Test A5

Name _____ Chemistry 11100

Section _____ FINAL EXAM Total Points = 300

TA _____ Wednesday, 8:00 AM

December 12, 2012

Directions:

1. Each student is responsible for following directions. Read this page carefully.

2. Write your name and other requested information on this page and on the separate answer sheet.

3. CODE your name on the answer sheet using an ordinary (#2) pencil.

4. CODE your correct *10-digit* identification number (PUID) on the answer sheet. THIS IS VERY IMPORTANT!

5. CODE your section number on the answer sheet. Please use all four digits, 0034, 0035, 0036, etc. This is also very important!

6. CODE the test number shown in the upper right-hand corner on the answer sheet in the block labeled "Test/Quiz Number". This is Test A5.

7. Put all calculations on the examination pages. DO NOT PUT ANY EXTRA MARKS ON THE COMPUTER ANSWER SHEET!

8. This exam consists of 43 multiple-choice questions worth 6.97 points each. Choose the one best or correct answer for each question and write it both on your exam paper and on the computer answer sheet. The computer answer sheet is the only one that will be graded!

9. This exam consists of 13 pages plus a page of Useful Information, Solubility Rules, a Periodic Table and a sheet of scratch paper. Please check to be sure that you have them all!

END OF EXAM

1) Please make sure that you have entered 43 answers on your scan sheet.

2) Make sure that you have entered your name, ID number, and lab section number (4 digits).

3) You MUST turn the scan sheet in to your TA before leaving the exam!

KEEP YOUR ANSWERS AND WORK COVERED TO PROTECT
THE INTEGRITY OF YOUR WORK!!

_____ 1. Convert 0.458 kg to mg.

(a) 4.58×10^{-3} mg
(b) 4.58×10^{1} mg
(c) 4.58×10^{4} mg
(d) 4.58×10^{5} mg
(e) 4.58×10^{6} mg

_____ 2. Naturally occurring copper consists of copper-63 (62.9296 amu), and copper-65 (64.9278 amu). Using the relative atomic mass from the periodic table, which of the following is the **best estimate** of the percent abundance of the two isotopes of copper?

(a) 10% copper-63 and 90% copper-65
(b) 25% copper-63 and 75% copper-65
(c) 50% copper-63 and 50% copper-65
(d) 75% copper-63 and 25% copper-65
(e) 90% copper-63 and 10% copper-65

_____ 3. Which set of ions is formed when $(NH_4)_2CO_3$ dissolves in water?

(a) 2 NH_4^+ , 1 CO_3^{2-}
(b) 1 $(NH_4)_2$, 1 CO_3
(c) 1 $(NH_4)_2^+$, 1 CO_3^-
(d) 2 N^{3-}, 8 H^+, and 1 CO_3^{2-}
(e) 2 NH_4^+, CO_3^-

_____ 4. What is the formula for phosphoric acid?

(a) H_2PO_4
(b) H_2PO_3
(c) H_3PO_4
(d) H_3PO_3
(e) H_4PO_4

_____ 5. In lab you measure the mass of a metal sample and find it to be 39.22 g. You place it in a graduated cylinder and the water level rises from 15.50 mL to 21.00 mL. What is the density of the solid?

(a) 1.87 g/mL
(b) 2.53 g/mL
(c) 6.53 g/mL
(d) 7.13 g/mL

_____ 6. Which of the following best describes HCl when dissolved in water?

(a) strong electrolyte
(b) weak electrolyte
(c) nonelectrolyte
(d) HCl does not dissolve in water

_____ 7. Which set of formulas is correct for the compounds ammonia, nitric acid, and nitrous acid, respectively?

(a) NH_3, HN, HNO
(b) NH_4, HNO_2, HNO_3
(c) NH_3, HNO_2, HNO_3
(d) NH_3, HNO_3, HNO_2
(e) NH_4, HNO_3, HNO_2

_____ 8. How many sodium ions are in 125 g of Na_2SO_4?

(a) 1.06×10^{24} Na^+ ions
(b) 5.30×10^{23} Na^+ ions
(c) 1.37×10^{24} Na^+ ions
(d) 1.76 Na^+ ions
(e) 1.46×10^{-24} Na^+ ions

_____ 9. Aluminum reacts with nitric acid according to the following balanced chemical equation. How many moles of hydrogen gas can be produced from 8 moles of aluminum? (Al = 26.98 g/mole; HNO_3 = 63.09 g/mole; H_2 = 2.016 g/mol)

$$2\ Al(s) + 6\ HNO_3\ (aq) \rightarrow 2\ Al(NO_3)_3\ (aq) + 3\ H_2\ (g)$$

(a) 8
(b) 12
(c) 18
(d) 24

_____ 10. _____ ion is an example of a polyatomic anion.

(a) calcium
(b) oxide
(c) carbonate
(d) ammonium
(e) chloride

_____ 11. Molarity is defined as

(a) grams of solute per liter of solution.
(b) moles of solvent per liter of solvent.
(c) moles of solvent per liter of solute.
(d) moles of solute per liter of solvent.
(e) moles of solute per liter of solution.

_____ 12. A 200.0 g sample of river water contains 6.50 mg of lead. How many parts per million (ppm) of lead are in the sample?

(a) 3.25×10^{-2} ppm
(b) 6.50 ppm
(c) 21 ppm
(d) 32.5 ppm

_____ 13. In the chemical equation shown below, what do the coefficients mean?

$$H_2 + I_2 \rightarrow 2\ HI$$

(a) 1 mole of hydrogen reacts with 1 mole of iodine to give 2 moles of hydrogen iodide.
(b) 1 atom of hydrogen reacts with 1 atom of iodine to give 2 molecules of hydrogen iodide.
(c) 1 molecule of hydrogen reacts with 1 molecule of iodine to give 2 molecules of hydrogen iodide.
(d) All of the above answers, (a), (b), and (c), are correct.
(e) Only (a) and (c) are correct.

_____ 14. Nitrogen triiodide decomposes to give nitrogen and iodine according to the following balanced equation.

$$2NI_3\ (s) \rightarrow N_2\ (g) + 3I_2\ (s)$$

How many grams of reactant, NI_3, would be required to produce 2.53 g iodine?
(NI_3 = 394.71 g/mol; N_2 = 28.02 g/mole; I_2 = 253.8 g/mole)

(a) 1.63 g
(b) 2.62 g
(c) 3.93 g
(d) 5.90 g

_____ 15. The correct answer for the addition 102.5 mL + 6.57 mL is: (considering significant figures)

(a) 109.07 mL
(b) 109 mL
(c) 109.0 mL
(d) 109.1 mL

_____ 16. If the temperature of water in a freezer decreases from 22°C to –25°C, what is the decrease in temperature in units of degrees Celsius and Kelvin?

(a) 47°C, 320 K
(b) 47°C, 273 K
(c) 47°C, 47 K
(d) 3°C, 276 K
(e) 3°C, 3 K

_____ 17. What is the parent structure (electron geometry) of phosphine, PH_3?

(a) Tetrahedral
(b) Trigonal pyramidal
(c) Bent
(d) Trigonal planar

_____ 18. What is the abbreviated electron configuration for the bromide ion?

(a) [Ar]
(b) [Kr]
(c) [Ar] $3s^2\ 3p^6$
(d) [Ar] $4s^2\ 4p^5$
(e) [Ar] $4s^2 3d^{10}\ 4p^5$

_____ 19. Calcium carbonate, $CaCO_3$, is often used in commercial antacids. It acts to reduce the acidity in the stomach by neutralizing stomach acid, which is mostly HCl, by the following reaction:

$$CaCO_3\ (s) + 2\ HCl\ (aq) \rightarrow CaCl_2\ (aq) + CO_2\ (g) + H_2O\ (l)$$

What mass of $CaCO_3$ is needed to neutralize 0.0550 mol HCl? ($CaCO_3$ = 100.09 g/mole; HCl = 36.461 g/mol)

(a) 17.55×10^{-2} g
(b) 2.75 g
(c) 5.50 g
(d) 11.0 g

_____ 20. When comparing a 10.00 g sample of iron (Fe) with a 10.00 g sample of lead (Pb) what is true?

(a) Each sample has the same number of atoms.
(b) There are more iron atoms than lead atoms.
(c) There are more lead atoms than iron atoms.
(d) The lead is heavier than the iron, and therefore there would be more atoms.

_____ 21. Which set of elements below contains, respectively, an alkaline earth metal, a noble gas, and a metalloid?

(a) Na, Ar, Si
(b) Ba, O, As
(c) Ti, Cl, Pb
(d) Bi, Kr, B
(e) Mg, Ne, Ge

_____ 22. Which combination of formula and name is **incorrect**?

(a) K^+ = potassium ion
(b) I^- = iodide ion
(c) Mg^+ = magnesium ion
(d) S^{2-} = sulfide ion
(e) N^{3-} = nitride ion

_____ 23. For each of the following pairs of ions, indicate which pair would form a precipitate when solutions containing these ions are mixed.

(a) Fe^{2+} and I^{-}
(b) Ag^{+} and NO_3^{-}
(c) Na^{+} and SO_4^{2-}
(d) K^{+} and OH^{-}
(e) Ca^{2+} and CO_3^{2-}

_____ 24. Iron and oxygen react to form iron(III) oxide.

$$4\ Fe\ (s) + 3\ O_2\ (g) \rightarrow 2\ Fe_2O_3\ (s)$$

What is the limiting reactant in a mixture of 6.0 moles of Fe and 6.0 moles of O_2?

(a) O_2
(b) Fe
(c) Fe_2O_3
(d) Impossible to determine

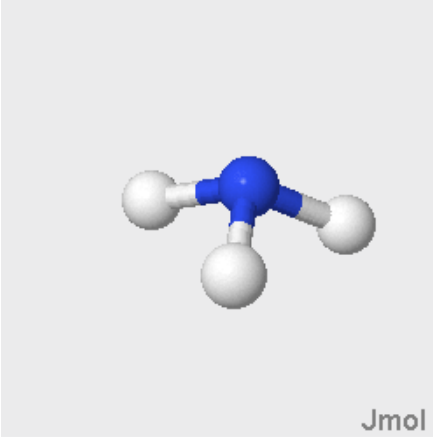
_____ 25. 20.0 g NH_3 and 20.0 g CO_2 were reacted according to the following balanced chemical equation.

$$2\ NH_3 + CO_2 \rightarrow CH_4N_2O + H_2O$$

How many grams of urea (CH_4N_2O) are produced?
(NH_3 = 17.034 g/mole; CO_2 = 44.01 g/mole; CH_4N_2O = 60.062 g/mole)

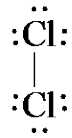
(a) 27.3 g
(b) 35.3 g
(c) 62.6 g
(d) 70.5 g

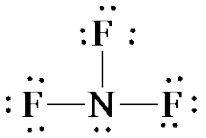
_____ 26. What is the molecular shape of the species below that has 3 bonded atoms and 1 unshared pair of electrons?

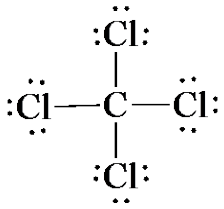


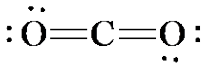
(a) octahedral
(b) trigonal bipyramidal
(c) trigonal pyramidal
(d) tetrahedral
(e) trigonal planar

_____ 27. Which of the following molecules is polar?

A 

B 

C 

D 

_____ 28. The frequency of microwave radiation in a common microwave oven that you might have in your kitchen is $2.46 \times 10^{9}\ s^{-1}$. What is the wavelength of this radiation?

(a) 1.20×10^{17} m
(b) 7.38×10^{17} m
(c) 1.22×10^{-1} m
(d) 3.00×10^{8} m
(e) 2.46×10^{9} m

_____ 29. Dissolving calcium chloride in water is an exothermic process. Which of the following statements is correct about the temperature of the resulting calcium chloride solution?

(a) The temperature of the resulting solution will be lower than the initial temperature of the pure water.
(b) The temperature of the resulting solution will be higher than the initial temperature of the pure water.
(c) The temperature of the resulting solution will be the same as the initial temperature of the pure water.
(d) The temperature of the water is not dependent on what is dissolved in it.
(e) There is not enough information about this process to determine how the temperature will change.

_____ 30. Mixing a solution of lithium sulfate with a solution of barium chloride results in the formation of solid, white barium sulfate, as shown in the equation below. What is the net ionic equation for this reaction?

$$Li_2SO_4(aq) + BaCl_2(aq) \rightarrow 2\ LiCl(aq) + BaSO_4(s)$$

(a) $Li_2SO_4(aq) + BaCl_2(aq) \rightarrow 2\ LiCl(aq) + BaSO_4(s)$
(b) $2\ Li^+(aq) + SO_4^{2-}(aq) + Ba^{2+}(aq) + 2\ Cl^-(aq) \rightarrow 2\ Li^+(aq) + 2\ Cl^-(aq) + Ba^{2+}(s) + 2\ SO_4^{2-}(s)$
(c) $2\ Li^+(aq) + SO_4^{2-}(aq) + Ba^{2+}(aq) + 2\ Cl^-(aq) \rightarrow 2\ Li^+(aq) + 2\ Cl^-(aq) + BaSO_4(s)$
(d) $Ba^{2+}(aq) + SO_4^{2-}(aq) \rightarrow BaSO_4(s)$
(e) $Li^+(aq) + Cl^-(aq) \rightarrow LiCl(aq)$

_____ 31. A compound has a melting point of 545 ^oC and dissolves well in water. What true about about the bonding in the compound and the reasoning to support this conclusion?

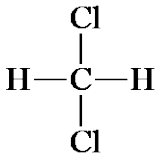
(a) It is ionic because it has a high melting point and dissolves in water.
(b) It is covalent because it has a high melting point and dissolves in water.
(c) It is ionic because it has a low melting point and is insoluble in water.
(d) It is covalent because it has a low melting point and is insoluble in water.

_____ 32. Identify the most polar bond.

(a) O-Cl
(b) C-Cl
(c) H-Cl
(d) Cl-Cl

_____ 33. Identify the correct Lewis structure for CH_2Cl_2.

A



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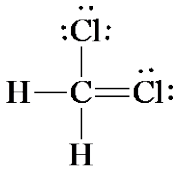

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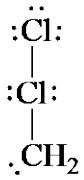

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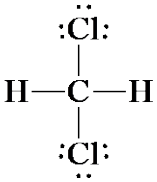


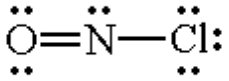
_____ 34. Copper metal dissolves in dilute nitric acid HNO_3 according to the following equation:

$$3Cu_{(s)} + 8HNO_{3(aq)} \rightarrow 3Cu(NO_3)_{2(aq)} + 2NO_{(g)} + 4H_2O_{(aq)}$$

How many grams of NO(g) can be produced from 10.0 grams of Cu?

(a) 7.08 g
(b) 4.72 g
(c) 3.15 g
(d) 0.105 g

_____ 35. Indicate the parent structure (electron geometry) and the molecular shape of the species below.



	Parent Structure or Electron Geometry	Molecular Shape
(a)	Tetrahedral	trigonal pyramidal
(b)	Trigonal planar	trigonal planar
(c)	Trigonal planar	linear
(d)	Linear	linear
(e)	Trigonal planar	bent

_____ 36. Which of the following molecules or ions exhibits resonance?

(a) N_2
(b) O_3
(c) CO_2
(d) SO_3^{2-}

_____ 37. A 25.0 mL sample of an HCl solution is placed in a flask with a few drops of phenolphthalein indicator. This solution is titrated with NaOH. If 32.6 mL of a 0.185 M NaOH solution is needed to reach the end point, what is the concentration of the HCl solution?

(a) 2.41×10^{-4} M
(b) 6.03×10^{-3} M
(c) 0.241 M
(d) 0.142 M

_____ 38. Which molecule, CF_4 or CCl_2F_2, is the most soluble in water and why?

(a) CF_4 because its molar mass is lighter.
(b) CF_4 because it is tetrahedral shaped.
(c) CCl_2F_2 because its molar mass is heavier.
(d) CCl_2F_2 because it is polar.

_____ 39. Among these four ions Mg^{2+}, Na^{+}, F^{-} O^{2-} which has the **smallest** ionic radius and <u>why</u>?

(a) O^{2-} because it has the most electrons.
(b) F^{-} because it is isoelectronic with Ne.
(c) Na^{+} because it has the smallest atomic radius.
(d) Mg^{2+} because it has the greatest number of protons.

_____ 40. Which color of visible light has the most energetic photons?

(a) Red, 650 nm
(b) Yellow, 570 nm
(c) Green, 510 nm
(d) Blue, 475 nm
(e) Violet, 400 nm

_____ 41. What did you determine (or measure) about the wine you analyzed in the "Analysis of Wine" lab?

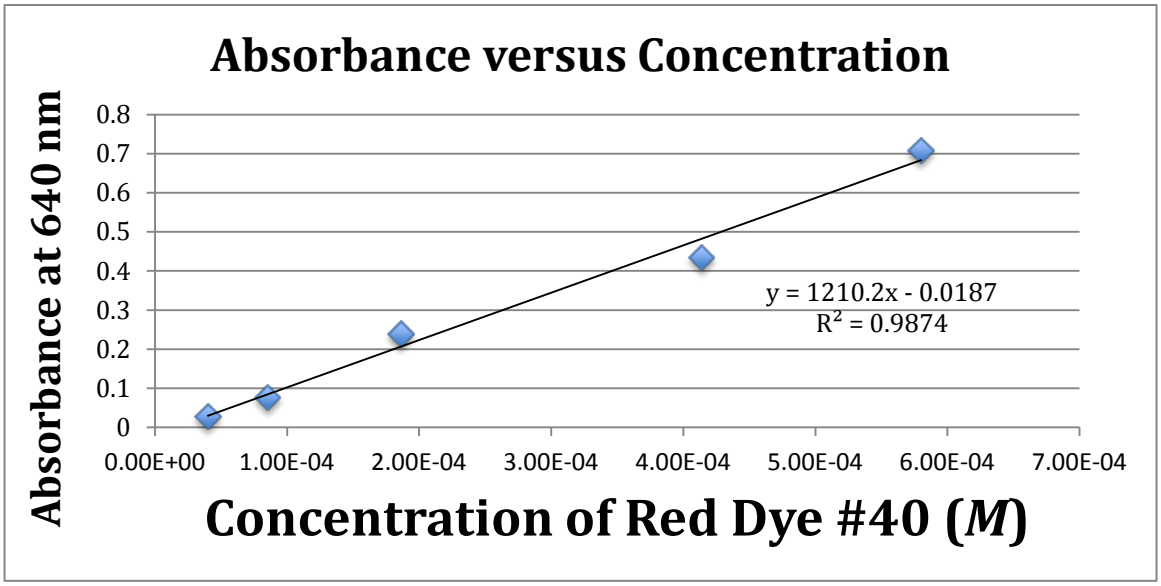
I. pH
II. Alcohol content
III. Acid content (or concentration)
IV. Density
V. Conductivity

(a) I, II, III
(b) I, II, III, IV
(c) I, II, III, IV, V
(d) I, II, III, V

_____ 42. In both the "Analysis of Wine" lab and "Training Lab 2" you performed titrations. In both experiments you added an indicator (phenolphthalein) to the solution in an Erlenmeyer flask which contained an acid. *Why did you add the indicator*?

(a) To buffer the solution.
(b) To identify when all the acid had been neutralized by the base.
(c) To hold the pH of the acid constant.
(d) To measure the initial volume of the acid.

_____ 43. In a lab to determine the concentration of red dye #40 in Purplesaurus Rex Kool-Aid a student made the following calibration curve. The trend line is on the plot.



The absorbance of the Kool-Aid solution was 0.41. What was the concentration of red dye #40 in the solution?

(a) 3.5×10^{-4} M

(b) 3.2×10^{-4} M

(c) 0.41 M

(d) 496 M

Useful Information

$$\% \text{ Error} = \frac{|\text{Actual - Theoretical}|}{\text{Theoretical}} \times 100\%$$

$$\% \text{ Recovery} = \frac{\text{mass of material recovered}}{\text{mass of material started with}} \times 100\%$$

$$\% \text{ Yield} = \frac{\text{Actual}}{\text{Theoretical}} \times 100$$

$$T_K = T_{o_C} + 273.15 \qquad T_{o_F} = 1.8(T_{o_C}) + 32$$

$M_iV_i = M_fV_f$

1 ppm = 1 g/ 1 x 10^6 g = 1 mg/1 L

Avogadro's number: 1 mole = 6.022 x 10^{23} formula units

4.184 J = 1 cal 1000 cal = 1 Cal

$$q = m \times C \times \Delta T$$

$$c = \lambda\nu \qquad E = h\nu = \frac{hc}{\lambda}$$

c = 3 x 10^8 m/s h = 6.626 x 10^{-34} J s

Solubility rules from Table 5.4: Rules used to predict the solubility of ionic compounds.

Ions	Rule
Na^+, K^+, NH_4^+ (and all other alkali metal ions)	Most compounds of alkali metal and ammonium ions are soluble.
NO_3^-, $CH_3CO_2^-$	All nitrates and acetates are soluble.
SO_4^{2-}	Most sulfates are soluble. Exceptions are $BaSO_4$, $SrSO_4$, $PbSO_4$, $CaSO_4$, Hg_2SO_4, and Ag_2SO_4.
Cl^-, Br^-. I^-	Most chlorides, bromides, and iodides are soluble. Exceptions are AgX, Hg_2X_2, PbX_2, and HgI_2 (X = Cl, Br, or I).
Ag^+	Silver compounds except $AgNO_3$ and $AgClO_4$ are insoluble. $AgCH_3CO_2$ is slightly soluble.
O^{2-}, OH^-	Oxides and hydroxides are insoluble. Exceptions are alkali metal hydroxides, $Ba(OH)_2$, $Sr(OH)_2$, and $Ca(OH)_2$ (somewhat soluble)
S^{2-}	Sulfides are insoluble. Exceptions are compounds of Na^+, K^+, NH_4^+, Mg^{2+}, Ca^{2+}, Al^{3+}, and Ni^{2+}
CO_3^{2-}, PO_4^{3-}, SO_3^{2-}	Most carbonates, phosphates, and sulfites are insoluble. Exceptions are compounds of Na^+, K^+, and NH_4^+

Key for A5 and E1

1.) D
2.) D
3.) A
4.) C
5.) D
6.) A
7.) D
8.) A
9.) B
10.) C
11.) E
12.) D
13.) E
14.) B
15.) D
16.) C
17.) A
18.) B
19.) B
20.) B
21.) E
22.) C
23.) E
24.) B
25.) A
26.) C
27.) B
28.) C
29.) B
30.) D
31.) A
32.) C
33.) D
34.) C
35.) E
36.) B or D
37.) C
38.) D
39.) D
40.) E
41.) A
42.) B
43.) A