Name_____ Honors Chemistry ____/____/____

Final Exam -2013 Version A
Bubble the correct answer for each of the following on your scantron.

1. A solution is prepared by mixing 23.0 g ethanol (C_2H_5OH) with 100.0 g water to give a final volume of 119 mL. Calculate the molarity of ethanol in this solution.
(A) 2.03 M (B) 4.20 M (C) 4.06 M (D) 1.93 M (E) 8.90 M

2. When hafnium metal is heated in an atmosphere of chlorine gas, the product of the reaction is found to contain 62.6 percent Hf by mass and 37.4 percent Cl by mass. What is the empirical formula for this compound?
(A) HfCl (B) $HfCl_2$ (C) $HfCl_3$ (D) $HfCl_4$ (E) Hf_2Cl_3

3. Which of the following reactions has the largest positive value of ΔS per mole of Cl_2
(A) $H_2(g) + Cl_2(g) \rightarrow 2\ HCl(g)$ (B) $Cl_2(g) + ½\ O_2(g) \rightarrow Cl_2O(g)$
(C) $Mg(s) + Cl_2(g) \rightarrow MgCl_2(s)$ (D) $2\ NH_4Cl(s) \rightarrow N_2(g) + 4\ H_2(g) + Cl_2(g)$
(E) $Cl_2(g) \rightarrow 2\ Cl(g)$

4. The ionization of benzoic acid is represented by this equation.
$C_6H_5COOH(aq) \rightleftharpoons H^+(aq) + C_6H_5COO^-(aq)$
If a 0.045 M solution of benzoic acid has an $[H^+] = 1.7 \times 10^{-3}$, what is the K_a of benzoic acid?
(A) 7.7×10^{-5} (B) 2.9×10^{-6} (C) 3.8×10^{-2}
(D) 8.4×10^{-1} (E) 6.7×10^{-5}

5. A compound contains 1.10 mol of K, 0.55 mol of Te, and 1.65 mol of O. What is the simplest formula of this compound?
(A) KTeO (B) KTe_2O (C) K_2TeO_3 (D) K_2TeO_6 (E) K_4TeO_6

6. Which type of radiation continues in a straight line when passed through an electric field?
(A) alpha (B) positron (C) beta (D) proton (E) gamma

7. $2S\ (s) + 3O_2\ (g) \rightarrow 2SO_3(g)$ $\Delta H = +800$ kJ/mol
$2SO_2(g) + O_2(g) \rightarrow 2SO_3\ (g)$ $\Delta H = +200$ kJ/mol
Based on the information given above, what is the ΔH for the following reaction?
$S(s) + O_2(g) \rightarrow SO_2(g)$
(A) 300 kJ (B) 500 kJ (C) 600 kJ (D) 1000 kJ (E) 1200 kJ

8. $2Al + 3FeO \rightarrow Al_2O_3 + 3Fe$ – A student uses 32.0 grams of aluminum and produces 80.4 grams of iron. What is his percent yield?
(A) 81.0% (B) 40.5% (C) 99.2% (D) 39.8% (E) none of the above

9. A gas has a volume of 4.0 L at a pressure of 0.80 atm. What is the volume if the pressure is changed to 0.20 atm at constant temperature?
(A) 1.0 L (B) 2.0 L (C) 8.0 L (D) 6 L (E) 16 L

10. Pi bonding occurs in each of the following species EXCEPT
(A) CO_2 (B) CO_3^{2-} (C) CCl_2F_2 (D) SeO_2 (E) HCN

11. $2Na + Cl_2 \rightarrow 2NaCl$ – How many grams of NaCl can be produced from 4.00 mole of sodium?
(A) 4.00 grams (B) 234 grams (C) 468 grams (D) 117 grams (E) none of the above

12. When pure sodium is placed in an atmosphere of chlorine gas, the following spontaneous reaction occurs.

$2Na(s) + Cl_2(g) \rightarrow 2NaCl(s)$

Which of the following statements is true about the reaction?

I. $\Delta S > 0$ II. $\Delta H < 0$ III. $\Delta G > 0$

(A) I only (B) II only (C) I & II only (D) II & III only (E) I ,II & III

13. What is the conjugate base of $H_2PO_4^-$?

(A) $HPO_4^{2-}(aq)$ (B) $H_2O(l)$ (C) $HPO_4^-(aq)$

(D) $H_3PO_4(aq)$ (E) HPO_4

14. How many moles of calcium fluoride, CaF_2, must be dissolved in 2.0 L of water at 25°C to form a saturated solution? CaF_2 1.6×10^{-10} K_{sp} at 25 °C

(A) 2.6×10^{-2} mol (B) 1.3×10^{-3} mol (C) 6.8×10^{-4} mol

(D) 3.4×10^{-4} mol (E) 1.6×10^{-10} mol

15. Hydrogen gas is collected over water at 21°C. At 21°C the vapor pressure of water is 18.7 torr. If the barometric pressure is 758 what is the pressure of hydrogen gas?

(A) 758 torr (B) 739 torr (C) 777 torr (D) 48.2 torr (E) 18.7 torr

16. Which species has the smallest Cl-A-Cl bond angle where A is the central atom?

(A) SCl_6 (B) CCl_4 (C) NCl_3 (D) OCl_2 (E) BCl_3

17. Which of the following is true about ionic compounds?

I. They are most crystalline solids at room temperature.

II. They only conduct electricity when dissolved in water.

III. They have free moving electrons.

(A) I only (B) I and II only (C) I and III only

(D) II and III only (E) I, II, and III

18. If 345 grams of $AlCl_3$ is dissolved in 890. grams of water, what is the mole fraction of aluminum chloride in water?

(A) 0.388 (B) 38.8 (C) 0.0522 (D) 0.0496 (E) 2.90

19. $C_6H_5OH(aq) + CN^-(aq) \rightleftharpoons HCN(aq) + C_6H_5O^-(aq)$

The equilibrium constant for this reaction is less than 1. What is the strongest base in this system?

(A) $C_6H_5OH(aq)$ (B) $CN^-(aq)$ (C) $HCN(aq)$

(D) $C_6H_5O^-(aq)$ (E) all bases are equal in strength

20. A sample of 5.16 grams of an ideal gas at 150.0 °C and 1.25 atmospheres pressure has a volume of 2.00 liters. What is the molar mass of the gas?

(A) 0.0218 gram/mole (B) 16.2 grams/mole (C) 37.0 grams/mole

(D) 71.6 grams/mole (E) 45.8 grams/mole

21. A 580. mL solution contains 120. mL of ethanol (C_2H_5OH). Calculate the volume percent of this solution.

(A) 4.83% (B) 20.7% (C) 7.47% (D) 4.50% (E) 0.207%

22. Determine the boiling point if 600. grams of toluene (C_7H_8) is dissolved in 800. grams of benzene(C_6H_6).

Boiling Point of benzene: 80.10ºC, $K_b = 2.53$ kg-K-mol^{-1}

(A) 59.5°C (B) 100.7°C (C) 20.6°C (D) 82.00°C (E) 1.90°C

23. A 0.239 g sample of a gas in a 100-mL flask exerts a pressure of 1520 mmHg at 14 °C. What is the gas?

(A) chlorine (B) xenon (C) krypton (D) nitrogen (E) oxygen

24. If a sulfur trioxide molecule is drawn so that the formal charge on each atom is zero, it will have the following types of bonds:

(A) 3 sigma and 0 pi (B) 3 sigma and 1 pi (C) 3 sigma and 2 pi
(D) 3 sigma and 3 pi (E) 3 sigma and 6 pi

25. How many mL of stock sodium chloride solution would you need to prepare 700. mL of a 0.60 M solution from a 7.0 M stock solution?

(A) 8200 mL (B) 640 mL (C) 120 mL (D) 60. mL (E) 30. mL

26. Which of the following atoms is the most paramagnetic?

(A) sodium (B) chlorine (C) magnesium (D) aluminum (E) sulfur

27. What is the pH of a 0.15 M solution of formic acid, HCOOH? K_a = HCOOH 1.9×10^{-4}

(A) 1.49 (B) 2.27 (C) 3.72
(D) 4.55 (E) 1.94

28. What is the $[H^+]$ in a 0.10 M solution of ascorbic acid, $C_6H_8O_6$? $C_6H_8O_6$, $K_a = 8.0 \times 10^{-5}$

(A) 8.0×10^{-6} M (B) 6.4×10^{-10} (C) 4.0×10^{-3} M
(D) 5.3×10^{-3} M (E) 2.8×10^{-3} M

29. When solid ammonium chloride, $NH_4Cl(s)$ is added to water at 25 °C, it dissolves and the temperature of the solution decreases. Which of the following is true for the values of ΔH and ΔS for the dissolving process?

	ΔH	ΔS
(A)	Postive	Positive
(B)	Positive	Negative
(C)	Positive	Equal to zero
(D)	Negative	Positive
(E)	Negative	Negative

30. Which of the following measurements shows good precision & bad accuracy, if the actual scientific value is 3.74 cm?

(A) 2.75 cm, 3.75 cm , 4.05 cm (B) 3.76 cm, 3.76 cm, 3.75 cm
(C) 4.02 cm, 4.02 cm, 4.01 cm (D) 4.52 cm. 4.78 cm, 3.01 cm

31. Which liquid is most volatile at 25°C?

(A) butane, C_4H_{10} (B) glycerol, $C_3H_5(OH)_3$ (C) octane, C_8H_{18}
(D) propanol, C_3H_7OH (E) nonane, $C_{10}H_{22}$

32. Which of the following represents the ground state electron configuration for the Mn^{3+} ion?

(A) $1s^2\ 2s^2 2p^6\ 3s^2 3p^6 3d^3\ 4s^1$ (B) $1s^2\ 2s^2 2p^6\ 3s^2 3p^6 3d^5\ 4s^2$ (C) $1s^2\ 2s^2 2p^6\ 3s^2 3p^6 3d^2\ 4s^2$
(D) $1s^2\ 2s^2 2p^6\ 3s^2 3p^6 3d^8\ 4s^2$ (E) $1s^2\ 2s^2 2p^6\ 3s^2 3p^6 3d^4$

33. How many significant figures are there in 0.0090290 m?

(A) 5 (B) 3 (C) 7 (D) 8

34. $2H_2 + O_2 \rightarrow 2H_2O$ – How many moles of water can be produced from 40.0 grams of H_2 and excess O_2?

(A) 10. moles (B) 640 moles (C) 20. moles (D) 40. moles (E) none of the above

35. When LiF is formed from its elements there are five steps. Which of the following steps is NOT endothermic?

I. Step 1: Sublimation of solid lithium. $Li(s) \rightarrow Li(g)$
II. Step 2: Ionization of lithium atom. $Li(g) \rightarrow Li^+(g) + e^-$
III . Step 4: Formation of fluoride ions. $F(g) + e^- \rightarrow F^-(g)$

(A) II only (B) II only (C) I and II only (D) II and III only (E) III only

36. If an endothermic reaction is spontaneous at 298 K, which of the following must be true for the reaction?

I. ΔG is greater than zero II. ΔH is greater than zero. III. ΔS is greater than zero

(A) I only (B) II only (C) I & II only (D) II & III only (E) I ,II & III

37. Which of the following has the largest value for the second ionization energy?

(A) sodium (B) chlorine (C) sulfur (D) aluminum (E) magnesium

38. In which of the following are the elements listed in order of increasing Electronegativity?

(A) Ba, Zn, C, Cl (B) N, O, S, Cl (C) N, P, As, Sb
(D) K, Ba, Si, Ga (E) Li, K, Na, Ca

39. $2Al + 3S \rightarrow Al_2S_3$ - Aluminum reacts with sulfur to produce aluminum sulfide. If I have 91 grams of Al and 55 grams of S, what is my limiting reagent?

(A) Al_2S_3 (B) Al (C) S (D) both Al & S (E) can't be determined

40. A sample of neon gas has a volume of 333 mL at 30.°C and a certain pressure. What volume would it occupy if it were heated to 60.°C at the same pressure?

(A) 399 mL (B) 366 mL (C) 333 mL (D) 666 mL (E) 167 mL

41. An aqueous 1.0 m $CaCl_2$ solution has a density of 1.05. Determine the molarity of the solution.

(A) 2.84 M (B) 8.57M (C) 0.945 M (D) 10.0 M (E) 0.857 M

42. For the types of radiation given, which of the following is the correct order of increasing ability to penetrate a piece of lead?

(A) Alpha particles < gamma rays < beta particles (B) Alpha particles < beta particles < gamma rays
(C) Beta particles < alpha particles < gamma rays (D) Beta particles < gamma rays < alpha particles
(E) Gamma rays < alpha particles < beta particles

43. Sublimation is an example of an:

(A) exothermic chemical change (B) endothermic physical change
(C) endothermic chemical change (D) exothermic physical change

44. Which set of quantum numbers (n, l, ml, ms) is NOT permitted by the rules of quantum mechanics?

(A) 1, 0, 0, +½ (B) 2, 1, –1, –½ (C) 3, 3, 1, –½ (D) 4, 3, 2, +½ (E) 4, 1, -1, +½

45. $4HCl + O_2 \rightarrow 2H_2O + 2Cl_2$ – How many moles of H_2O can be produced from 30. moles of HCl?

(A) 7.5 moles (B) 15 moles (C) 30. moles (D) 60. moles (E) none of the above

46. Which of the following would likely have the highest melting point?

(A) LiCl (B) LiF (C) NaCl (D) NaF (E) KF

47. As the temperature is raised from 25°C to 75°C, the average kinetic energy of neon atoms changes by a factor of

(A) ⅓ (B) $(348/298)^{1/3}$ (C) 348/298 (D) 3 (E) 9

48. How many sulfate ions are there in 111 grams of aluminum sulfate?

(A) 1.95×10^{23} (B) 3.90×10^{23} (C) 5.86×10^{23} (D) 2.98×10^{24} (E) none of the above

49. The bonding in carbon monosulfide consists of:

(A) 1 sigma bond and 2 pi bonds (B) 2 sigma bonds and 1 pi bond
(C) 3 sigma bonds (D) 3 pi bonds (E) 1 sigma and 1 pi bond

50. $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ - Using 42.0 grams of methane Lisa was able to produce 56.0 grams of water. Calculate her percent yield?

(A) 44.4% (B) 59.3% (C) 94.5% (D) 75.0% (E) none of the above