Honor Chem Review for the Final Exam name Key

In addition to the problems below you will need to review significant figures, temperature conversions, solving for EF, types of chemical rxns, single replacement (M replace a M) and (NM replace NM), isotopes, pv=nrt, entropy, properties of IC/CC, density, 3 I's of chemistry, mole conversions (g,moles, particles)

1. What type of bond is found in the following substances?
a. O_2 non-polar covalent
b. CaO ionic
c. CO_2 polar covalent
d. Calcium nitrate ionic bond Ca^{+2} & NO_3^-
polar covalent bond in polyatomic ion nitrate

2. Titration of sodium hydroxide and sulfuric acid: What volume, in cm3, of 0.200 M NaOH is required to neutralize 43.5 cm3 of .19 M sulfuric acid?

Steps 1-5

1) $2\,NaOH + H_2SO_4 \Rightarrow Na_2SO_4 + 2H_2O$

.200M ?mL .19M 43.5mL

$M = \frac{mol}{L}$ 2) $.19M = \frac{x}{.0435}$ 3) $\frac{.00826\,mol\,H_2SO_4}{1}\left(\frac{2\,mol\,NaOH}{1\,mol\,H_2SO_4}\right) = .01653\,mol\,NaOH$

4) $.200M = \frac{.01653}{x\,L}$ 5) $x = .08265\,L$ → 82.65mL NaOH

3. If element X forms an ionic compound with the formula of Na_3X. What is the formula for a compound of X and calcium?

$Na_3^{+3}X^{-3}$ $Ca_3^{+2}X_2^{-3}$

4. Find the molar mass of magnesium sulfate heptahydrate.

$MgSO_4 \cdot 7H_2O$ $24.31 + 32.06 + 64 + 7(18.02)$

246.51 g/mol

5. How many atoms of oxygen are in .65 moles of calcium phospate?

$\frac{.65\,mol\,Ca_3(PO_4)_2}{1}\left(\frac{6.02\times10^{23}\,f_u}{1\,mol}\right)\left(\frac{8\,O\,atoms}{1\,f_u}\right) = 3.1\times10^{24}\,O\,atoms$

6. What mass of water is released, when 20g of magnesium sulfate heptahydrate is completely dehydrated?

$7H_2O$ $7(18.02) = 126.14$

$MgSO_4 \cdot 7H_2O = 246.51$

$.511\ldots(20g) = 10.2$ → 10g

7. What is the mass percent of iron in Iron (II) nitrate?

$Fe(NO_3)_2$: $55.85 + 28.02 + 96 = 179.87$

$\frac{Fe\ 55.85}{179.87} = .31 \times 100$ → 31%

8. A 600.0 cm3 container is filled with 3.35g of carbon dioxide at 123 C. What pressure is exerted by the gas? $PV=nRT$ R = gas constant .0821 atm·L/mol·K

$P = x$

$V = 600.0\,cm^3 = .6000\,L$

$n = 3.35\,g\,CO_2\left(\frac{1\,mol}{44.01\,g}\right) = .0761\,mol$

$T = 123°C + 273 = 396K$

$x(.6) = (.0761)(.0821)(396)$

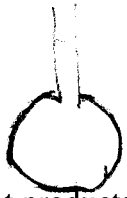
$x = 4.12\,atm$

9. Write the expression for finding the number of moles of sucrose, $C_{12}H_{22}O_{11}$, in a 125g sample?

$144.12 + 22.22 + 176 = 342.34$

$$\frac{125g}{1}\left(\frac{1\,mol}{342.34g}\right)$$

10. What volume of 12M HCl must be used to prepare 500 cm3 of a 2.00 M solution? Ask to see a volumetric flask?



$M_1V_1 = M_2V_2$

$12Mx = 2.00M(500mL)$

83.33mL 12M HCl

11. What products result when (aq) solutions of NaCl and silver nitrate are mixed? Use phase symbols on the products.

$NaCl_{(aq)} + AgNO_{3(aq)} \rightarrow NaNO_{3(aq)} + AgCl_{(s)}$

12. Which gas will diffuse most rapidly at the same temperature and pressure? (explain your choice) dinitrogen pentoxide, ammonia, carbon dioxide or hydrogen

$N_2O_{5(g)}$ $NH_{3(g)}$ $CO_{2(g)}$ $H_{2(g)}$

lowest molar mass

13. What is the concentration of the sodium ion in a 1.5 M sodium phosphate solution?

$1.5M\ Na_3PO_4\ (3\ moles\ Na) = 4.5M\ Na^+$

14. Write the electron configuration for Ti in its ground state. What kind of metal is titanium?

$_{22}Ti: 1s^2\,2s^2\,2p^6\,3s^2\,3p^6\,4s^2\,3d^2$

Transition Metal (D-Block)

15. Which of the following is the strong acid? Give the formulas for the acids.
HCl or HF, perchloric acid or chlorous acid, sulfuric acid or sulfurous acid

$HClO_3$ $HClO_2$ H_2SO_4 H_2SO_3

16. The heat of combustion of methane, CH_4, is –890kJ/mole. What mass of methane must be burned to produce 365 KJ of heat?

↳ smallcase k

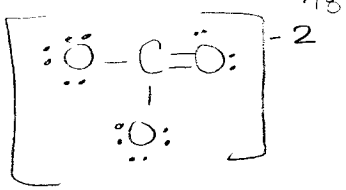
$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O + 890\ kJ$$

? g 365 kJ

$$365\ kJ \left(\frac{1\ mole\ CH_4}{890\ kJ}\right)\left(\frac{16.05\ g}{1\ mol}\right) = 6.58\ g\ CH_4$$

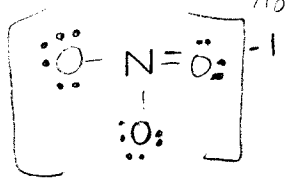
17. Draw the correct lewis diagram and shape of the following:

Carbonate ion CO_3^{-2} $4+18+2=24$ $-6/18$



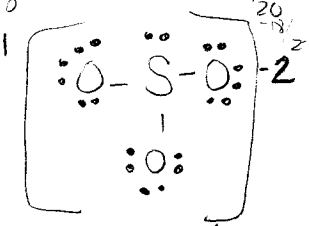
trigonal planar

nitrate ion NO_3^- $5+18+1=24$ $-9/18$



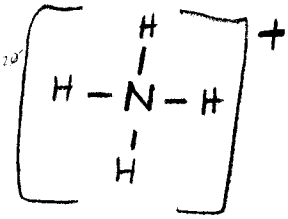
trigonal planar

sulfite SO_3^{-2} $6+18+2=26$ $-6/20$



pyramidal

ammonium NH_4^+



tetrahedral

18. Which bond is the least polar? Arrange by increasing polartiy:

C-H < F-Br < Na-S < Ca-F

2.5 2.1 .4 | 4.0 2.8 1.2 | .9 2.5 1.6 | 1.0 4.0 3.0

19. Oxidation #'s: What change in the oxidation number of Fe occurs when iron replaces copper (II)nitrate in a single replacement reaction.

$$\overset{0}{Fe} + Cu(NO_3)_2 \rightarrow \overset{+2}{Fe}(NO_3)_2 + Cu$$

lost 2e- oxidation

$H^+ + H_2O \Rightarrow H_3O^+$

20. A HCl solution with a pH of 2 contains what types of ions and molecules?

HCl pH = 2 $[H^+][OH^-] = 1\times10^{-14}$

$H^+ = [.01]$ $OH = [1\times10^{-12}]$ H_2O $[.01][1\times10^{-2}] = 1\times10^{-14}$

21. A 35.0 mL sample of sulfuric acid solution from an automobile storage battery is titrated with 2.63 M sodium hydroxide solution to a phenolphthalein endpoint, requiring 19.20 mL. What is the molarity of the sulfuric acid solution?

$H_2SO_4 + 2NaOH \Rightarrow Na_2SO_4 + 2HOH$

35.0mL 2.63M 19.20mL

Stoich problem w/ Molarity

$M = \frac{moles}{L}$

① $2.63 = \frac{x}{.01920}$

② $x = .050496 \text{ mol NaOH}\left(\frac{1 \text{ mol } H_2SO_4}{2 \text{ mol NaOH}}\right) = .025248 \text{ mol } H_2SO_4$

③ $M = \frac{mol}{L}$ $x = \frac{.025248 \text{ mol}}{.035 \text{ L}} = .721M\ H_2SO_4$

22. According to the equation:
Tin (IV) oxide reacts with hydrogen gas to form tin and water
What volume of hydrogen measured at 2atm and 253K, is required to react with 4.00 g of Tin (IV) oxide?

$SnO_2 + 2H_{2(g)} \Rightarrow Sn + 2H_2O$

4g ? L

STOICH w/ gas law

$PV = nrt$

STOICH

① $4g\ SnO_2\left(\frac{1 \text{ mol}}{150.69 \text{ g}}\right)\left(\frac{2 \text{ mol } H_2}{1 \text{ mol } SnO_2}\right) = .053 \text{ mol } H_2$

② $PV = nrt$ (Pressure (atm), Volume (L), mol, constant .0821, return)

$(2atm)(xL) = (.053mol)(.0821)(253K)$

$x = .551\ L\ H_2$

118.69
32.00
150.69

23. Which quantity of carbon is contained in .3 moles of glucose? Give our answer in moles.

$.3 \text{ mol } C_6H_{12}O_6\left(\frac{6 \text{ mol C}}{1 \text{ mole } C_6H_{12}O_6}\right) = 1.8 \text{ mol C}$

24. The amount of chloride ion in a water sample is to be determined by adding excess silver nitrate. If 2.5 g of silver chloride is precipitated, what mass of chloride ion is in the original sample?

% Comp. $\rightarrow AgCl_{(s)}$ 2.5g

$$\frac{Cl}{AgCl}\ \frac{35.45}{143.32} = .247\ldots(2.5g) = \boxed{.62g\ Cl^-}$$

(35.45 + 107.87)

25. At STP, what volume of CO2 is produced when 5.32g of calcium carbonate reacts with excess hydrochloric acid?

Calcium carbonate + hydrochloric acid → calcium chloride + carbon dioxide + water

$CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + H_2O$

5.32g excess ? L @ STP

Stoich

$$5.32g\ CaCO_3 \left(\frac{1\ mol}{100.09g}\right)\left(\frac{1\ mol\ CO_2}{1\ mol\ CaCO_3}\right)\left(\frac{22.4L}{1\ mol}\right) = \boxed{1.19\ L\ CO_2}$$

Stoich

26. Set up the equation: A sample of hydrogen gas occupies 15.0 L at 2.0 atm and 25 C. What volume does it occupy at STP?

Combined gas LAW

$$\frac{PV}{nRT} = \frac{PV}{nRT}$$

STP = 0°C 1atm

$$\frac{(2atm)(15.0L)}{298\ K} = \frac{(1atm)(xL)}{273K} \qquad \boxed{x = 27L\ H_2}$$

25+273

27. How many atoms are represented in the formula for Copper (II) phosphate?

$Cu_3(PO_4)_2$ Cu^{+2} P^{-3}

Cu = 3
P = 2
O = 8

13 atoms

28. How many atoms are represented in the formula for ammonium acetate?

$NH_4C_2H_3O_2$

12 atoms

29. What mass of magnesium oxide is produced when 20g of Mg react with 22 g of oxygen?

L.R. =

STOICH FIND L.R.

$2Mg + O_2 \rightarrow 2MgO$

20g 22g ?g

eqn #1 eqn #2

eqn #1 $\frac{20gMg}{1}\left(\frac{1mol}{24.31g}\right)\left(\frac{2molMgO}{2molMg}\right)\left(\frac{40.31g}{1mol}\right) = 33.g\ MgO$ → 30g MgO

eqn #2 $\frac{22gO_2}{1}\left(\frac{1mol}{32g}\right)\left(\frac{2molMgO}{1molO_2}\right)\left(\frac{40.31g}{1mol}\right) =$ 55.g MgO

30. What quantity of potassium ions, K+, is obtained from 12g of potassium nitrate?

$\frac{12gKNO_3}{1}\left(\frac{1mol}{101.11g}\right)\left(\frac{6.02\times10^{23}f_u}{1mol}\right)\left(\frac{1K^+ion}{1f_u}\right) = 7.1\times10^{22}\ K^+\ ions$

31. What is the molarity of a solution which contains 15.5 g of sodium hydroxide in 5.0L of solution?

NaOH

$M = \frac{mol}{L}$ $\chi = \frac{.3875mol}{5.0L}$

$15.5gNaOH\left(\frac{1mol}{40g}\right) = .3875mol$

$\chi = .078M$

32. Which could be the molar mass of a compound that has the EF formula CO2?

a. 44 only b. 44, 132, 154 c) 44 and 88

$EF_{mass}\ CO_2 = 44.01$ Any mult. of that

33. What amount of energy is released when 66.0g of carbon dioxide is formed?

Carbon + oxygen → carbon dioxide + 393.5KJ

$C + O_2 \rightarrow CO_2 + 393.5KJ$

66.0g ?KJ

STOICH

$\frac{66.0gCO_2}{1}\left(\frac{1mol}{44.01g}\right)\left(\frac{393.5KJ}{1molCO_2}\right) = 590.KJ$

34. aqueous sodium phosphate forms:

$Na_3PO_{4(aq)} \rightarrow 3Na^+_{(aq)} + PO_4^{-3}{}_{(aq)}$

35. How many hydrogen atoms are present in one mole of ammonium acetate?

$NH_4C_2H_3O_2$

$\frac{1molNH_4C_2H_3O_2}{1}\left(\frac{6.02E^{23}f_u}{1mol}\right)\left(\frac{7Hatoms}{1f_u\ NH_4C_2H_3O_2}\right) =$ 4×10^{24} H atoms

36. What is the pH of 0.02 M KOH solution?

$pH + pOH = 14$

$[H^+][OH^-] = 1 \times 10^{-14}$

$-\log pH = [H^+]$

$-\log pOH = [OH^-]$

$[OH^-] = .02$

$pOH = 1.047$

$pH = 14 - 1.047$

$pH = 13$

37. What is the electron configuration for magnesium ion?

Mg^{+2} isoelectronic w/ Ne

$Mg^{+2}: 1s^2\ 2s^2\ 2p^6$

38. What is the molarity of a NaOH solution if 20.0 cm3 of that solution is neutralized by 8.00cm3 of 0.19 M HCl?

$NaOH + HCl \rightleftharpoons NaCl + H_2O$

Stoich 1 to 1 ratio

	NaOH	HCl
	?M	8.00mL
	20.0mL	.19M

$M = \frac{moles}{L}$

$.19M = \frac{x}{.008L}$ $\quad .00152\,mol\ HCl \left(\frac{1\,mol\ NaOH}{1\,mol\ HCl}\right) = .00152\,mol\ NaOH$ $\quad M = \frac{.00152\,mol}{.020\,L}$

$M = .076\ NaOH$

39. What is the Bronsted Lowry base in the forward reaction?

define: accepts proton

$HCl\ (aq) + H_2O\ (l) \Leftrightarrow H_3O^+\ (aq) + Cl^-\ (aq)$

accepts H+ (proton

H_2O Bronsted Lowry Base

40. What is the molarity of sulfuric acid solution if 30.0mL is exactly neutralized by 35.23mL of 0.134 M NaOH?

$H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$

Stoich molarity

	H_2SO_4	NaOH
	?M	.134M
	30.0mL	35.23mL

$M = \frac{mol}{L}$

① $.134M = \frac{x}{.03523}$ $\quad x = .00472082\,mol\ NaOH$

② $\frac{.00472082\,mol\ NaOH}{1}\left(\frac{1\,mol\ H_2SO_4}{2\,mol\ NaOH}\right) = .00236\ldots\,mol\ H_2SO_4$ (STOICH)

41. What is the molarity of the chloride ion in 250mL of a solution containing 1.60g of Calcium chloride?

① $\frac{1.60g\ CaCl_2}{1}\left(\frac{1\,mol}{110.9g}\right) = .02256\ldots\,mol\ CaCl_2$

② $M = \frac{mol}{L}$ $\quad x = \frac{.02256\,mol}{.250\,L}$

$x = .090\,M\ CaCl_2$

③ $1\,mol\ CaCl_2 = 2\,mol\ Cl^-$ $\quad .18M\ Cl^-$

③ $x = \frac{.00236\,mol}{.030\,L}$

$M = .0787\ H_2SO_4$