CHEM 101 Fall 2004 Practice Final Exam

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Directions: Choose the best answer for each multiple choice question (numbers 1 - 40).

1. Identify the **net ionic** equation for the reaction of HCl and $Ba(OH)_2$.

$2HCl(aq) + Ba(OH)_2(aq) \rightarrow BaCl_2(aq) + 2H_2O(l)$

(a) $HCl(aq) + OH^-(aq) \rightarrow Cl^-(aq) + H_2O(l)$
(b) $2HCl(aq) + Ba(OH)_2(aq) \rightarrow 2Cl^-(aq) + Ba^{2+}(aq) + 2H_2O(l)$
(c) $H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$
(d) $2H^+(aq) + 2OH^-(aq) \rightarrow 2H_2O(l)$
(e) $2HCl(aq) + Ba^{2+}(aq) \rightarrow BaCl_2(aq) + 2H^+(aq)$

2. The molarity of a solution is defined as
I. the number of moles of solute per kilogram of solvent.
II. the number of moles of solute per liter of solution.
III. the number of equivalent weights of solute per liter of solution.
IV. the number of moles of solute per kilogram of solution.
V. the number of moles of solute per liter of solvent.
(a) I (b) I and II (c) II and III (d) II (e) I, II, and III

3. In the following reaction, the oxidizing agent is ____, when it is _____ in the following reaction.

$6KOH(aq) + 3Cl_2(aq) \rightarrow KClO_3(aq) + 5KCl(aq) + 3H_2O(l)$

(a) Cl_2, reduced to KCl (b) Cl_2, oxidized to $KClO_3$
(c) Cl_2, oxidized to KCl (d) Cl_2, reduced to $KClO_3$
(e) KOH, reduced to H_2O

4. Suppose you have a 100-gram sample of each of the following compounds. Which sample contains the smallest number of moles of hydrogen atoms?
(a) NH_3 (b) H_2O (c) H_3PO_4 (d) CH_4 (e) HClO

5. These three species ^{80}Se, ^{81}Br and ^{82}Kr have
(a) the same atomic mass. (b) the same number of protons.
(c) the same number of neutrons. (d) the same mass number.
(e) the same number of electrons.

6. The **total** number of electrons in *p* orbitals in a palladium atom (atomic number = 46) in its ground state is: _____.
(a) 6 (b) 12 (c) 18 (d) 24 (e) 30

7. Which of the following atoms or ions is **not** diamagnetic?
(a) S^{2-} (b) Zn (c) Mg (d) Mg^{2+} (e) B

8. What is the electronic geometry for 5 regions of high electron density on a central atom?
(a) octahedral (b) square planar (c) tetrahedral
(d) trigonal bipyramidal (e) trigonal planar

9. Which of the following changes in water represents a <u>chemical</u> change?
(a) Melting of ice.
(b) Boiling water.
(c) Sublimation of solid ice directly to gaseous water.
(d) Calcium reacting with water to produce calcium hydroxide.
(e) Heating water from 25°C to 60°C.

10. Which response includes all the compounds listed below and only the compounds?
I. ethyl alcohol II. air
III. mercury IV. steam
V. calcium fluoride

(a) I, II, and IV (b) III and V
(c) II, IV, and V (d) I, III, and IV
(e) another one or another combination

11. If 25 grams of methane, CH_4, and 30 g of ammonia, NH_3, are combined with excess oxygen, how much <u>methane or ammonia</u> will be left when the reaction is finished?

$$2CH_4 + 2NH_3 + 3O_2 \rightarrow 2HCN + 6H_2O$$

(a) 0.10g NH_3 (b) 0.20 mol CH_4
(c) 0.10 g CH_4 (d) 10 g NH_3
(e) 0.20 mol NH_3

12. What is the percent by mass of sulfur in $Al_2(SO_4)_3$?

(a) 9.38% (b) 18.8% (c) 24.6%
(d) 28.1% (e) 35.4%

13. Which of the following statements about AsF_5 is false?
    a. The electronic geometry is trigonal bipyramidal.
    b. As is sp^3d hybridized.
    c. As has one lone pair.
    d. Bonding angles are 90º, 120º or 180º.
    e. The molecular geometry is trigonal bipyramidal.

14. What volume of 40.0% $NaNO_3$ solution contains 0.15 mole of $NaNO_3$? Density = 1.32 g/mL.
    (a) 42.0 mL (b) 3.86 mL (c) 9.60 mL
    (d) 24.1 mL (e) 38.2 mL

15. Calculate the molarity of the resulting solution if enough water is added to 50.0 mL of 4.20 *M* NaCl solution to make a solution with a volume of 2.80 L.
    (a) 75.0 *M* (b) 0.043 *M* (c) 33.1 *M*
    (d) 0.067 *M* (e) 0.0750 *M*

16. What volume of 0.130 *M* HCl solution will just react with 0.424 gram of $Ba(OH)_2$?

    $$2HCl + Ba(OH)_2 \rightarrow BaCl_2 + 2H_2O$$

    (a) 38.1 mL (b) 32.6 mL (c) 24.1 mL
    (d) 18.6 mL (e) 96.7 mL

17. Arrange the following elements in order of **increasing** first ionization energy.

    Mg, Al, Si, P, S

    (a) Al < Mg < Si < S < P (b) Mg < Al < Si < P < S
    (c) Al < Mg < Si < P < S (d) Mg < Al < Si < S < P
    (e) Al < Mg < P < Si < S

18. Which of the following elements has the most negative electron affinity?

    (a) Si (b) P (c) S (d) Se (e) Te

19. Which of the following anions represents a peroxide?

    (a) O^- (b) O_2^- (c) O^{2-} (d) O_2^{2-} (e) O_3^-

20. Which of the following oxides does **not** give an acidic solution when dissolved in water?
(a) SO_2 (b) CO_2 (c) N_2O_5 (d) P_4O_{10} (e)Na_2O

21. Arrange the following in order of increasing acidic character (most acidic at the right).
Al_2O_3, Na_2O, N_2O_5
(a) $Al_2O_3 < Na_2O < N_2O_5$ (b) $N_2O_5 < Al_2O_3 < Na_2O$
(c) $Al_2O_3 < N_2O_5 < Na_2O$ (d) $Na_2O < Al_2O_3 < N_2O_5$
(e) $Na_2O < N_2O_5 < Al_2O_3$

22. The number of **unshared pairs** of electrons in the outer shell of oxygen in Cl_2O is _____.
(a) one (b) two (c) three (d) four (e) zero

23. The Lewis dot formula for CO_2 shows
(a) two single covalent bonds.
(b) one single covalent bond and one double covalent bond.
(c) one single covalent bond and one triple covalent bond.
(d) a total of 8 x 3 = 24 electrons (dots).
(e) two double covalent bonds.

24. How many resonance structures does the nitrate ion, NO_3^-, have?
(a) one (b) two (c) three (d) four (e) zero

25. Which of the following molecules has the **most ionic** bond character?
(a) NCl_3 (b) F_2 (c) HF (d) ClF (e) HCl

26. According to the Arrhenius theory, which of the following is a base?

(a) CsOH (b) HOOH (c) CH_3OH (d) HCOOH (e) CH_3COOH

27. What is the <u>molarity</u> of H_3PO_4 if 86 mL of 0.35 *N* solution is diluted to 5.00 L?
(a) 0.00602 *M* (b) 0.0181 *M* (c) 0.00301 *M*
(d) 0.00201 *M* (e) 6.78 *M*

28. What is the oxidation number of tin in the $HSnO_3^-$ ion?

(a) +1 (b) +2 (c) +3 (d) +4 (e) +5

29. When balancing the following net ionic equation by the half reaction method, what is the sum of the coefficients, including the coefficient of the electrons, in the oxidation half-reaction?
$Pb^{4+} + SeO_3^{2-} \rightarrow Pb^{2+} + SeO_4^{2-}$ (aqueous, acidic solution)
(a) eight (b) ten (c) twelve (d) four (e) seven

30. What is the pressure of 64.0 g of oxygen gas in a 1.50-L container at -37°C?
(a) 4.12 atm (b) 25.8 atm (c) 51.6 atm (d)19.6 atm (e) 8.2 atm

31. A 300.-mL sample of hydrogen, H_2, was collected over water at 21°C on a day when the barometric pressure was 748 torr. What mass of hydrogen is present? The vapor pressure of water is 19 torr at 21°C.
(a) 0.0186 g (b) 0.0240 g (c) 0.0213 g (d) 0.0269 g (e) 0.0281 g

32. If an element consisted of three isotopes in the following relative abundance, what would the atomic weight of the element be? This is a **hypothetical** example.

30.00%	37.00 amu
50.00%	38.00 amu
20.00%	40.00 amu

(a) 38.00 amu (b) 38.10 amu (c) 38.20 amu (d) 39.98 amu (e) none of these

33. For which of the following would hydrogen bonding **not** be an important factor in determining physical properties in the liquid state?
(a) HI (b) H_2O (c) HF (d) NH_3 (e) H_2O_2

34. How much heat is released when 40.0 g of steam at 250.0□C cools and condenses to water at 30.0°C? (Sp. heat of $H_2O(l)$ = 4.18 J/g•°C, Sp. heat of $H_2O(g)$ = 2.03 J/g•°C, heat of vap. of $H_2O(l)$ = 2.260 kJ/g)
(a) 24.0 kJ (b) 23.0 J (c) 32.9 kJ (d) 114 kJ (e) 122 kJ

35. Which one of the following pairs is **incorrectly** matched?

Substance	Classification
a. sand	covalent solid
b. diamond	molecular solid
c. Fe	metallic solid
d. CaF_2	ionic solid
e. quartz	covalent solid

36. If the mole fraction of methyl alcohol in a solution (with only water) is 0.28, what is the mole fraction of the water in that solution?
(a) 0.28 (b) 1.28 (c) 0.62 (d) 0.72 (e) 0.36

37. Calculate the freezing point of a solution that contains 68.4 g of sucrose (table sugar) in 300. g of water. One mole of sucrose is 342 g. K_f for H_2O = 1.86°C/*m*.
(a) - 0.186°C (b) - 0.372°C (c) - 0.558°C (d) - 0.744°C (e) -1.24°C

38. When 1.150 grams of an unknown nonelectrolyte dissolves in 10.0 grams of water, the solution freezes at -2.16°C. What is the molecular weight of the unknown compound? K_f for water = 1.86°C/*m*.
(a) 88.6 g/mol (b) 116 g/mol (c) 74.2 g/mol (d) 99.0 g/mol (e) 132 g/mol

39. Estimate the molecular weight of a biological macromolecule if a 0.100-gram sample dissolved in 50.0 mL of benzene has an osmotic pressure of 9.76 torr at 25.0°C.
(a) 3.8×10^3 g/mol (b) 4.2×10^4 g/mol (c) 5.6×10^4 g/mol
(d) 6.7×10^4 g/mol (e) 8.3×10^3 g/mol

40. What is the van't Hoff factor for a dilute solution of $CaCl_2$ likely to be?
(a) exactly 3 (b) exactly 2 (c) exactly 1 (d) slightly less than 3
(e) slightly less than 2

ANSWERS: 1 (c), 2 (d), 3 (a), 4 (e), 5 (c), 6 (c), 7 (e), 8 (d), 9 (d), 10 (e), 11 (e), 12 (d), 13 (c), 14 (d), 15 (e), 16 (a), 17 (a), 18 (c), 19 (d), 20 (e), 21 (d), 22 (b), 23 (e), 24 (c), 25 (c), 26 (a), 27 (d), 28 (d), 29 (e), 30 (b), 31 (b), 32 (b), 33 (a), 34 (d), 35 (b), 36 (d), 37 (e), 38 (d), 39 (a), 40 (d)