Name: _____

PRACTICE FINAL EXAM

CHEM 1412
April, 2011

Grade:		**200**

Instructions:

1. There are **17 (!) pages** in this exam. Put your initials on every page.
2. You have 2 hours to complete the exam.
3. You may use calculators.
4. **Write only in ink!** Exams taken in pencil will not be accepted for regrades.
5. **Write all answers to the multiple-choice questions (pages 4-7) on the answer sheet on page 2.**
6. For the non-multiple choice problems on p. 2 and 3, *show all work*; report answers with correct units and to the correct number of significant figures. Partial credit will be given on these problems, when possible.

DON'T PANIC

CHEM 1411 Questions

1. What answer should be reported, with the correct number of significant figures, for the following calculation? **(443.621 – 343.9) × 11.600** (x pts)

(a) 1156.7636
____ (b) 1156.8
(c) 1157
(d) 1160
(e) 1200

2. **Isotopes** of an element have the same number of _____ but different numbers of _____. (x pts)

(a) protons, neutrons
____ (b) neutrons, protons
(c) neutrons, electrons
(d) electrons, protons

3. Calculate the mass of 7.86×10^{22} atoms of aluminum. (x pts)

(a) 0.131 g Al
____ (b) 2.91×10^{24} g Al
(c) 3.52 g Al
(d) 3.5215 g Al
(e) 4.84×10^{-3} g Al

4. Calculate the number of moles in 48.5 g of $Mg(ClO_3)_2$. (x pts)

(a) 0.0598 mol
____ (b) 0.335 mol
(c) .0191 mol
(d) 0.254 mol
(e) 0.00523 mol

5. A compound of nitrogen and oxygen with a molecular mass of 92.01 g/mol contains 30.45% N, and 69.55% O. Calculate the **empirical** and **molecular** formulas, arranging the atoms in the order NO. (x pts)

(a) empirical formula = NO_2, molecular formula = NO_2
____ (b) empirical formula = NO_2, molecular formula = N_2O_4
(c) empirical formula = NO, molecular formula = N_2O_2
(d) empirical formula = N_2O, molecular formula = N_2O_4
(e) empirical formula = NO_2, molecular formula = NO_4

6. Which of the following is a molecular compound? (x pts)

(a) RbBr
____ (b) $NaNO_3$
(c) $SrSO_3$
(d) $CuCl_2$
(e) N_2O_4

7. What is the name of the compound $MgCO_3$? (x pts)

(a) manganese carbon trioxide
____ (b) magnesium acetate
(c) magnesium carbonate
(d) magnesium carbon trioxide
(e) manganese carbonic acid

8. Which of the following elements is a halogen? (x pts)

(a) nickel
____ (b) potassium
(c) helium
(d) bromine
(e) magnesium

9. How many moles of O_2 are needed to completely react with 2.14 moles of C_2H_6 in the following reaction? (x pts)

$$2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O$$

(a) 2.14 moles
____ (b) 15.0 moles
(c) 7.49 moles
(d) 30.0 moles
(e) 0.611 moles

10. For the following reaction, calculate the theoretical yield of $AlCl_3$ starting from 3.20 g of Al and 7.90 g Cl_2.

$$2Al(s) + 3Cl_2(g) \rightarrow 2AlCl_3(s)$$

(a) 15.9 g
____ (b) 22.3 g
(c) 29.7 g
(d) 0.119 g
(e) 9.90 g

11. A solution of 50.00 mL of 0.500 M sodium chloride solution is mixed with excess lead(II) nitrate solution. How many grams of precipitate are produced? (x pts)

(a) 6.95 g
____ (b) 3.48 g
(c) 1.06 g
(d) 2.12 g
(e) 13.9 g

12. To what volume should you dilute 20.0 mL of 2.00 M H_2SO_4 to obtain a 0.250 M H_2SO_4 solution? (x pts)

(a) 160 L
____ (b) 0.160 mL
(c) 10.0 L
(d) 1.6 L
(e) 0.160 L

13. In a titration, 12.00 mL of a solution of vinegar containing acetic acid, $HC_2H_3O_2$, is titrated to the equivalence point with 10.00 mL of 0.500 M NaOH. What is the concentration of acetic acid in the vinegar solution? (x pts)

$$HC_2H_3O_2(aq) + NaOH(aq) \longrightarrow NaC_2H_3O_2(aq) + H_2O(aq)$$

(a) 0.417 M
____ (b) 0.256 M
(c) 0.335 M
(d) 0.115 M
(e) 0.209 M

14. In which one of the following compounds or ions is the oxidation number of the indicated element stated **incorrectly**? (x pts)

(a) NO_2 — N is +4
____ (b) CrO_4^{2-} — Cr is +6
(c) MnO_4^- — Mn is +8
(d) SO_3 — S is +6
(e) $Na_2Cr_2O_7$ — Cr is +6

15. Consider the following reaction and choose the correct statement. (x pts)

$$2Rb + Cl_2 \rightarrow 2RbCl$$

(a) Rb is oxidized, Cl_2 is reduced, Rb is the oxidizing agent, Cl_2 is the reducing agent
____ (b) Rb is oxidized, Cl_2 is reduced, Rb is the reducing agent, Cl_2 is the oxidizing agent
(c) Rb is reduced, Cl_2 is oxidized, Rb is the oxidizing agent, Cl_2 is the reducing agent
(d) Rb is reduced, Cl_2 is oxidized, Rb is the reducing agent, Cl_2 is the oxidizing agent
(e) Rb is oxidized, Cl_2 is oxidized, Cl_2 is the reducing agent and Rb is the oxidizing agent

16. Which of the following are oxidation reduction reactions: (x pts)

W. $2Mg(s) + O_2(g) \rightarrow 2MgO(s)$
X. $H_2SO_4(aq) + Mg(OH)_2(s) \rightarrow MgSO_4(aq) + 2\,H_2O(l)$
Y. $Pb(NO_3)_2(aq) + Na_2SO_4(aq) \rightarrow PbSO_4(s) + 2NaNO_3(aq)$
Z. $Sn(s) + 4HNO_3(aq) \rightarrow SnO_2(s) + 4NO_2(g) + 2H_2O(l)$

(a) W and Z
____ (b) X and Y
(c) W and Y
(d) X and Z
(e) W, Y and Z

17. A sample of neon gas occupies a volume of 12.6 L at 25.0°C. If the temperature is changed to -35.0°C, what will be the new volume of the gas (in L) if the pressure remains constant?(x pts)

(a) -17.7 L
____ (b) 15.8 L
(c) 13.2 L
(d) 10.1 L
(e) 22.4 L

18. Lithium hydroxide, LiOH, is used in spacecraft to recondition the air by absorbing the carbon dioxide exhaled by the astronauts. The reaction that occurs is:

$$2LiOH(s) + CO_2(g) \longrightarrow Li_2CO_3(s) + H_2O(l)$$

If the spacecraft carries 1.20 kg of LiOH (MM 23.95 g/mol), how many liters of CO_2 gas (MM 44.01 g/mol) can be absorbed at 27°C and 258 mmHg? (x pts)

(a) 2120 L
____ (b) 1820 L
(c) 1570 L
(d) 542 L
(e) 3620 L

19. Which of the following gases will be the slowest to diffuse through a room? (x pts)

(a) methane, CH_4
____ (b) hydrogen sulfide, H_2S
(c) carbon dioxide, CO_2
(d) water, H_2O
(e) neon, Ne

20. If 35.0 kJ of heat energy is added to 125 g of water initially at 25.0°C, what will be the final temperature of the water? The specific heat of water is 4.18 J g^{-1} $°C^{-1}$. (x pts)

(a) 92.0°C
____ (b) 72.8°C
(c) 54.1°C
(d) 69.2°C
(e) 81.8ºC

21. When aluminum oxide, Al_2O_3, is heated to high temperatures, it decomposes to produce aluminum metal by the following thermochemical equation:

$$2Al_2O_3(s) \rightarrow 4Al(s) + 3O_2(g); \Delta H° = +3352 \text{ kJ}$$

How many kJ of heat are required to produce 2714 g of aluminum metal? (x pts)

(a) 3.372×10^5 kJ
____ (b) 70.0 kJ
(c) 8.430×10^4 kJ
(d) 1.349×10^6 kJ
(e) 2.274×10^6 kJ

22. Use the following data to determine the enthalpy of reaction in kJ for the following reaction.(x pts)

$$4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + 6H_2O(g)$$

Substance	**ΔH_f^o (kJ/mol)**		**Substance**	**ΔH_f^o (kJ/mol)**
$NH_3(g)$	-45.9		$H_2O(g)$	-241.8
NO(g)	90.3		$H_2O(l)$	-286
$H_2SO_4(l)$	-814		$O_2(g)$	0

(a) 906 kJ
____ (b) -197.4 kJ
(c) -1273.2 kJ
(d) -906 kJ
(e) -1478 kJ

23. Use Hess's law to derive the enthalpy of the following reaction: (x pts)

$$2NO(g) + O_2(g) \rightarrow N_2O_4(g)$$

Use the following thermochemical equations:

$$N_2O_4(g) \rightarrow 2NO_2(g);\ \Delta H° = +57.93 \text{ kJ}$$

$$NO(g) + {}^1/_2O_2(g) \rightarrow NO_2(g);\ \Delta H° = -56.57 \text{ kJ}$$

(a) -171.1 kJ
____ (b) 1.36 kJ
(c) -114. 50 kJ
(d) 171.1 J
(e) -55.2 J

24. What is the maximum number of electrons that can be held in a set of 5*p* orbitals? (x pts)

(a) 2
____ (b) 6
(c) 10
(d) 14
(e) none of the above

25. When set to stun, the electromagnetic radiation being emitted from a regulation Starfleet phaser emits 275 kJ per mole of photons. What is the wavelength of the emitted photons in nm? (x pts)

(a) 435 nm
____ (b) 275 nm
(c) 4.35×10^{5} nm
(d) 7.22×10^{-19} nm
(e) 4.35×10^{-7} nm

26. The **aufbau principle** states that: (x pts)

(a) Orbitals should be filled from lower energy levels upwards.
____ (b) No two electrons in an atom can have the same value for all four quantum numbers.
(c) When electrons occupy degenerate orbitals, one electron should be placed in each orbital until the set is half-filled.
(d) It is impossible to precisely determine both the position and the velocity of a particle at a given moment in time.
(e) When you have eliminated the impossible, whatever remains, however improbable, must be the truth.

27. What is the complete electron configuration of the element **selenium (Se)**? (x pts)

(a) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^4$
____ (b) $1s^2\ 2s^2\ 2d^6\ 3p^6\ 4s^2\ 4p^4$
(c) $1s^1\ 1p^1\ 2s^2\ 2p^6\ 3s^6\ 4s^2\ 3d^{10}\ 5p^4$
(d) $1s^2\ 2s^2\ 3p^6\ 4s^2\ 5p^4\ 6d^{10}\ 7s^2\ 8p^4$
(e) none of the above

28. Which of the following are **correctly** arranged with respect to the size of the atom/ion?(x pts)

(i) $K^+ < Ar < Cl^-$
(ii) $Br^- < Br < Br^+$
(iii) $O < S < P$
(iv) $S^{2-} < Cl^- < F^-$

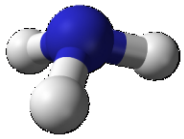
(a) i and iii only
____ (b) i only
(c) iii only
(d) ii and iv only
(e) ii only
(f) iv only

29. What is the hybridization of a central atom that has three single bonds and one lone pair connected to it? (x pts)

(a) sp
____ (b) sp^2
(c) sp^3
(d) sp^3d
(e) sp^3d^2

30. In the molecular structure pictured below, how many **electron groups** are around the central atom, and what is the **electron group geometry** of this structure? (x pts)

(a) 3, trigonal planar
____ (b) 3, trigonal pyramidal
(c) 4, tetrahedral
(d) 4, trigonal pyramidal
(e) 3, tetrahedral



CHEM 1412 Questions

31. **London (dispersion) forces** are: (x pts)

(a) the attractions between nonpolar molecules caused by instantaneous dipoles.
____ (b) the attraction between molecules which have hydrogens connected to a nitrogen, oxygen, or fluorine atom.
(c) the attraction between polar molecules resulting from the attractions of partial positive and partial negative charges.
(d) the attraction between an ion and a polar molecule.
(e) an energy field created by all living things which surrounds us and penetrates us and binds the Galaxy together.

32. Which of the following molecules are polar? CCl_4, CH_3Br, NF_3, CO_2 (x pts)

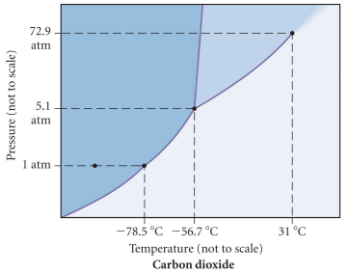
(a) CCl_4 and CO_2 only
____ (b) CH_3Br and NF_3 only
(c) CH_3Br and CO_2 only
(d) CH_3Br only
(e) NF_3 only
(f) CO_2 only

33. What is the strongest type of intermolecular force between solute and solvent in a mixture of CBr_4 and CCl_4? (x pts)

(a) hydrogen bonding
____ (b) dipole-dipole forces
(c) ion-dipole forces
(d) dispersion forces
(e) none of these forces are present between these compounds

34. Consider the phase diagram for carbon dioxide shown below. What physical process occurs when CO_2 is heated from -78.5°C to 20°C at 1 atm? (x pts)

(a) melting
____ (b) boiling
(c) condensation
(d) sublimation
(e) CO_2 becomes a supercritical fluid



35. Which of the following solutions will have the highest boiling point? (Assume ideal behavior.) (x pts)

(a) 0.30 *m* NaCl
____ (b) 0.20 *m* $CaCl_2$
(c) 0.60 *m* glucose
(d) 0.15 *m* Na_3PO_4
(e) all of the solutions will have the same boiling point

36. A 20.00% by mass aqueous solution of glucose ($C_6H_{12}O_6$, MW 180.16 g/mol), has a density of 1.080 g/mL at 20°C. Calculate the **molarity** of glucose in the solution. (x pts)

(a) 1.199 M
____ (b) 1.110 M
(c) 1.388 M
(d) 2.160 M
(e) none of the above

37. A solution is prepared by dissolving 100.0 g of NaCl (MM 58.44 g/mol) in 500.0 g of water. What is the boiling point of the solution? For water, K_b = 0.512°C/*m* and T_b = 100.000°C. Assume ideal behavior for the aqueous solution. (x pts)

(a) 100.003ºC
____ (b) 103.50ºC
(c) 101.75ºC
(d) 96.50ºC
(e) none of the above

38. What is the concentration of particles (in units of molarity) in a cell having an osmotic pressure of 1520 torr at a temperature of 25°C? (R = 0.0821 L atm / K mol) (x pts)

(a) 1.03 M
____ (b) 0.974 M
(c) 741 M
(d) 0.0817 M
(e) 62.1 M

39. Azomethane, CH_3NNCH_3, decomposes in a **first order** reaction to give ethane, CH_3CH_3, and nitrogen gas:

$$CH_3NNCH_3(g) \rightarrow CH_3CH_3(g) + N_2(g)$$

If the initial concentration of CH_3NNCH_3 is 0.500 M, what will its concentration be after 1.50 hours? The rate constant for the reaction is 2.48×10^{-4} s^{-1}. (x pts)

(a) 0.498 M
____ (b) 1.91 M
(c) 0.524 M
(d) 7.63 M
(e) none of the above

40. A particular radioactive substance is known to decay by a **first-order** reaction. If the initial mass of a sample of the substance weighs 2.00 grams, and the half-life for the decay is 15 minutes, how much will be remaining after 1.00 hour? (x pts)

(a) 1.00 g
____ (b) 0.500 g
(c) 0.250 g
(d) 0.125 g
(e) 0.000 g

41. For the reaction 6A(g) + 2B(g) → not2B(g) the following data were obtained at constant temperature. Find the rate law for the reaction, and calculate the value of the rate constant (including the correct units). (x pts)

Initial Concentrations, M		**Initial Rate**
[A]	**[B]**	**(M min^{-1})**
0.100	0.100	5.00
0.300	0.100	45.0
0.100	0.200	10.0
0.300	0.200	90.0

(a) rate = k $[A]^2$ [B], k = 5000 M^{-2} min^{-1}
____ (b) rate = k [A] [B], k = 500 M^{-2} min^{-1}
(c) rate = k [A] $[B]^2$, k = 5000 M^{-1} min^{-1}
(d) rate = k $[A]^2$ [B], k = 500 M^{-1} min^{-1}
(e) none of the above

42. The rate constant of a reaction is 4.50×10^{-5} L mol^{-1} s^{-1} at 195°C and 3.20×10^{-3} L mol^{-1} s^{-1} at 258°C. Use the Arrhenius equation to find the activation energy of this reaction in units of kJ/mol. (x pts)

$$\ln\left(\frac{k_2}{k_1}\right) = -\left(\frac{E_a}{R}\right)\left(\frac{1}{T_2} - \frac{1}{T_1}\right) \qquad R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$$

(a) 28.3 kJ/mol
____ (b) 1.40×10^5 kJ/mol
(c) 2.83×10^4 kJ/mol
(d) 140. kJ/mol
(e) none of the above

43. Consider the following reaction:

$$2NO_2 + F_2 \rightarrow 2NO_2F$$

The experimental rate law for the reaction is Rate = k $[NO_2][F_2]$. Is the mechanism shown below consistent with the experimental rate law? (x pts)

Step 1: $NO_2 + F_2 \xrightarrow{k_1} NO_2F + F$ *slow*

Step 2: $NO_2 + F \xrightarrow{k_2} NO_2F$ *fast*

(a) Yes; the rate law for the rate-determining step of the mechanism is rate = $k_1[NO_2][F_2]$, which is consistent with the experimental rate law.
____ (b) No; the rate law for the rate-determining step of the mechanism is rate = $k_2[NO_2][F]$, which is not consistent with the experimental rate law.
(c) No; the rate law for the overall reaction is rate = $k[NO_2]^2[F_2]$, which is not consistent with the experimental rate law.
(d) Yes; the reactions add up to give the correct overall equation.
(e) The reaction does not occur unless there is a multi-phasic temporal convergence in the space-time continuum.

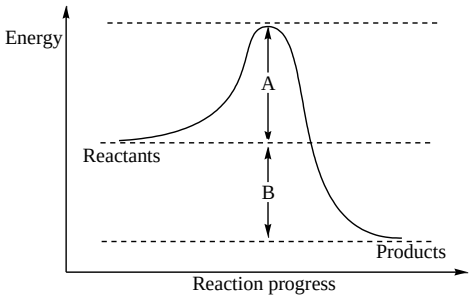
44. State whether the following potential-energy diagram represents an endothermic or exothermic reaction, and identify the energy change labeled A and B. (x pts)

(a) exothermic; A = the activation energy of the forward reaction; B = ΔH

____ (b) endothermic; A = ΔH; B = activation energy of the forward reaction

(c) exothermic; A = ΔH; B = activation energy of the forward reaction

(d) endothermic; A = activation energy of the forward reaction; B = ΔH



45. For the reaction below, which ONE of the following changes will increase the yield of NO?(x pts)

$$N_2(g) + O_2(g) \rightleftharpoons 2NO(g); \Delta H° = +180.5 \text{ kJ}$$

(a) decreasing the volume of the container.

____ (b) adding a catalyst to the reaction mixture.

(c) removing N_2 from the mixture

(d) increasing the temperature of the reaction mixture.

(e) none of the changes listed will affect the equilibrium concentrations in the reaction.

46. One reaction that occurs in producing steel from iron ore is the reduction of iron(II) oxide by carbon monoxide to give iron metal and carbon dioxide. At 1000 K, K_p = 0.259.

$$FeO(s) + CO(g) \rightleftharpoons Fe(s) + CO_2(g); K_p = 0.259 \text{ at } 1000 \text{ K}$$

What is the equilibrium partial pressure of CO_2 at 1000 K if the initial partial pressures are P_{CO} = 0.750 atm and P_{CO2} = 0.250 atm? (x pts)

(a) 0.206 atm

____ (b) 0.794 atm

(c) 0.294 atm

(d) 0.178 atm

(e) 0.057 atm

47. At a particular temperature, $K_c = 4.0\times10^{-48}$ for the equation

$$2H_2O(g) \rightleftharpoons 2H_2(g) + O_2(g)$$

Calculate K_c for the following equations: (x pts)

$$H_2(g) + \tfrac{1}{2}O_2(g) \rightleftharpoons H_2O(g)$$

(a) -1.6×10^{-95}

____ (b) 2.5×10^{47}

(c) -2.0×10^{-48}

(d) 2.0×10^{-48}

(e) 5.0×10^{23}

48. At 700 K, $K_c = 0.29$ for the reaction

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

In a given experiment, 4.0 M N_2, 2.0 M H_2, and 2.0 M NH_3 are placed in a container. Calculate the value of Q_c for these conditions. Is the system at equilibrium? If not, in which direction will it proceed? (x pts)

(a) $Q = 0.12$, equilibrium shifts to the right
____ (b) $Q = 0.12$, equilibrium shifts to the left
(c) $Q = 0.25$, equilibrium shifts to the right
(d) $Q = 0.25$, equilibrium shifts to the left
(e) $Q = 0.50$, equilibrium shifts to the left

49. Nitrogen dioxide decomposes according to the reaction

$$2NO_2(g) \rightleftharpoons 2NO(g) + O_2(g)$$

where $K_p = 4.48\times10^{-13}$ at a certain temperature. A pressure of 2.00 atm of NO_2 is introduced into a container and allowed to come to equilibrium. What is the equilibrium partial pressures of NO(g)? (x pts)

(a) 1.53×10^{-4} atm
____ (b) 7.65×10^{-5} atm
(c) 1.21×10^{-4} atm
(d) 1.55×10^{-5} atm
(e) none of the above

50. Choose the stronger acid and the correct explanation: HOBr or HOCl (x pts)

(a) HOBr is the stronger acid because Br is larger than Cl.
____ (b) HOCl is the stronger acid because Cl is more electronegative than Br.
(c) HOBr is the stronger acid because Br is more electronegative than Cl.
(d) HOCl is the stronger acid because Cl is larger than Br.

51. Felix Felicis is a magical potion that grants unusually good luck to whoever drinks it. (Its use on this exam is prohibited!) A particular solution of Felix Felicis has a pH of 8.52. What is the pOH, $[H_3O^+]$, and $[OH^-]$ of this potion? (x pts)

(a) pOH = 5.48, $[H_3O^+] = 3.0\times10^{-9}$ M, $[OH^-] = 3.3\times10^{-6}$ M
____ (b) pOH = 5.5, $[H_3O^+] = 3\times10^{-9}$, $[OH^-] = 3\times10^{-6}$
(c) pOH = 5.48, $[H_3O^+] = 3.3\times10^{-6}$ M, $[OH^-] = 3.0\times10^{-9}$ M
(d) pOH = 5.48, $[H_3O^+] = 0.93$ M, $[OH^-] = 1.1\times10^{-14}$ M
(e) none of the above

52. In many medical applications, the value of K_w at 37°C (body temperature) is more appropriate than the 25°C value of 1.0×10^{-14}. The pH of pure water at 37°C is 6.80. Calculate the $\boldsymbol{K_w}$ of pure water at this temperature. (x pts)

(a) $K_w = 1.0\times10^{-14}$
____ (b) $K_w = 1.6\times10^{-7}$
(c) $K_w = 6.3\times10^{-8}$
(d) $K_w = 2.5\times10^{-14}$
(e) $K_w = 4.0\times10^{-4}$

53. Valeric acid, $HC_5H_9O_2$, is an oily, colorless, unpleasant-smelling liquid which is found in the perennial plant valerian, and is used to make pleasant-smelling esters for perfumes and cosmetics. Its K_a is 1.5×10^{-5}. Calculate the pH of a 0.20 M solution of valeric acid. (x pts)

(a) 2.76
____ (b) 0.70
(c) 4.82
(d) 5.52
(e) 11.24

54. Which one of the following salts will produce a **neutral** solution? (x pts)

(a) $KClO_2$
____ (b) $NaC_2H_3O_2$
(c) $FeCl_3$
(d) $NaNO_3$
(e) NH_4Cl

55. Calculate the pH of 0.25 *M* $NaC_2H_3O_2$. For the acid form, $HC_2H_3O_2$, $K_a = 1.8\times10^{-5}$. (x pts)

(a) 11.33
____ (b) 2.67
(c) 4.93
(d) 9.07
(e) none of the above

56. A 0.00100 M solution of pyridine, a weak base, has a pH of 8.16. What is the value of K_b for pyridine? (x pts)

(a) $K_b = 2.0\times10^{-9}$
____ (b) $K_b = 5.0\times10^{-6}$
(c) $K_b = 4.8\times10^{-14}$
(d) $K_b = 1.4\times10^{-3}$
(e) none of the above

57. What is the definition of a Lewis Acid? (+1 pts)

(a) A Lewis Acid is a proton donor.
____ (b) A Lewis Acid is a proton acceptor.
(c) A Lewis Acid is an electron-pair donor.
(d) A Lewis Acid is an electron-pair acceptor.
(e) A Lewis Acid is the conjugate form of a Clark Base.

58. A buffer solution is prepared which contains 0.800 M NH_3 and 0.600 M NH_4Cl. What is the pH of the buffer solution? (The K_b of NH_3 is 1.8×10^{-5}.) (x pts)

(a) 9.37
____ (b) 4.87
(c) 9.13
(d) 4.63
(e) none of the above

59. Which of the following mixtures will form a buffer solution? (x pts)

A. 50.0 mL of 0.10 M NH_3 and 50.0 mL of 0.10 M NH_4Cl
B. 150.0 mL of 0.10 M NaBr and 135.0 mL of 0.175 M HBr
C. 25.0 mL of 0.25 M NH_3 and 50.0 mL of 0.25 M HCl
D. 50.0 mL of 0.20 M HF and 25.0 mL of 0.20 M KOH

(a) A only
(b) B only
____ (c) C only
(d) A and C only
(e) A and D only

60. Calculate the pH during the titration of 50.00 mL of 2.00 M HCl after 75.00 mL of 2.00 M NaOH solution has been added. (x pts)

(a) 13.42
____ (b) 0.58
(c) -0.30
(d) 12.18
(e) 13.78

61. When 100.0 mL of 1.00 M acetic acid, $HC_2H_3O_2$, is titrated with 0.500 M NaOH, what is the pH at the equivalence point? (The K_a of $HC_2H_3O_2$ is 1.8×10^{-5}.) (x pts)

(a) 11.39
____ (b) 4.87
(c) 9.13
(d) 9.37
(e) 9.25

62. Silver chloride, AgCl, has $K_{sp} = 1.8\times10^{-10}$. Calculate the molar solubility of AgCl in pure water. (x pts)

(a) 1.3×10^{-5} M
____ (b) 1.8×10^{-10} M
(c) 3.2×10^{-20} M
(d) 9.0×10^{-11} M
(e) none of the above

63. Lead(II) chloride, $PbCl_2$, has $K_{sp} = 1.7\times10^{-5}$. Calculate the molar solubility of $PbCl_2$ in 0.250 M $CaCl_2$(aq) solution (x pts)

(a) 6.8×10^{-5} M
____ (b) 3.4×10^{-5} M
(c) 2.7×10^{-4} M
(d) 1.7×10^{-5} M
(e) none of the above

64. Which ONE of the following statements is NOT true? (x pts)

(a) The free energy change for a spontaneous reaction is related to the maximum amount of work obtainable from a system.

____ (b) The free energy change of a system is negative for a spontaneous process.

(c) The entropy change of the universe is not related to whether or not a reaction is spontaneous.

(d) Some energy is always lost as waste heat at temperatures above absolute zero.

(e) All of these statements are true.

65. For a particular reaction, $\Delta H°$ is -25.0 kJ, and $\Delta S°$ is -25.0 J/K. Calculate $\Delta G°$ for the reaction at 298 K. (x pts)

(a) -17.6 kJ

____ (b) -32.5 kJ

(c) 7425 kJ

(d) 600 kJ

(e) 17.6 kJ

66. If ΔG^o for a reaction is 23.6 kJ, what is the value of the equilibrium constant, K? (x pts)

(a) 7.3×10^{-5}

____ (b) 1.1

(c) 0.99

(d) 1.4×10^{4}

(e) none of the above

67. A voltaic cell is constructed with a Zn/Zn^{2+} half-cell (using a zinc electrode) as the anode and a Cu/Cu^{2+} half-cell (using a copper electrode) as the cathode. A salt bridge containing sodium sulfate, Na_2SO_4, connects the two cells. The reduction half-cell potentials for zinc and copper are listed below. Which one of the following statements is NOT true about this cell? (x pts)

$Cu^{2+}(aq) + 2e^- \rightleftharpoons Cu(s)$ $\quad E°_{cell} = +0.34$

$Zn^{2+}(aq) + 2e^- \rightleftharpoons Zn(s)$ $\quad E°_{cell} = -0.76$

(a) Some of the Zn^{2+} in the anode electrolyte solution deposits on the anode as Zn metal.

____ (b) The electrons travel from the anode to the cathode.

(c) As the reaction proceeds, SO_4^{2-} ions from the salt bridge migrate into the anode electrolyte solution.

(d) The cathode is positively charged.

(e) The cell has a cell potential of 1.10 V.

(f) The cell notation for the cell is $Zn(s)|Zn^{2+}(aq)||Cu^{2+}(aq)|Cu(s)$

68. A voltaic cell is constructed with an Ag/Ag^+ half-cell (using a silver electrode) and a I_2/I^- half-cell (using a platinum electrode). The platinum electrode is found to be negative. What is the overall cell reaction and the standard cell potential ($E°_{cell}$) for the cell? The standard cell potentials for this reaction are shown below. (x pts)

$Ag^+(aq) + e^- \rightleftharpoons Ag(s)$ +0.80 V
$I_2(s) + 2e^- \rightleftharpoons 2I^-(aq)$ +0.53 V

(a) $2Ag^+(aq) + 2I^-(aq) \rightarrow 2Ag(s) + I_2(s)$; $E°_{cell} = 0.27$ V
____ (b) $2Ag(s) + I_2(s) \rightarrow 2Ag^+(aq) + 2I^-(aq)$; $E°_{cell} = 0.27$ V
(c) $2Ag(s) + I_2(s) \rightarrow 2Ag^+(aq) + 2I^-(aq)$; $E°_{cell} = -0.27$ V
(d) $2Ag^+(aq) + 2I^-(aq) \rightarrow 2Ag(s) + I_2(s)$; $E°_{cell} = -0.27$ V
(e) none of the above

69. Balance the following redox skeleton reaction. What are the coefficients on Cr^{3+} and O_2 in the balanced equation? (x pts)

__ $Cr_2O_7^{2-}(aq)$ + __ $H_2O_2(aq) \rightarrow$ __ $Cr^{3+}(aq)$ + __ $O_2(aq)$ [acidic]

(a) 2, 3
____ (b) 2, 3
(c) 1, 2
(d) 2, 1
(e) 1, 3

70. Antimony-121, $^{121}_{51}Sb$, forms by beta emission. What is the **parent nuclide** for this product?(x pts)

(a) Tellurium-121, $^{121}_{52}Te$
____ (b) Tin-121, $^{121}_{50}Sn$
(c) Iodine-121, $^{121}_{53}I$
(d) Tellirium-122, $^{122}_{52}Te$
(e) Tin-122, $^{122}_{50}Sn$

Physical Constants

Avogadro's number	6.022×10^{23} units/mol
Planck's Constant	$h = 6.626\times10^{-34}$ J s
Speed of light	$c = 3.00\times10^{8}$ m/s
Universal gas constant	$R = 0.0821$ L atm K^{-1} mol^{-1} $R = 8.314$ J K^{-1} mol^{-1}
Ion-product of water	$K_w = 1.0\times10^{-14}$
Faraday Constant	$F = 9.65\times10^{4}$ C/mol e^- = 9.65×10^{4} J / V mol e^-

Conversion Factors

(Conversion factors are exact except where indicated.)

1 in = 2.54 cm	°C = $\frac{5}{9}$ (°F – 32)	1 mmHg = 1 torr
3.281 ft = 1 m (not exact)	°F = $\frac{9}{5}$ °C + 32	1 atm = 1.01325 x 10^5 Pa
1.609 km = 1 mi	K = °C + 273.15	1 atm = 760 mmHg
5280 ft = 1 mi	1 atm = 101 kPa (not exact)	1 atm = 760 torr
1 gal = 3.785 L (not exact)		1 atm = 14.7 lb / in^2

Equations

For a quadratic equation of the form $ax^2 + bx + c = 0$,

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$