Name: _____ Date: _____ Period: _____
LTHS: Chemistry

Second Semester Exam Review
Regular Chemistry 2015-2016

Unit 7 – Naming

1. What is the difference between covalent compounds and ionic compounds? How can you identify them?

covalent compounds - 2 non metals (share electrons)
ionic compounds - metal + non metal or contains polyatomic ion (transfer electrons)

2. What are the rules for naming/writing formulas for covalent molecules?

1. Name 1st element
2. Name 2nd element • change ending to -ide
3. Use prefixes to represent no "mono" for 1st element. drop vowel @ the end of the prefix with oxygen

e.g. carbon monoxide

3. What are the rules for naming/writing formulas for an ionic compound?

1. Name 1st element (metal/cation)
2. Name 2nd element (nonmetal/anion)
   • change ending to -ide if its monatomic
3. Use roman numerals with transition metals

eg. NaCl -sodium chloride e.g. $Fe(ClO_3)_3$ iron (III) chlorate

4. When is it appropriate to use roman numerals? What do they represent? How do you determine them? e.g. SnO_2 is Tin (?) oxide

when your metal has a variable charge (more than 1 possible charge)
roman numeral represents the charge of the iron Tin (IV) oxide

5. Write the name for the following compounds:
   a. NO_3 nitrogen trioxide
   b. HCl hydrogen chloride
   c. FeS iron (II) sulfide
   d. BrF_5 bromine pentafluoride
   e. $CoSO_4$ cobalt (II) sulfate
   f. H_2SO_4 hydrogen sulfate
   g. Si_2Br_6 disilicon hexabromide
   h. $CdCl_2$ cadmium chloride

6. Write the formulas for the following:
   a. Potassium sulfide K_2S
   b. Dihydrogen monoxide H_2O
   c. Tin (IV) chloride $SnCl_4$
   d. Calcium oxide CaO
   e. Carbon tetrachloride CCl_4
   f. Aluminum fluoride AlF_3
   g. Iron (III) carbonate $Fe_2(CO_3)_3$

Unit 8 – Chemical and Nuclear Reactions

7. Write a complete balanced equation from the following: Solid zinc is placed in aqueous hydrochloric acid which produces aqueous zinc chloride and hydrogen gas.

$Zn(s) + 2HCl(aq) \longrightarrow ZnCl_2(aq) + H_2(g)$

8. Balance each of the following equations using whole numbers:

a. $\_2\_ H_2O \rightarrow \_2\_ H_2 + \_\_\_\_ O_2$

b. $\_\_\_\_ AgNO_3 + \_\_\_\_ NaCl \rightarrow \_\_\_\_ AgCl + \_\_\_\_ NaNO_3$

c. $\_3\_ MnO_2 + \_4\_ Al \rightarrow \_3\_ Mn + \_2\_ Al_2O_3$

d. $\_16\_ Cr + \_3\_ S_8 \rightarrow \_8\_ Cr_2S_3$

e. $\_2\_ Al + \_3\_ H_2SO_4 \rightarrow \_\_\_\_ Al_2(SO_4)_3 + \_3\_ H_2$

f. $\_\_\_\_ C_6H_{12}O_6 + \_6\_ O_2 \rightarrow \_6\_ CO_2 + \_6\_ H_2O$ + heat

9. Identify the types of reactions for examples a-f in the previous problem.

a. Synthesis
b. double replacement
c. Single replacement
d. Synthesis
e. Single replacement
f. combustion

10. Predict the products, and balance the following reactions. You do NOT need to include state symbols.

a. $\_2\_ Cs(s) + \_\_\_ Br_2(l) \rightarrow 2CsBr$

b. $\_\_\_ K_2SO_4(aq) + \_\_\_ CaCl_2(aq) \rightarrow 2KCl + CaSO_4$

c. $\_2\_ C_2H_2(g) + \_5\_ O_2(g) \rightarrow 4CO_2 + 2H_2O$

11. For each of the following precipitation reactions, complete and balance the equation indicating clearly which product is the insoluble precipitate. If no reaction occurs, state "No Reaction."

a. $Pb(NO_3)_2(aq) + 2NaCl(aq) \rightarrow PbCl_2(s) + 2NaNO_3(aq)$

b. $FeCl_3(aq) + 3KOH(aq) \rightarrow Fe(OH)_3(s) + 3KCl(aq)$

12. Complete the following table distinguishing the different radiation particles.

Name	**Alpha**	Beta	Gamma
Symbol	$^{4}_{2}He^{+2}$	$^{0}_{-1}\beta$ or $^{0}_{-1}e$	$^{0}_{0}\gamma$
Composition	2 protons 2 neutrons	1 electron	pure energy
Charge	+2	−1	0
Stopped by	paper, skin, clothing	aluminum (thin metal)	lead, steel, concrete

13. What is the difference between fission and fusion?

fission - decay when a nucleus splits into smaller parts producing neutrons & gamma rays (chain reaction)

fusion - 2 or more small nuclei collide at high speed to produce a new nucleus

14. Identify the types of radiation and complete the following nuclear reactions.

a. $^{40}_{19}K \rightarrow {}^{40}_{20}Ca + {}^{0}_{-1}e$ — beta decay

b. $^{238}_{92}U \rightarrow {}^{234}_{90}Th + {}^{4}_{2}He + {}^{0}_{0}\gamma$ — alpha + gamma decay

c. $^{14}_{6}C \rightarrow {}^{0}_{-1}e + {}^{14}_{7}N$ — beta decay

15. How are nuclear reactions different from chemical reactions?

matter cannot be created or destroyed in a chemical reaction

atoms change / form / decay in a nuclear reaction

Unit 9 – Stoichiometry

The following questions deal with the following balanced equation for the burning of propane gas:

$$C_3H_8(g) + 5\ O_2(g) \rightarrow 4\ H_2O(g) + 3\ CO_2(g)$$

16. How many moles of CO_2 are produced when 17 moles of O_2 react?

$$17\ mol\ O_2 \times \frac{3\ mol\ CO_2}{5\ mol\ O_2} = 10.\ mol\ CO_2$$

17. How many molecules of C_3H_8 must react to produce 1500.0 g of water?

$$1500.0\ g\ H_2O \times \frac{1\ mol\ H_2O}{18.02\ g\ H_2O} \times \frac{1\ mol\ C_3H_8}{4\ mol\ H_2O} \times \frac{6.022 \times 10^{23}\ molecules}{1\ mol\ C_3H_8}$$

$$= 1.2532 \times 10^{25}\ molecules\ C_3H_8$$

18. If 38.5 grams of oxygen react, how many grams of carbon dioxide are produced?

$$38.5\text{g } O_2 \times \frac{1\text{mol } O_2}{32.00\text{g}} \times \frac{3\text{mol } CO_2}{5\text{mol } O_2} \times \frac{44.01\text{g } CO_2}{1\text{mol } CO_2} = 31.8\text{g } CO_2$$

19. Nitrogen reacts with magnesium to produce magnesium nitride. Write the balanced equation.

$$N_2 + 3Mg \longrightarrow Mg_3N_2$$

a. What is the theoretical yield of when 5.00 g of magnesium is reacted with 25.0 g of nitrogen gas? What is the limiting reactant?

LR →
$$5.00\text{g Mg} \times \frac{1\text{mol Mg}}{24.31\text{g Mg}} \times \frac{1\text{mol } Mg_3N_2}{3\text{mol Mg}} \times \frac{100.95\text{g } Mg_3N_2}{1\text{mol } Mg_3N_2} = \boxed{6.92\text{g } Mg_3N_2}$$ TY

$$25.0\text{g } N_2 \times \frac{1\text{mol } N_2}{28.02\text{g } N_2} \times \frac{1\text{mol } Mg_3N_2}{1\text{mol } N_2} \times \frac{100.95\text{g } Mg_3N_2}{1\text{mol } Mg_3N_2} = 90.06\text{g } Mg_3N_2$$

20. The following questions deal with the following balanced equation for the production of ammonia:

$$N_2 + 3H_2 \rightarrow 2NH_3$$

a. If 14.0 g N_2 is mixed with excess H_2, what is the theoretical yield?

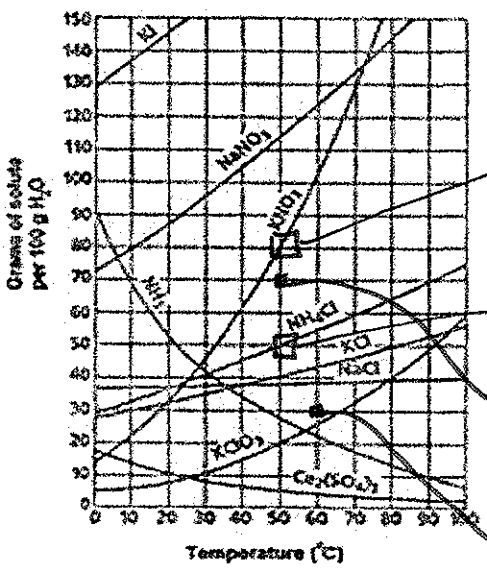
$$14.0\text{g } N_2 \times \frac{1\text{mol } N_2}{28.02\text{g } N_2} \times \frac{2\text{mol } NH_3}{1\text{mol } N_2} \times \frac{17.04\text{g } NH_3}{1\text{mol } NH_3} = 17.0\text{g } NH_3$$

b. What is the percentage yield if 16.1 g NH_3 form?

$$\%\text{ yield} = \frac{\text{actual}}{\text{theoret.}} \times 100 = \frac{16.1}{17.0} \times 100 = 94.6\%$$

Unit 10 – Solutions

Use the solubility curve to answer the following questions.



21. Based on the solubility curve for potassium nitrate, how many grams of the salt will dissolve in 100 g of water at 50°C?

80 g

22. Based on the solubility curve for ammonium chloride how many grams of the salt will dissolve in 200 g of water at 50°C?

$$\frac{50\text{g}}{100\text{g } H_2O} = \frac{x}{200\text{g}}$$ 100g

23. At 50°C and 70 grams of KNO_3, is the solution unsaturated, saturated or supersaturated?

unsaturated

24. Is NH_3 saturated, unsaturated or supersaturated if 60 grams is added to 100 grams of water at 30°C?

Supersaturated

25. What are the characteristics of unsaturated, saturated, and supersaturated? How are they similar or different?

Unsaturated: more solute can be dissolved in given solute

Saturated: solvent has "maximum" amount of solute dissolved

Supersaturated: more solute is dissolved than in a saturated solution
very unstable, will form precipitate if disturbed

26. When two solutions are mixed, and a solid forms and settles out of the mixture, the solid is referred to as a precipitate.

27. On the basis of the Solubility Rules for Ionic Compounds, predict which of the following substances will be soluble in water:
    c. Aluminum chloride - soluble
    d. $BaSO_4$ - insoluble
    e. Iron (III) hydroxide - insoluble
    f. Na_2CO_3 - soluble

28. Describe how polarity affects solubility.
"like dissolves like" polar molecules dissolve polar molecules

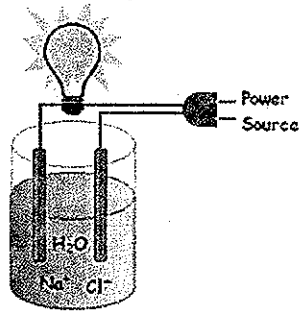
29. Assume liquid A is polar and liquid B is nonpolar for the following questions:
    a. Will liquid A dissolve in water? yes - water is polar
    b. Will liquid B dissolve in water? no -
    c. Will liquid A dissolve in liquid B? no -
    d. A new liquid, liquid C, dissolves in liquid B. Will it dissolve in water?
    no, if it dissolves in B, it must be nonpolar
    so it will not dissolve in polar water

30. Write the solvation equation for NaCl.

$$NaCl(s) \longrightarrow Na^+_{(aq)} + Cl^-_{(aq)}$$

31. What is the difference between a strong and weak electrolyte?
Strong electrolyte - conducts electricity because it completely dissociates into ions.
Weak electrolyte - conducts some electricity only dissociates partially into ions

32. What is the explanation behind why the lightbulb is lit up when placed in a saltwater solution?



Salt dissociates $NaCl_{(s)} \longrightarrow Na^+_{(aq)} + Cl^-_{(aq)}$
Free flowing ions conduct electricity

33. What is the percent by mass of ethanol in a solution that contains 25.05 g of ethanol dissolved in 145.30 g of water?

$\%\text{ mass} = \frac{\text{g solute}}{\text{g solution}} \times 100$ (g solution = solute + solvent)

$\% = \frac{25.05\text{ g}}{(25.05 + 145.30)\text{ g}} \times 100 = 14.71\%$

34. If I wanted to make 250 g of a 8.5% NaCl solution, how many grams of salt would I need to dissolve?

$8.5\% = \frac{x}{250\text{ g}} \times 100 \quad x = 21.25\text{ g} = 21\text{ g NaCl}$

35. If 0.60 mole of NaCl is dissolved in enough water to make 0.50 L of solution, calculate the molarity?

$M = \frac{\text{mol}}{\text{L}} \quad M = \frac{.60\text{ mol}}{.50\text{ L}} = 1.2\text{ M}$

36. How many moles of solute are contained in 250. mL of 3.00 M solution of HCl?

$\frac{x\text{ mol}}{.250\text{ L}} = 3.00\text{ M} \quad x = .750\text{ mol}$

37. How many grams of NaOH are in 10.0 L of a 0.550 M solution of NaOH?

$\frac{x\text{ mol}}{10.0\text{ L}} = .550\text{ M} \quad x = 5.50\text{ mol} \times \frac{40.00\text{ g}}{1\text{ mol}} = 220.\text{ g NaOH}$

38. What volume of 0.25 M $CaCl_2$ solution can be prepared from 0.50 moles of $CaCl_2$?

$.25\text{ M} = \frac{.50\text{ mol}}{\text{L}} \quad \text{L} = 2.0\text{ L}$

39. How does the concentration of a solution change if I triple the volume?

Triple volume → 1/3 concentration

Unit 11 – Equilibrium

40. What is collision theory? What are the requirements for a successful collision?

particles must collide with sufficient energy and correct orientation to react

41. How would each of the following affect the rate of a reaction?
    a. Increasing the temperature — increase reaction rate by increasing energy of collisions
    b. decreasing Surface Area — decrease reaction rate - less particles are on outside
    c. decreasing the Concentration of Reactants — decrease reaction rate - less particles
    d. changing the volume of the reaction — decrease volume → increase reaction rate
    e. Adding a Catalyst — Speeds up reaction rate - lowers activation energy

42. Indicate whether the statements are True or False. CHANGE any false ones to make them true!

a. At equilibrium the amount of products must equal the amount of reactants.

False - rate of forward and reverse reaction must be equal

b. During equilibrium, the concentration of the products does not change.

True

c. A collision between reactants is all that is needed to cause a reaction.

False - must have correct orientation and sufficient energy

d. At the beginning of a reaction the forward reaction is faster than the reverse reaction, but then the forward reaction slows down as the reverse reaction speeds up.

True

43. If Keq > 1, products are favored. If Keq < 1, reactants are favored.

44. Write equilibrium expression for the following reactions:

a. $4NH_3\ (g) + 7O_2\ (g) \leftrightarrow 4NO_2\ (g) + 6H_2O\ (g)$ $K = \frac{[NO_2]^4[H_2O]^6}{[NH_3]^4[O_2]^7}$

* only gas a aqueous No solid No liquid *

b. $NH_4NO_3\ (s) \leftrightarrow N_2O\ (g) + 2H_2O\ (g)$ $K = [N_2O][H_2O]^2$

c. $SO_3\ (g) + H_2O\ (l) \leftrightarrow H_2SO_4\ (l)$ $K = \frac{1}{[SO_3]}$

45. For the reaction, $N_2\ (g) + O_2\ (g) \leftrightarrow 2NO\ (g)$ at a certain temperature the equilibrium concentrations are found to be $[N_2] = 0.041$ M, $[O_2] = 0.0078$ M, and $[NO] = 4.7 \times 10\text{-}4$ M. Calculate K for the reaction.

$K = \frac{[NO]^2}{[N_2][O_2]} = \frac{(4.7\times10^{-4})^2}{(.041)(.0078)} = 6.9\times10^{-4}$

46. For the equilibrium system $PCl_{5(g)} \leftrightarrow PCl_{3(g)} + Cl_{2(g)}$, Keq = 15. If the concentrations of PCl_5 and PCl_3 are 0.045M and 0.35M respectively, what is the concentration of the Cl_2?

$K = \frac{[PCl_3][Cl_2]}{[PCl_5]}$ $15 = \frac{0.35\ [Cl_2]}{0.045}$ $[Cl_2] = 19$ M

47. What factors can change the value of K?

only temperature, shift right K ↑, shift left K ↓

48. What is Le Chatelier's Principle?

If stress is applied to a system at equilibrium, it will shift the equilibrium position to reduce the stress

49. For the reaction, heat + N_2O_4 (g) ↔ $2NO_2$ (g) use Le Châtelier's Principle to predict shift (left or right) in the equilibrium position for each of the following changes and determine what happens to the [NO_2] (increase, decrease, no change)

	Equilibrium Shift	[NO_2]
Addition of N_2O_4	right	↑
Addition of NO_2	left	↓
Increase volume/ decrease pressure	right	↑
Increase in temperature	right	↑

Unit 12 – Acids and Bases

50. List the properties of acids and bases.

Acid	Base
pH < 7 taste sour $[H_3O^+] > [OH^-]$ proton donor	pH > 7 taste slippery $[H_3O^+] < [OH^-]$ proton acceptor

51. What does pH measure?

level of acidity → concentration of $[H^+]$ ions

52. In each of the following chemical equations, identify the acid-base pairs

a. HNO_3 (aq) + H_2O (l) → H_3O^+(aq) + NO_3^-(aq)
A B CA CB

b. CH_3NH_2 (aq) + HCl (aq) ↔ $CH_3NH_3^+$(aq) + Cl^-(aq)
B A CA CB

c. NH_4^+ (aq) + H_2O (l) ↔ H_3O^+(aq) + NH_3(aq)
A B CA CB

53. What is the difference between strong acids/bases and weak acids/bases.

Strong acids and bases dissociate/ionize completely
weak acids and bases only partially

54. Which of the following reactions represents a strong acid and which is a weak acid? How do you know?

a. HBr (aq) → H+ (aq) + Br -(aq) Strong single arrow
b. HF (aq) ↔ H+ (aq) +F -(aq) weak double arrow

55. Rank the following from strongest to weakest:

Formula	Ka	Formula	Ka
H_2CO_3	4.5 x 10-7	HClO	3.0 x 10-8
$HC_2H_3O_2$	1.8 x 10-5	HF	6.8 x 10-4

HF , $HC_2H_3O_2$, H_2CO_3, HClO

56. Write the conjugate bases for the 4 acids in the previous problem.

HCO_3^- , $C_2H_3O_2^-$, ClO^- , F^-

57. Write the Ka expression for the dissociation of H_2CO_3:

$H_2CO_3\ (aq) + H_2O\ (l) \leftrightarrow H_3O^+(aq) + HCO_3^-\ (aq)$

$K_a = \frac{[H_3O^+][HCO_3^-]}{[H_2CO_3]}$

58. For pure water at 25°C, Kw = 1.0×10^{-14}.

59. For every change in pH of 1, how much does the $[H_3O^+]$ change?

10x change in $[H_3O^+]$

60. Rank the following solutions from the most acidic to most basic?

a. $[H^+] = 0.00015$ M — pH = 3.82
b. $[OH^-] = 1.04 \times 10\text{-}12$ M — pH = 2.017
c. $[OH^-] = 4.39 \times 10\text{-}5$ M — pH = 9.642
d. $[H^+] = 4.29 \times 10\text{-}11$ M — pH = 10.368

b, a, c, d

61. Calculate [H+] in each of the following solutions and indicate whether the solution is acidic, basic or neutral:

a. $[OH^-] = 3.99 \times 10^{-5}$M > $[H^+] = 2.51 \times 10^{-10}$ M Base
b. $[OH^-] = 2.91 \times 10^{-9}$M < $[H^+] = 3.44 \times 10^{-6}$ M Acid

62. Calculate [OH-] in each of the following solutions and indicate whether the solution is acidic, basic or neutral:

a. $[H^+] = 1.27 \times 10^{-3}$M — pH = 2.896 — $[OH^-] = 7.87 \times 10^{-12}$ M Acid
b. $[H^+] = 4.49 \times 10^{-8}$M — pH = 7.348 — $[OH^-] = 2.23 \times 10^{-7}$ M Base

63. Calculate the pH in each of the following solutions and indicate whether the solution is acidic, basic or neutral:

a. $[H^+] = 0.00100$ M — pH = 3.000 acid
b. $[H^+] = 9.18 \times 10\text{-}11$M — pH = 10.037 base

64. Calculate $[H^+]$ in each of the following solutions and indicate whether the solution is acidic, basic or neutral:

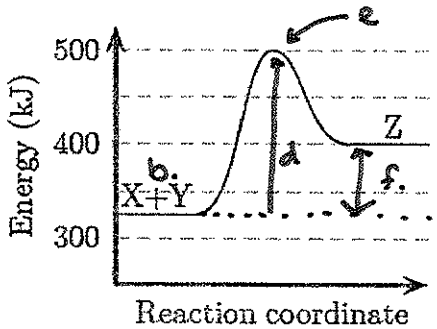
a. pH = 4.11 — $[H^+] = 7.8 \times 10^{-5}$ M Acid
b. pH = 13.21 — $[H^+] = 6.2 \times 10^{-14}$ M Base

65. Complete the following table

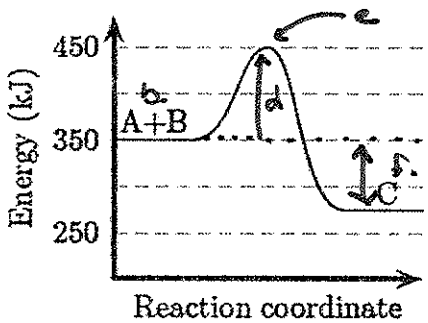
	$[H_3O^+]$	$[OH^-]$	pH	pOH	Acid, Base or Neutral
0.025 M HNO_3	.025	4.0×10^{-13}	1.60	12.40	Acid
0.00150 M NaOH	6.67×10^{-12}	.00150	11.176	2.824	Base

Unit 13 – Thermochemistry

66. Label the following on the diagrams below
    a. Exothermic or endothermic
    b. Energy of reactants
    c. Energy of products
    d. Activation energy
    e. Activated complex
    f. ΔH



endothermic



exothermic

67. Calculate the ΔH of each reaction above. What does the ΔH tell you about each reaction?

~75 kJ -75 kJ

ΔH is amount of energy absorbed or released

68. If a reaction is exothermic, then:
    a. is the ΔH negative or positive? negative
    b. energy should be included on the right side or the left side of the balanced equation? right
    c. energy is absorbed or produced by the reaction? ~~absorbed~~ released

69. If a reaction is endothermic, then:
    a. is the ΔH negative or positive? positive
    b. energy should be included on the right side or the left side of the balanced equation? left
    c. energy is absorbed or produced by the reaction? absorbed

70. Use the following balanced equation for the burning of propane gas:
$C_3H_8\ (g) + 5\ O_2\ (g) \rightarrow 4\ H_2O\ (g) + 3\ CO_2\ (g)\ \Delta H = -2043\ kJ/mol$

a. If 350 grams of propane burn, how much heat energy is produced?

$$350g\ C_3H_8 \times \frac{1mol\ C_3H_8}{44.11g} \times \frac{-2043kJ}{1mol\ C_3H_8} = -14,859 = -15,000\ kJ$$

b. In order the produce 10,000.0 kJ of energy, how many grams of oxygen must react?

$$-10,000kJ \times \frac{5mol\ O_2}{-2043kJ} \times \frac{32.00g\ O_2}{1mol\ O_2} = 783.2g\ O_2$$

71. How many joules of energy are required to raise the temperature of 125 g of water from 25.0°C to 99°C?

$q = mS\Delta T$

$q = ?$
$m = 125g$
$S = 4.184J/g\cdot°C$
$\Delta T = 99 - 25 = 74°C$

$q = 125g \times 4.184J/g°C \times 74°C$
$= 38,702J$
$= 39,000\ J$

72. A 29.87 gram piece of Titanium absorbs 79.89 J of heat. If the metal starts out at 64.6°C, what is the final temperature of the metal? (Specific heat of titanium is 0.52 J/g°C)

$q = 79.89J$
$m = 29.87g$
$S = .52J/g°C$
$\Delta T = ?$

$$\Delta T = \frac{q}{mS} = \frac{79.89J}{29.87g \times .52J/g°C} = 5.1°C$$

$\Delta T = T_f - T_i$
$5.1°C = T_f - 64.6°C$
$T_f = 69.7°C$

73. A 36.75 g sample of an unknown solid is heated to 84.3°C and placed into a calorimeter containing 43.83 g of water at 33.7°C. If the final temperature of the solid sample and water is 36.3°C, what is the specific heat of the solid?

$q_{sur} = -q_{sys}$

m 43.83g m 36.75
S 4.184J/g°C S x
ΔT 36.3 − 33.7 = 2.6 ΔT 36.3 − 84.3 = −48.0°C

$$S = \frac{43.83g \times 4.184J/g°C \times 2.6°C}{-36.75 \times -48.0°C} = .27\ J/g°C$$

74. An unknown mass of water at ~~28.3~~ 28.3°C is mixed with 57.5 g of ethanol at 64.0°C. The final temperature of the mixture is 45.8°C. The specific heat of water and ethanol is 4.184 J/g°C and 2.44 J/g°C respectively. What is the mass of water?

$q_{sur} = -q_{sys}$

m x
S 4.184J/g°C
ΔT 45.8 − 28.3 = 17.5°C

m 57.5g
S 2.44J/g°C
ΔT 45.8 − 64.0 = −18.2

$$m = \frac{57.5g \times 2.44J/g°C \times -18.2°C}{-4.184J/g°C \times 17.5°C} = 34.9\ g\ H_2O$$