, Hypobromous acid, HBrO, the acid ionization constant is 2.0x10 ⁻⁹ . What is the approximate pH of a 0.05 M solution of this acid?
(A) 9.0 (B) 5.0 (C) 3.4 (D) 4.6
24. The weak base, aniline (Anil), has a base equilibrium constant, $K_b = 4.3 \times 10^{-10}$. What is the pH of a 0.05 M aqueous solution of anilinium chloride (Anil-ICI)?
(A) 11.0 (B) 8.7 (C) 5.3 (D) 3.0
25. If added to 2 L of 0.40 M HNO ₃ , which of the following would form a buffer?
 (1) 0.6 mol of potassium lactate (KLac) (2) 0.6 mol of sodium carbonate (Na₂CO₃) (3) 1.2 mol of sodium acetate (NaAc) (4) 1.2 mol of ammonium bromide (NH₄Br)
(A) 1 & 2 & 3 (B) 2 & 3 & 4 (C) 3 only (D) 2 & 3
For #26 - #30: Consider Carbonic acid, H_2CO_3 , which is a diprotic acid with acid dissociation constants, $Ka' = 4.2 \times 10^{-7}$ and $Ka'' = 4.8 \times 10^{-11}$.
26. What is the approximate pH of a 0.05 M solution of sodium carbonate, Na ₂ CO ₃ ?
(A) 5.8 (B) 11.5 (C) 10.2 (D) 8.2
27. What is the approximate pH of a solution containing 0.25 M K ₂ CO ₃ and 0.40 M NaHCO ₃ ?
(A) 10.5 (B) 9.4 (C) 10.1 (D) 6.6







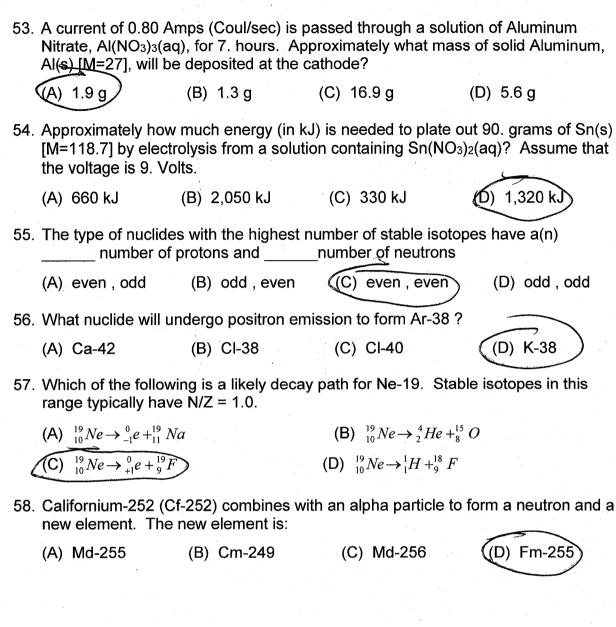


For #51 - #52: Use Table 2 (Some Reduction and Oxidation Potentials in Aqueous Solution) near the top of the test.

51. If aqueous Zn(II) Fluoride, ZnF₂(aq) is placed in an electrolysis cell, and a voltage is applied, what will be the principal products of the electrolysis?

52. If aqueous Aluminum Iodide, AlI₃(aq) is placed in an electrolysis cell, and a voltage is applied, what will be the principal products of the electrolysis?





The last 2 questions are on the following page

- 59. Typical values of N/Z for stable nuclei rise with increasing atomic numbers because:
 - (A) More neutrons are required to form attractive interactions with the protons
 - (C) More long-range neutron-neutron attractions are required to counter the increasing short-range proton-proton repulsions
 - (B) Increased numbers of neutrons shield the short range proton-proton repulsions
 - (D) More short-range neutron-neutron attractions are required to counter the increasing long-range proton-proton repulsions.
- 60. Use the Molar Masses below to calculate the approximate Binding Energy per Nucleon (Eb/N) of Kr-92.

$$m(_1^1H) = 1.008 \text{ g/mol}$$
, $m(_0^1n) = 1.009 \text{ g/mol}$, $m(_{36}^{92}Kr) = 91.926 \text{ g/mol}$

(A) 4.7x108 kJ/mol

(C) 8.5x10¹¹ kJ/mol

(B) 8.5x108 kJ/mol

(D) 7.8x10¹⁰ kJ/mol