

Spring 2015 Honors Chemistry Final Review Key

Scientific Method

- observation - act of noticing
- hypothesis - testable explanation of observation
- experiment - step-by-step procedure to test the hypothesis
 - dependent variable - items affected by any changes to the ind. variable
 - independent variable - item being tested
 - controls - items held constant, so they don't affect the experiment
- data/analysis
 - data - information gathered during an experiment, can be quantitative (numbers & measurements) or qualitative (descriptions)
 - analysis - interpret the data & draw conclusions
- theory or scientific law
 - theory - explanation of how phenomena occur
 - law - explanation of what phenomena occurs

1. a) observation - honeybee colonies are dying
b) hypothesis - a pathogen is believed to be killing the colonies
c) set up several (perhaps 6) healthy honeybee colonies. Each should have the same number and type of bee and kept in the same environmental conditions but separate from each other. Introduce the pathogen to half of the colonies and observe.
d) If the pathogen hypothesis is supported, then those colonies that were infected would die while the three colonies without the pathogen would be healthy
e) If the hypothesis is not supported, then either all colonies would be dead or all would be healthy.

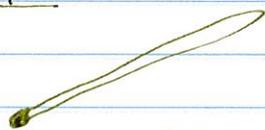
2. Lab safety

- Loose clothing/dangling jewelry can either knock over glassware or become contaminated in chemicals
- Wear goggles so that no chemicals get into eyes.
- Wear closed toe shoes so that spilled chemicals do not get on your skin or broken glass does not cut your foot.
- Do not eat/drink in lab because food can get contaminated by chemicals
- Do not play in the lab because you can knock over/spill chemicals.

3. Lab Equipment



beaker



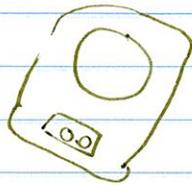
thermometer



funnel



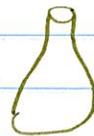
graduated cylinder



electronic balance



Beaker



Erlenmeyer flask

4. Scientific Notation

- $0.00000678\text{ s} \rightarrow 6.78 \times 10^{-6}\text{ s}$
- $19100000\text{ J} \rightarrow 1.91 \times 10^7\text{ J}$
- $0.000546\text{ g} \rightarrow 5.46 \times 10^{-4}\text{ g}$
- $121100000000\text{ }^\circ\text{C} \rightarrow 1.211 \times 10^{10}\text{ }^\circ\text{C}$
- $8.76 \times 10^4\text{ atm} \rightarrow 87600\text{ atm}$
- $3.42 \times 10^{-4}\text{ mol} \rightarrow 0.000342\text{ mol}$

Significant Figures

5. a) $100.0\text{g} \rightarrow 4\text{ s.f.}$
b) $0.5406040\text{m} \rightarrow 7\text{ s.f.}$
c) $0.000005\text{s} \rightarrow 1\text{ s.f.}$
d) $0.0034565400\text{J} \rightarrow 8\text{ s.f.}$

6. a) $100.0\text{g} \rightarrow 100.\text{g}$
b) $0.5406040\text{m} \rightarrow 0.541\text{m}$
c) $0.000005\text{s} \rightarrow 0.00000500\text{s}$
d) $0.0034565400\text{J} \rightarrow 0.00346\text{J}$
- } rounded to
3 sig. figures

7. Nuclear Chemistry

- a) produces elements \rightarrow fusion
b) nuclear reactors \rightarrow fission
c) fuel for stars \rightarrow fusion
d) high temperatures \rightarrow fusion

states of matter

8. (1) liquid (5) solid
(2) gas (6) gas & plasma
(3) solid (7) liquid
(4) plasma

9. a) physical e) physical
b) chemical f) chemical
c) physical g) physical
d) physical h) chemical

10. a) copper - element b) cereal - heterogeneous mix.
c) air - homogeneous mix. d) oxygen - element
e) carbon monoxide - compound e) coffee - homogeneous mix.

11. a) chemical
 b) physical
 c) physical
 d) chemical
 e) physical
 f) physical

12. It's a liquid in your hand.

13. Nomenclature

- a) sodium sulfide \rightarrow Na_2S
 b) $\text{HCl} \rightarrow$ hydrochloric acid
 c) gold (III) fluoride \rightarrow AuF_3
 d) $\text{N}_2\text{O}_5 \rightarrow$ dinitrogen pentoxide
 e) carbonic acid \rightarrow H_2CO_3
 f) $\text{Ca}(\text{NO}_3)_2 \rightarrow$ calcium nitrate
 g) dihydrogen monoxide \rightarrow H_2O
 h) $\text{H}_3\text{PO}_3 \rightarrow$ phosphorous acid
 i) lead (IV) sulfate \rightarrow $\text{Pb}(\text{SO}_4)_2$
 j) $\text{Fe}_2(\text{C}_2\text{O}_4)_3 \rightarrow$ iron (III) oxalate

Chemical Reactions

14. a) $\text{NaCl}(\text{s}) + \text{F}_2(\text{g}) \rightarrow \text{NaF}(\text{s}) + \text{Cl}_2(\text{g})$ single-repl.
 b) $\text{KClO}_3(\text{s}) \rightarrow \text{KCl}(\text{s}) + \text{O}_2(\text{g})$ decomposition
 c) $\text{S}_8(\text{s}) + \text{O}_2(\text{g}) \rightarrow \text{SO}_2(\text{g})$ synthesis
 d) $\text{HCl}(\text{aq}) + \text{CaCO}_3(\text{s}) \rightarrow \text{CaCl}_2(\text{aq}) + \text{H}_2\text{O}(\text{l}) + \text{CO}_2(\text{g})$ double-repl.
 e) $\text{C}_3\text{H}_8(\text{l}) + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{g})$ combustion
15. a) $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightarrow 2\text{NH}_3(\text{g})$ synthesis
 b) $2\text{AlBr}_3(\text{aq}) + 3\text{K}_2\text{SO}_4(\text{aq}) \rightarrow \text{Al}_2(\text{SO}_4)_3(\text{aq}) + 6\text{KBr}(\text{aq})$ double-repl.
 c) $\text{C}_5\text{H}_{12}(\text{l}) + 8\text{O}_2(\text{g}) \rightarrow 5\text{CO}_2(\text{g}) + 6\text{H}_2\text{O}(\text{g})$ combustion
 d) $2\text{Ag}_2\text{O}(\text{s}) \rightarrow 4\text{Ag}(\text{s}) + \text{O}_2(\text{g})$ decomposition
 e) $3\text{Na}(\text{s}) + \text{Fe}(\text{NO}_3)_3(\text{aq}) \rightarrow \text{Fe}(\text{s}) + 3\text{NaNO}_3(\text{aq})$ single-repl.

$$\% \text{element} = \frac{\text{mass element}}{\text{molar mass}} \times 100$$

Moles

17. a) CuBr_2

$$\begin{array}{r} \text{Cu (63.55g)} = 63.55\text{g} \\ 2 \text{ Br (79.90g)} = 159.80\text{g} \\ \hline 223.35\text{g} \end{array}$$

$$\% \text{Cu} = \frac{63.55\text{g}}{223.35\text{g}} \times 100 = 28.45\%$$

$$\% \text{Br} = \frac{159.80\text{g}}{223.35\text{g}} \times 100 = 71.55\%$$

b) $\text{CO}_2(\text{CO}_3)_3$

$$\begin{array}{r} 2 \text{ Co (58.93g)} = 117.86\text{g} \\ 3 \text{ C (12.01g)} = 36.03\text{g} \\ 9 \text{ O (16.00g)} = 144.00\text{g} \\ \hline 297.89\text{g} \end{array}$$

$$\% \text{Co} = \frac{117.86\text{g}}{297.89\text{g}} \times 100 = 39.56\%$$

$$\% \text{C} = \frac{36.03\text{g}}{297.89\text{g}} \times 100 = 12.10\%$$

$$\% \text{O} = \frac{144.00\text{g}}{297.89\text{g}} \times 100 = 48.34\%$$

$$18. \frac{34.5\text{g H}_2\text{O}}{18.02\text{g}} \Big| \frac{1\text{mol}}{18.02\text{g}} = 1.91\text{mol H}_2\text{O}$$

$$19. \frac{.456\text{mol H}_2\text{O}}{1\text{mol}} \Big| \frac{6.02 \times 10^{23} \text{ molec.}}{1\text{mol}} = 2.75 \times 10^{23} \text{ molecules H}_2\text{O}$$

$$20. \frac{21.1\text{g CaCl}_2}{110.98\text{g}} \Big| \frac{1\text{mol}}{110.98\text{g}} = .190\text{mol CaCl}_2$$

$$21. \frac{6.789 \times 10^{22} \text{ f.units CaCl}_2}{6.02 \times 10^{23} \text{ f.units}} \Big| \frac{1\text{mol}}{6.02 \times 10^{23} \text{ f.units}} = .113\text{mol CaCl}_2$$

$$22. \frac{99.99\text{g HNO}_3}{63.02\text{g}} \Big| \frac{1\text{mol}}{63.02\text{g}} \Big| \frac{6.02 \times 10^{23} \text{ f.units}}{1\text{mol}} = 9.52 \times 10^{23} \text{ f.units HNO}_3$$

$$23. \frac{7.87 \times 10^{25} \text{ molec SO}_3}{6.02 \times 10^{23} \text{ molec.}} \Big| \frac{1\text{mol}}{6.02 \times 10^{23} \text{ molec.}} \Big| \frac{80.07\text{g}}{1\text{mol}} = 10500\text{g SO}_3$$

24. a) $C_6H_{14} \rightarrow C_3H_7$ b) C_3H_8
 c) $C_6H_{12}O_6 \rightarrow C_2H_2O$ d) $CO_2(CO_3)_3$

Stoichiometry

26. a) $\frac{21.0 \text{ mol K}}{3 \text{ mol K}} \times 3 \text{ mol KNO}_3 = 21.0 \text{ mol KNO}_3$

b) $\frac{1.50 \text{ mol K}}{3 \text{ mol K}} \times \frac{1 \text{ mol Au}}{1 \text{ mol Au}} \times 196.97 \text{ g Au} =$

c) $\frac{50.00 \text{ g Au(NO}_3)_3}{383.00 \text{ g Au(NO}_3)_3} \times \frac{1 \text{ mol Au(NO}_3)_3}{1 \text{ mol Au(NO}_3)_3} \times \frac{3 \text{ mol KNO}_3}{1 \text{ mol Au(NO}_3)_3} \times \frac{101.11 \text{ g KNO}_3}{1 \text{ mol KNO}_3} = 39.60 \text{ g KNO}_3$

d) $\frac{30.00 \text{ mol K}}{3 \text{ mol K}} \times \frac{1 \text{ mol Au}}{1 \text{ mol Au}} = 10.00 \text{ mol Au}$

$\frac{9.00 \text{ mol Au(NO}_3)_3}{1 \text{ mol Au(NO}_3)_3} \times \frac{1 \text{ mol Au}}{1 \text{ mol Au}} = 9.00 \text{ mol Au}$

e) $\frac{1173 \text{ g K}}{39.10 \text{ g K}} \times \frac{1 \text{ mol K}}{3 \text{ mol K}} \times \frac{1 \text{ mol Au}}{1 \text{ mol Au}} = 10.00 \text{ mol Au}$

$\frac{3447 \text{ g Au(NO}_3)_3}{383.00 \text{ g Au(NO}_3)_3} \times \frac{1 \text{ mol Au(NO}_3)_3}{1 \text{ mol Au(NO}_3)_3} \times \frac{1 \text{ mol Au}}{1 \text{ mol Au}} = 9.00 \text{ mol Au}$

Au(NO₃)₃ is the limiting reactant

Au(NO₃)₃ is the limiting reactant

Atomic Structure

27. Element	Atomic #	Mass #	#protons	#electrons	#neutrons
sulfur	16	32	16	16	$32 - 16 = 16$
cadmium	48	$48 + 64 = 112$	48	48	64
tantalum	73	181	73	73	$181 - 73 = 108$
einsteinium	99	$99 + 153 = 252$	99	99	153

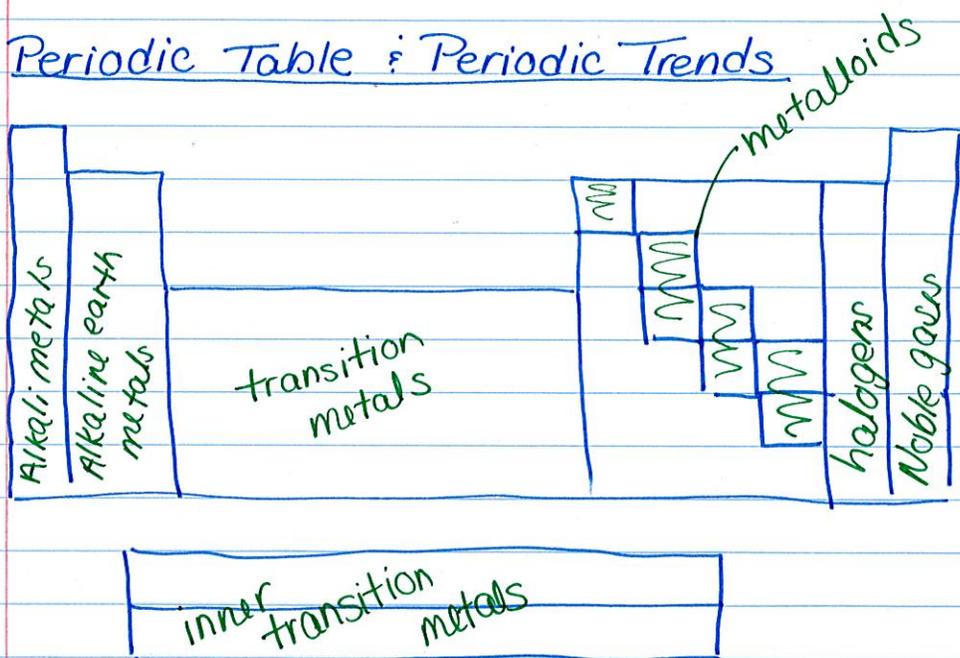
- 28 a) Ti: [Ar] 4s² 3d² or 1s² 2s² 2p⁶ 3s² 3p⁶ 4s² 3d²
 b) Ni: [Ar] 4s² 3d⁸ or 1s² 2s² 2p⁶ 3s² 3p⁶ 4s² 3d⁸
 c) Br: [Ar] 4s² 3d¹⁰ 4p⁵ or 1s² 2s² 2p⁶ 3s² 3p⁶ 4s² 3d¹⁰ 4p⁵
 d) Sr: [Kr] 5s² or 1s² 2s² 2p⁶ 3s² 3p⁶ 4s² 3d¹⁰ 4p⁶ 5s²

Chemical Bonds

29. a) $\text{CO}_2 \rightarrow$ covalent
b) $\text{FeF}_2 \rightarrow$ ionic
c) $\text{NH}_3 \rightarrow$ covalent
d) $\text{CaBr}_2 \rightarrow$ ionic
e) $\text{MgSO}_4 \rightarrow$ covalent + ionic
f) $\text{KC}_2\text{H}_3\text{O}_2 \rightarrow$ covalent + ionic

Periodic Table & Periodic Trends

30.



31. 18 groups \rightarrow vertical columns
32. 7 periods \rightarrow horizontal rows

33. a) $\text{Br} > \text{Ni} > \text{Sc}$
b) $\text{Sc} > \text{Ni} > \text{Br}$
c) $\text{Sc} > \text{Ni} > \text{Br}$
d) $\text{Br} > \text{Ni} > \text{Sc}$

34. a) $\text{F} > \text{Se} > \text{Pb}$
b) $\text{Pb} > \text{Se} > \text{F}$
c) $\text{Pb} > \text{Se} > \text{F}$
d) $\text{F} > \text{Se} > \text{Pb}$

Reaction Rates & Collision Theory

35. a) rate increases
b) rate increases
c) rate decreases
d) rate increases because the catalyst lowers the activation energy needed for the reaction.

Kinetic Molecular Theory: States of Matter

36. a) hot chocolate \rightarrow exothermic
b) hands \rightarrow endothermic

37. exothermic

38. endothermic

39. $q = mc\Delta T$
 $q = 1086.75\text{J}$
 $m = 15.75\text{g}$
 $c = ?$
 $\Delta T = 175^\circ\text{C} - 25^\circ\text{C} = 150^\circ\text{C}$

$1086.75\text{J} = (15.75\text{g})(c)(150^\circ\text{C})$
 $1086.75\text{J} = (2362.5\text{g}^\circ\text{C})(c)$
 $\frac{1086.75\text{J}}{2362.5\text{g}^\circ\text{C}} = c$
 $.46\text{J/g}^\circ\text{C} = c$

40. $q = mc\Delta T$
 $q = ?$
 $m = 2300.\text{g}$
 $c = .90\text{J/g}^\circ\text{C}$
 $\Delta T = 16^\circ\text{C} - 2^\circ\text{C} = 14^\circ\text{C}$

$q = (2300.\text{g})(.90\text{J/g}^\circ\text{C})(14^\circ\text{C})$
 $q = 29,000\text{J}$

41. $q = mc\Delta T$
 $q = ?$
 $m = 454\text{g}$
 $c = .386\text{J/g}^\circ\text{C}$
 $\Delta T = 28.0^\circ\text{C} - 96.0^\circ\text{C} = -68.0^\circ\text{C}$

$q = (454\text{g})(.386\text{J/g}^\circ\text{C})(-68.0^\circ\text{C})$
 $q = -11,900\text{J}$

Solutions

Factors that affect the rate a solute dissolves

4)

1. Temperature - higher temps increase solid solutes kinetic energy, move more
2. Surface Area - larger solute surface can connect to solvent particles more
3. Stirring - makes solute & solvent come into contact more often

42. $M = n/V$

$$n = \frac{15.0 \text{ g Mg(OH)}_2}{58.33 \text{ g/mol}} = .257 \text{ mol}$$

$$M = \frac{.257 \text{ mol}}{.400 \text{ L}} = .643 \text{ M}$$

$$V = 400 \text{ mL} = .400 \text{ L}$$

43. $V = n/M$

$$n = \frac{5.00 \text{ g HCl}}{36.46 \text{ g/mol}} = .137 \text{ mol}$$

$$V = \frac{.137 \text{ mol}}{.76 \text{ mol/L}} = .180 \text{ L}$$

$$M = .76 \text{ M}$$

44. $n = M \cdot V$

$$n = (1.23 \text{ mol/L})(1.00 \text{ L})$$

$$M = 1.23 \text{ M}$$

$$n = 1.23 \text{ mol}$$

$$V = 1.00 \text{ L}$$

$$\frac{1.23 \text{ mol NH}_3}{1 \text{ mol}} \times 17.04 \text{ g} = 21.0 \text{ g NH}_3$$

Colligative Properties

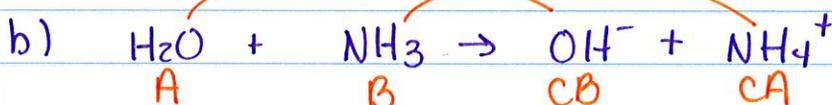
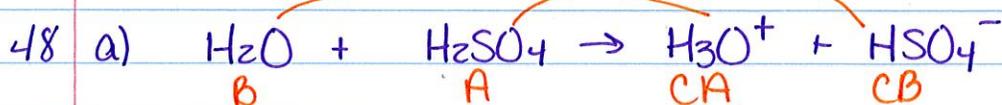
Boiling Pt. Elevation - ... because solute particles interfere with the solvent particles escaping as a gas so higher temperatures are needed to give the solvent particles enough kinetic energy to escape the liquid.

Freezing Pt. Depression - ... because solute particles interfere with the solvent particles from forming a crystal so lower temperatures are needed to force the crystal to form

- 45 a) it will increase
b) it will decrease

Acids and Bases

46. Arrhenius acid - releases H^+
Arrhenius base - releases OH^-
47. Brønsted-Lowry acid - donates H^+
Brønsted-Lowry base - accepts H^+
conjugate acid - what the base becomes after accepting an H^+
conjugate base - what is left over after the acid donates H^+



49. strong acids - dissociate 100% ex) $HI, HCl, HBr, HNO_3, HClO_3, HClO_4, H_2SO_4$
weak acids - dissociate 5%

50 i) $[HBr] = 4.04 \times 10^{-5} M$ $pH = -\log[4.04 \times 10^{-5}] = 4.4$
 $pOH = 14.0 - pH = 14.0 - 4.4 = 9.6$

ii) $[KOH] = 8.88 \times 10^{-8} M$ $pOH = -\log[8.88 \times 10^{-8}] = 7.1$
 $pH = 14.0 - pOH = 14.0 - 7.1 = 6.9$

iii) $M = n/V$ $M = \frac{.714 \text{ mol}}{.500 L} = 1.43 M$
 $n = \frac{45.0 \text{ g } HNO_3}{63.02 \text{ g}} = .714 \text{ mol}$
 $V = 500. \text{ mL} = .500 L$
 $pH = -\log[1.43] = -.16$
 $pOH = 14.0 - pH = 14.0 - -.16 = 14.16$

iv) $M = n/V$ $M = \frac{1.13 \text{ mol}}{.500 L} = 2.25 M$
 $n = \frac{45.0 \text{ g } NaOH}{40.00 \text{ g}} = 1.13 \text{ mol}$
 $V = 500. \text{ mL} = .500 L$
 $pOH = -\log[2.25] = -.35$
 $pH = 14.0 - pOH = 14.0 - -.35 = 14.35$

51. $M_A V_A = M_B V_B$

$$M_A = .85M$$

$$V_A = .0250L$$

$$M_B = .75M$$

$$V_B = ?$$

$$(.85M)(.0250L) = (.75M)(V_B)$$

$$.02125 M \cdot L = (.75M)(V_B)$$

$$\frac{.02125 M \cdot L}{.75M} = V_B$$

$$.028L$$

$$= V_B$$