Chem 2A Semester Review

1. solid ⇌ liquid ⇌ gas
   - solid → liquid: melting
   - liquid → solid: freezing
   - solid → gas: sublimation
   - gas → liquid: condensation
   - liquid → gas: vaporization
   - endothermic →
   - ← exothermic

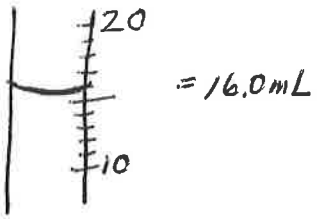
   All physical changes

2. Physical changes DO NOT change identity.
   It is a change in size, form, or state
   melting, vaporization, crushing, tearing, dissolving
   Chemical changes DO change the identity
   Burning, digesting, fermenting, rusting

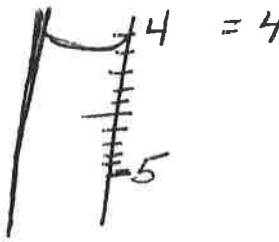
3. a) distillation b) filtering c) crystallization
   These are physical separation techniques.

Chp 2

4. 305.0 = 4 sig figs 0.002 = 1 sig fig
   Always include a decimal place past smallest tick mark



= 16.0mL



= 4.10mL

5. a. $\begin{array}{r} 27 \\ +273 \\ \hline 300 \end{array}$ b. $\begin{array}{r} 300.0 \\ -\ 1.006 \\ \hline 299.0 \end{array}$ c. $(4.6)(0.02) = 0.09$ d. $\frac{430}{3.56} = 120$

   e. $11.8 + 6.02 + 5.005 = 22.8$

6. $D = \frac{m}{V}$ volume = $0.50^3 = 0.125\,cm^3$ $\frac{3.20g}{0.125\,cm^3} = 26\,g/cm^3$
   2 sig figs

7. length = meter mass = kilogram
   ~~Temp~~ = K amount = MOLE

8. No negatives on Kelvin. 0K = absolute zero (no movement)
   K = °C + 273 K − 273 = C

Chp 3

9. proton is + 1amu Neutron 0. 1amu electron - 0amu
   (In nucleus)

10.

$_{15}P^{3-}$ 31	15	15	16	18	31
U-234	92	92	142	92	234

Chp 4

11. $N = 1s^2 2s^2 2p^3$ $K^+ = [Ar]$ or $1s^2 2s^2 2p^6 3s^2 3p^6$

$Cu = 1s^2 2s^2 2p^6 3s^2 3p^6 4s^1 3d^{10}$

$Br^- = 1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6$

$P = 1s^2 2s^2 2p^6 3s^2 3p3$

orbital p 1s 2s 2p 3s 3p K^+ 1s 2s 2p 3s 3p

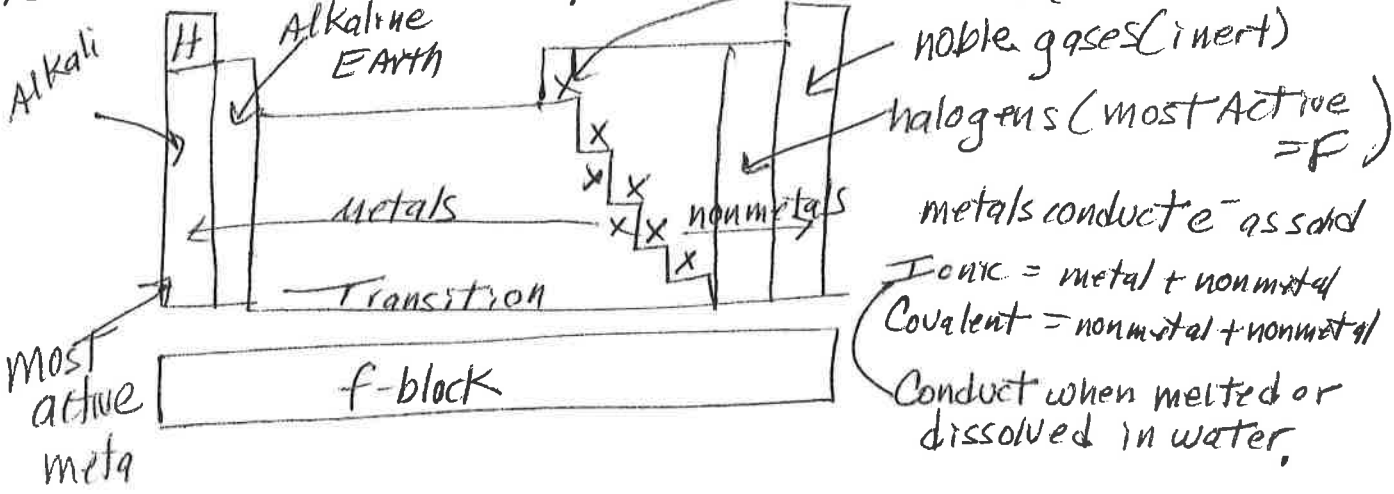
Cr & Cu families want to ½ fill their d sublevel
end in $4s^1 3d^5$ $4s^1 3d^{10}$

3 unpaired electrons in phosphorus

12. $(0.51839)(106.905) + (0.48161)(108.904) = 107.868$ amu

Chp 5

13



14. IA = +1 IIA = +2 IIIA = +3 VA = -3 VIA = -2 VIIA = -1

I & VII I & VI I & V and .....
1:1 2:1 3:1

15. Inc in radius → more protons to pull on cloud
↓ more energy levels

a. Ba b. Cs c. P d. Sr e. I

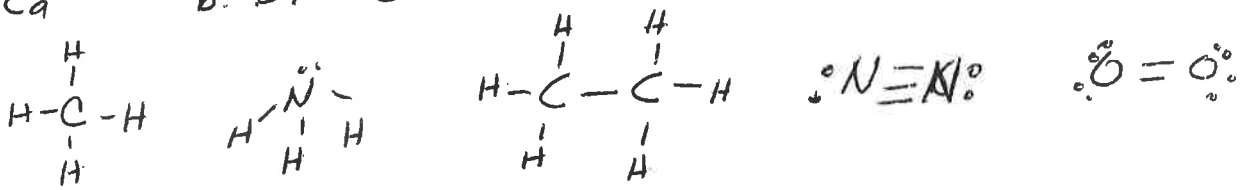
16. Energy to Remove outermost electron. INC Nonmetals don't want to lose electrons → INC

a. Ca b. Ba c. Cl d. Sn e. Br ↑ INC

17. Attraction an atom has to electrons in a bond. Nonmetals have a strong attraction → INC

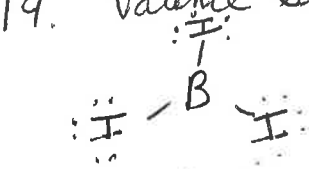
a. Ca b. Ba c. Cl d. Sn e Br

18.

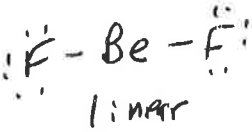


Polar

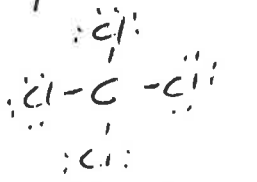
19. Valence shell electron pair repulsion



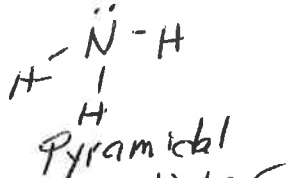
Trigonal planar



linear

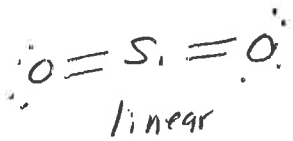


Tetrahedral

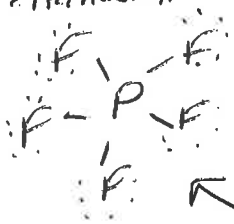


Pyramidal Polar

Polar



linear



bipyramidal

↖ polar bonds / nonpolar

20. Covalent low melting pts
Usually won't dissolve in water
No conductivity
dissolve in methanol

Ionic high melting pts
dissolve in water
Conduct a current in water
No dissolving in methanol

21. Ionic – strong bonds
Negative & positive ions
Network Covalent Very strong network = high melting/boiling pt
Covalent = weaker bond

22. hydrogen bonding – between molecules that contain H–N H–F & H–O Bonds
strongest dipole-dipole interaction
Dipole-Dipole between molecules that are polar
Dispersion – Temporary dipole (weakest IMF)
Br_2 has a larger Radius easier to induce a dipole = higher M.P.

23. iron(III)chloride iron(II)chloride Copper(II)oxide sulfurdioxide
Dinitrogen monoxide, diphosphorus pentaoxide calcium hydroxide
sodium sulfate sodium sulfite = = ionic + covalent bonds

24. Na_2SO_4 $(NH_4)_2CO_3$ FeO $AgClO_3$ Ba_3N_2 $Ca(NO_3)_2$

25. 2 moles of NH_3 = 2 x 17.0 g/mol = 34.0 g

a) $\frac{1 \text{ atom of N}}{6.02\times10^{23} \text{ atom}} \left| \frac{1 \text{ mole}}{1 \text{ mole}} \right| \frac{14.01 \text{ g}}{1 \text{ mole}} = 2\times10^{-23} \text{ g}$

b) $\frac{8.5\times10^{-18} \text{ atoms Xe}}{6.02\times10^{23} \text{ atom}} \left| \frac{1 \text{ mol}}{} \right. = 1.4\times10^{-41} \text{ moles}$

c) one form unit $Pb(NO_3)_2$ $\left| \frac{6 \text{ oxygen}}{1 Pb(NO_3)_2} \right. = 6 \text{ atoms}$

d) $\frac{192 \text{ g}}{96.13 \text{ g}} \left| \frac{1 \text{ mol}}{} \right. = 2.00 \text{ mol}$

$\frac{192 \text{ g}}{96.13 \text{ g}} \left| \frac{1 \text{ mol}}{} \right| \frac{1 \text{ mol C}}{1 \text{ mole of } (NH_4)_2CO_3} \left| \frac{12.0 \text{ g}}{1 \text{ mol C}} \right. = 24 \text{ g C}$

e. $\frac{8.2 \text{ L}}{22.4 \text{ L}} \left| \frac{1 \text{ mol}}{} \right| \frac{2.02 \text{ g}}{1 \text{ mol}} = 0.74 \text{ g } H_2$

26. $\frac{104.79 \text{ g Fe}}{55.85 \text{ g}} = \frac{1.875}{1.875} = 1 \times 2 = 2$

a

$\frac{44.96 \text{ O}}{16.00 \text{ g}} = \frac{2.81}{1.875} = 1.5 \times 2 = 3$ Fe_2O_3

b Ca $40.08 \times 3 = 120.24$
P $30.97 \times 2 = 61.94$
O $16.00 \times 8 = 128.00$
310.18 g

$\%P = \frac{61.94}{310.18} \times 100 = 19.97\%$

27. Molecular formula is Actual Ratio of atoms in a compound made up of nonmetals

C $\frac{19.54}{12.01} = \frac{1.626\,98}{1.626\,695} = 1$

Cl $= \frac{57.67}{35.45} = \frac{1.626\,798}{1.626\,695} = 1$

N $= \frac{22.79}{14.01} = \frac{1.626\,695}{1.626\,695} = 1$

C Cl N Add up = 61.47

$\frac{184.5 \text{ molar mass}}{61.47 \text{ emp formula mass}} = 3$

$C_3Cl_3N_3$ = molecular formula

28. $2HCl + 2Li = 2LiCl + H_2$ Single replacement

$H_2SO_4 + Ca(OH)_2 \rightarrow CaSO_4 + 2H_2O$ Double Replacement

$2C_4H_6 + 11O_2 \rightarrow 6H_2O + 8CO_2$ Combustion

$KCl + AgNO_3 \rightarrow AgCl + KNO_3$ Double replacement

29. $2H^+ + 2Li \rightarrow 2Li^+ + H_2$ d. $Ag^+ + Cl^- \Rightarrow AgCl$

Chp 9

30. $4Al + 3O_2 \rightarrow 2Al_2O_3$

$\frac{8\,mol}{3\,mol} = \frac{x\,mol}{2\,mol} = 5.3 = 5\,mol$

$\frac{18\,mol\,Al}{4\,mol} = \frac{x\,mol}{2\,mol\,Al_2O_3} = 9\,mol$ $\frac{18\,mol\,O_2}{3\,mol} = \frac{x\,mol}{2\,mol} = 12$

L.R = Al

31. $2C_2H_6 + 7O_2 \rightarrow 6H_2O + 4CO_2$

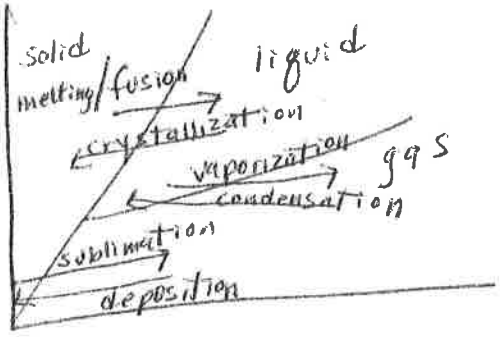
a) $\frac{168\,g}{2\,mol(30.0\,g/mol)} = \frac{x\,L}{7\,mol(22.4\,L/mol)} = 439\,L$

b) $\frac{22\,L}{7\,mol(22.4)} = \frac{x\,g}{4\,mol(44.0\,g/mol)} = 25\,g$

c) $\frac{45\,g}{7\,mol(32.0\,g/mol)} = \frac{x\,mol\,CO_2}{4\,mol} = 0.804\,mol$ O_2 = L.R.

$\frac{60\,g\,ethane}{2\,mol(30.0\,g/mol)} = \frac{x\,mol}{4\,mol} = 4.0\,mol$

Chp 10



33. $CO = 28.0\ g/mol$ $CO_2 = 44.0\ g/mol$ $Cl_2 = 71.0\ g/mol$

$H_2 = 2.0\ g/mol$ $I_2 = 253.8\ g/mol$

H_2 diffuses fastest — H_2 would have highest K.E because of low molar mass.

Cl_2 & I_2 unsafe to breathe

34. Equal volumes of gases at the same temp & pressure have the same number of molecules.

a) 6.05×10^{14}

b) $22.4\ L = 6.02 \times 10^{23}$ molecules

c) $\frac{88.0\ g}{44.0\ g/mol} = 2.00\ mol \times 22.4\ \frac{L}{mol} = 44.8\ L$

d) $\frac{242\ L}{22.4\ L/mol} = 10.80\ mol \times 6.02 \times 10^{23} = 6.50 \times 10^{24}$ molecules

35. $\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$ $\frac{(762\ mm\ Hg)(80.00\ L)}{295} = \frac{(762\ mm\ Hg)\ x\ L}{317}$

$= 86\ L$

36. $PV = nRT$

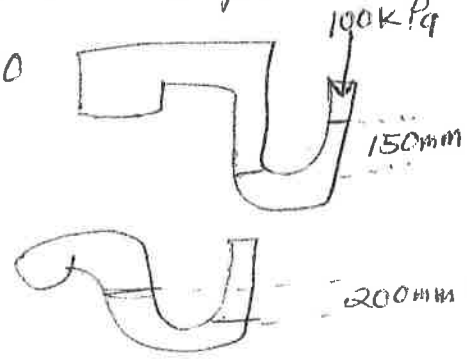
$(1.4\ atm)(x\ L) = (4.0\ mol)(0.0821\ \frac{atm\ L}{K\ mol})(303\ K) = 71\ L$

37. $\frac{(8.00\ L)(762\ mm\ Hg)}{22 + 273 = 295\ K} = \frac{(x\ L)(750\ mm\ Hg)}{15 + 273 = 288\ K} = 79.4\ L$

38. Inc. Temperature — Heat it — Inc. pressure & Cool

39. Low pressures & High temps

40



$\frac{100\ kPa}{101.3\ kPa} \mid \frac{760\ mm\ Hg}{} = 750.2\ mm\ Hg$

$\frac{750.2\ mm\ Hg}{+150}$

$900.2\ mm\ Hg = 900\ mm\ Hg$

$\frac{750.2}{-200.0}$

$550.2\ mm\ Hg$

41. Saturated holds max amount of solute in a specific Amount of solute at a particular temperature

Unsat can hold more solute at a particular temperature

42. Cool it

43. Molarity = $\frac{\text{mol solute}}{\text{L of solution}}$ Molality = $\frac{\text{mol solute}}{\text{Kg solvent}}$

$M = \frac{mol}{L}$ $CaCl_2$ $733g / 111.1 g/mol = 6.597659766\ mol$

$\frac{6.597659766\ mol}{0.500L} = 13.2L$

$= 10\ L$ in sig fig

b. $M_1V_1 = M_2V_2$

$(12M)(XmL) = (0.5M)(300mL) = 12.5mL = 10mL$

44 NaCl 2 particles $AlCl_3$ 4 particles $C_6H_{12}O_6$ 1 particle

$NaBr$ = 2 particles Provided All are same molality

Chp 14

45 Proton donor = acid Proton acceptor = base

a) $HCl + NH_3 \rightarrow NH_4^+ + Cl^-$

b) $HSO_4^- + OH^- \rightarrow H_2O + SO_4^{2-}$

46. NaOH $Ca(OH)_2$ HCl HNO_3

47. make lots of H_3O^+ or OH^- in solution

Higher the Ka = stronger the acid

48. $pH = -\log[H_3O^+]$ $pH + pOH = 14$

$[H_3O^+]$ & $[OH^-]$ are inversely related

$K_w = 1.0 \times 10^{-14}$ pH Over 7 = base pH under 7 = acid

Most basic = 14 Most acidic = 0

a) $\frac{1.0 \times 10^{-14}}{3.2 \times 10^{-3}} =$ b. $\frac{1.0 \times 10^{-14}}{8.6 \times 10^{-2}} =$

c) $4 \times 10^{-3} M$ d. pOH = 9.5 inverse of -9.5 =

49. $M_aV_a = M_bV_b$

$(0.150M)(27.50mL) = (xM)(15.00mL) = 0.275M$

50. Endo = Absorbs energy Exo - releases energy

energy is a reactant energy is a product

feels cold feels hot

51. $2P + 5Cl_2 \rightarrow 2PCl_5$ $\Delta H = -886 kJ$ exothermic

$\frac{5 mol}{886 kJ} = \frac{0.02 mol}{x kJ} = 3.544 kJ$

52 $J = (m)(\Delta t)(C_p)$ ← specific heat

$J = (79g)(47.0°C)(4.184 J/g \cdot C°) = 160,000J$

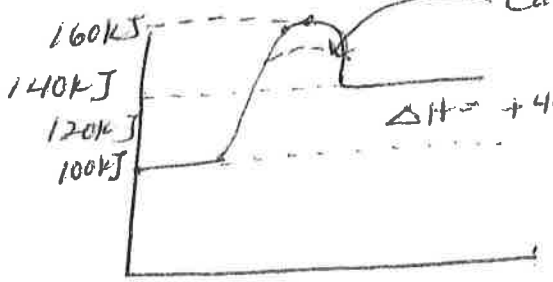
That No energy is lost or gained

53 Cooking utensils Insulators

Chp 17

54. Speed of a reaction

55



$\Delta H_{reverse} = -40kJ$

$E_{a\,Reverse} = 20kJ$

56. ① Inc temp (faster = more effective collisions)
② greater concentration (More particles = More effective collisions)
③ catalyst (lower Ea)
④ Inhibitor (causes Reactants to move up hill slower) Less effective collisions
⑤ greater surface area = more places to collide

57. Slowest

58. When Rate of forward Rxn = Rate of Reverse RXN

59 a ← more Ag^+ $\frac{[Zn^{+2}]}{[Ag^+]^2} = Keq$

b. $\frac{[NH_4^+]^2[OH^-]}{[NH_3]} = Kb$ cool it to shift left
heat it to shift right

Temp changes value of Keq

60. $H_2 + F_2 \rightleftharpoons 2HF$

$\frac{[HF]^2}{[H_2][F_2]} = \frac{(0.02M)^2}{(0.03M)(0.03M)} = 0.444$

61 $AgCl_{(s)} \rightleftharpoons Ag^+_{(aq)} + Cl^-_{(aq)}$

a) $Ksp = [Ag^+][Cl^-]$
$1.8 \times 10^{-10} = (x^2)$ $= 1.3 \times 10^{-5} M$
Both ion concentrations are the same

b) It would decrease the solubility
Common ion effect stress ←

62 oxidation = loss Reduction = gain

CO_2 H_2CO_3 $HC_2H_3O_2$

$BaSO_4$ $BaSO_3$

Ag is oxidized Cl is reduced

63 $2(Au^{+3} + 3e^- \rightarrow Au)$ 1.50 volts = Reduction

a) $3(Fe \rightarrow Fe^{2+} + 2e^-)$ +0.44 volts = oxidation

1.94 V

$2Au^{+3} + 3Fe \rightarrow 2Au + 3Fe^{2+}$

b) $Zn^{+2} + Cu \rightarrow Cu^{+2} + Zn$

$Zn^{+2} + 2e^- \rightarrow Zn$

$Cu \rightarrow Cu^{+2} + 2e^-$ oxidation

64 Alpha $^4_2\alpha$ Beta $^0_{-1}\beta$ gamma $^0_0\gamma$

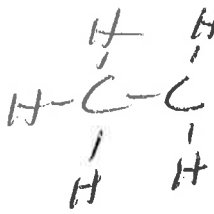
A. $^{230}_{90}Th \rightarrow ^{226}_{88}Ra + ^4_2\alpha$ B) $^{14}_{6}C \rightarrow ^{14}_{7}N + ^0_{-1}\beta$

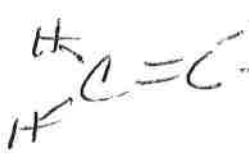
C. $^{223}_{87}Fr \rightarrow ^{223}_{86}Rn + ^0_{-1}\beta$

66. 300g → 150g → 75g → 37.5g → 18.75g → 9.375

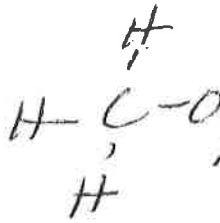
10 days 20 days 30 days 40 days 50 days

4.6875g After 60 days

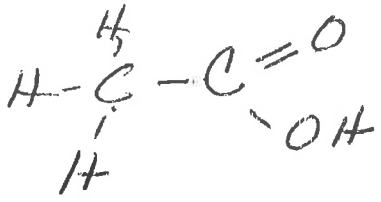
67. Alkane  All single bonds

alkene  double bond

alkyne $H-C\equiv C-H$ Triple bond

68 Organic alcohol  methanol

=alcohol

organic acid →  $HC_2H_3O_2$ Acetic or Ethanoic acid

69. $\frac{5.0g}{28.0g/mol} = 0.17857 mol$

$\frac{4.0g}{2.0g/mol} = 2 mol$

$\frac{2.0g\ He}{4.0g/mol} = 0.50\ mol$

$\frac{0.50}{2.67857} =$

$\frac{0.50\ mol}{2.67857\ mol\ total}$

0.187 mole fraction of Helium