

Chemistry 150

Exam 2

Be sure to put your name on each page. This page can be removed from your exam so that you will have a Periodic Table handy throughout the exam, it does not need to be turned in. Show all your work for non-multiple choice problems which require any sort of calculation, no credit will be given for answers without work shown. If you have shown a significant amount of work or multiple drawings for a problem, draw a box around what you consider your final answer.

Avogadro's Number = 6.022×10^{23} units/mol

$32.00^\circ\text{F} = 0.000^\circ\text{C} = 273.15\text{K}$

1 foot = 12 inches

1 inch = 2.54cm (exactly)

1 pound = 453.6 g = 16 ounces

1 amu = 1.6605×10^{-24} g

Masses of subatomic particles:

Proton $1.00728\text{amu} = 1.6726 \times 10^{-24}$ g

Neutron $1.00866\text{amu} = 1.6749 \times 10^{-24}$ g

Electron $0.000549\text{amu} = 9.1094 \times 10^{-28}$ g

Density of Water = $1.000 \frac{\text{g}}{\text{mL}}$

$R = 0.08206 \frac{\text{L}\cdot\text{atm}}{\text{mol}\cdot\text{K}}$

$PV = nRT$

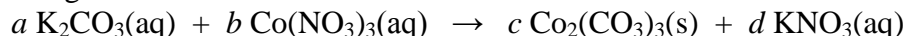
1 H 1.0079																	2 He 4.0026
3 Li 6.941	4 Be 9.0122											5 B 10.811	6 C 12.011	7 N 14.007	8 O 15.999	9 F 18.998	10 Ne 20.180
11 Na 22.990	12 Mg 24.305											13 Al 26.982	14 Si 28.086	15 P 30.974	16 S 32.066	17 Cl 35.453	18 Ar 39.948
19 K 39.098	20 Ca 40.078	21 Sc 44.956	22 Ti 47.88	23 V 50.942	24 Cr 51.996	25 Mn 54.938	26 Fe 55.847	27 Co 58.933	28 Ni 58.69	29 Cu 63.546	30 Zn 65.39	31 Ga 69.723	32 Ge 72.61	33 As 74.922	34 Se 78.96	35 Br 79.904	36 Kr 83.80
37 Rb 85.468	38 Sr 87.62	39 Y 88.906	40 Zr 91.224	41 Nb 92.906	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.91	46 Pd 106.42	47 Ag 107.87	48 Cd 112.41	49 In 114.82	50 Sn 118.71	51 Sb 121.76	52 Te 127.60	53 I 126.90	54 Xe 131.29
55 Cs 132.91	56 Ba 137.33	57 La 138.91	72 Hf 178.49	73 Ta 180.95	74 W 183.84	75 Re 186.21	76 Os 190.23	77 Ir 192.22	78 Pt 195.08	79 Au 196.97	80 Hg 200.59	81 Tl 204.38	82 Pb 207.2	83 Bi 208.98	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra 226.03	89 Ac 227.03	104 Rf (261)	105 Db (262)	106 Sg (263)	107 Bh (262)	108 Hs (265)	109 Mt (266)	110 (269)	111 (272)	112 (277)		114 (279)		116 (288)		

58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm (145)	62 Sm 150.36	63 Eu 151.97	64 Gd 157.25	65 Tb 158.93	66 Dy 162.50	67 Ho 164.93	68 Er 167.26	69 Tm 168.94	70 Yb 173.04	71 Lu 174.97
90 Th 232.04	91 Pa 231.04	92 U 238.03	93 Np 237.05	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (258)	101 Md (258)	102 No (259)	103 Lr (260)

Score

Multiple Choice: Circle the letter of the most correct response. (6pts. per question)

1. Consider the following reaction:



For every mol of $\text{Co}_2(\text{CO}_3)_3(\text{s})$ that forms, how many mols of $\text{K}_2\text{CO}_3(\text{aq})$ have reacted?

- a. 0.33 mols
- b. 0.5 mols
- c. 1 mol
- d. 2 mols
- e. 3 mols**

2. Which of the following reactions would form only water and a salt?

- a. $\text{HCl}(\text{aq}) + \text{Pb}(\text{NO}_3)_2(\text{aq})$
- b. $\text{Fe}(\text{NO}_3)_3(\text{aq}) + \text{Mg}(\text{OH})_2(\text{aq})$
- c. $\text{HNO}_3(\text{aq}) + \text{Na}_2\text{SO}_3(\text{aq})$
- d. $\text{HClO}_4(\text{aq}) + \text{Mg}(\text{OH})_2(\text{aq})$**
- e. $\text{Ni}(\text{C}_2\text{H}_3\text{O}_2)_2(\text{aq}) + \text{Zn}(\text{s})$

3. Which of the following statements is *true*?

- a. Oxidation can happen without reduction
- b. Oxidation is losing electrons**
- c. Increasing charge is a reduction
- d. Loss of electrons is reduction
- e. Oxidizing agents are oxidized in a reaction

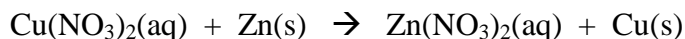
4. In which of the following formulas does sulfur (S) have the *highest* oxidation number?

- a. $\text{SO}_2(\text{g})$
- b. $\text{SF}_3(\text{g})$
- c. $\text{SO}_4^{2-}(\text{aq})$**
- d. $\text{H}_2\text{S}(\text{g})$
- e. $\text{S}(\text{s})$

5. Which of the following would you expect to be *soluble* in water?

- a. $\text{AgC}_2\text{H}_3\text{O}_2$**
- b. $\text{Pb}(\text{OH})_2$
- c. CrCO_3
- d. BaSO_4
- e. $\text{Mg}_3(\text{PO}_4)_2$

6. Consider the following reaction:

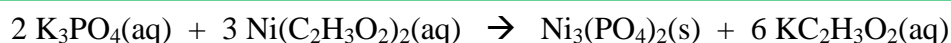


What is being *oxidized* in this reaction?

- a. $\text{Cu}(\text{NO}_3)_2(\text{aq})$
- b. $\text{Zn}(\text{s})$**
- c. $\text{Zn}(\text{NO}_3)_2(\text{aq})$
- d. $\text{Cu}(\text{s})$
- e. This is not a redox reaction

Chemical Equations: For each of the following, write a correctly balanced chemical equation and identify the reaction type. Be sure to include state labels. (12pts each)

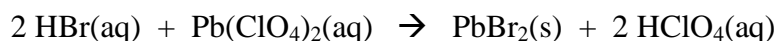
Potassium phosphate (aq) + Nickel(II) acetate(aq) → Nickel(II) phosphate + Potassium acetate



Metathesis/Exchange/Double displacement reaction

Precipitation Reaction

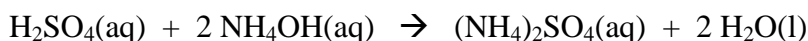
Hydrobromic acid(aq) + Lead(II) perchlorate(aq) → Lead(II) bromide + Perchloric acid



Metathesis/Exchange/Double displacement reaction

Precipitation Reaction

Sulfuric acid(aq) + Ammonium hydroxide(aq) → Ammonium sulfate + Water



Metathesis/Exchange/Double displacement reaction

Acid-base/Neutralization Reaction

Problems:

10. You have diluted 15.0mL of a 0.815M solution of barium nitrate with enough water to make 175.0mL of solution. What is the new concentration of *nitrate ions* in this solution? (10pts)

This is a dilution problem with an added bit, so we can start by using $C_1V_1=C_2V_2 \dots$

$$(0.815\text{M})(15.0\text{mL}) = C_2(175.0\text{mL})$$

$C_2 = 0.0699\text{M}$ barium nitrate. We can think of barium nitrate in water with the following reaction:



So for every “ $\text{Ba}(\text{NO}_3)_2$ ” unit, there will be *two* nitrates in solution...

$$\left(\frac{0.0699 \text{ mol Ba}(\text{NO}_3)_2(\text{aq})}{1 \text{ L solution}} \right) \left(\frac{2 \text{ mol NO}_3^{-}(\text{aq})}{1 \text{ mol Ba}(\text{NO}_3)_2(\text{aq})} \right) = 0.140 \text{ M NO}_3^{-}(\text{aq})$$

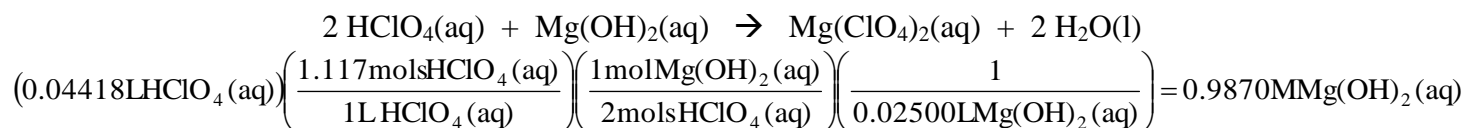
11. You have dissolved 10.00g of lithium sulfate in enough water to make 150.00mL of solution. What is the concentration of the resulting solution? (10pts)

We have to start with the correct formula for lithium sulfate, Li_2SO_4 , formula weight = $109.944 \frac{\text{g}}{\text{mol}}$.

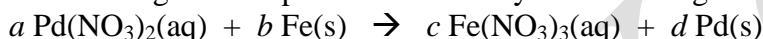
$$(10.00\text{g}) \left(\frac{1 \text{ mol}}{109.944\text{g}} \right) \left(\frac{1}{0.15000\text{L}} \right) = 0.6064\text{M Li}_2\text{SO}_4(\text{aq})$$

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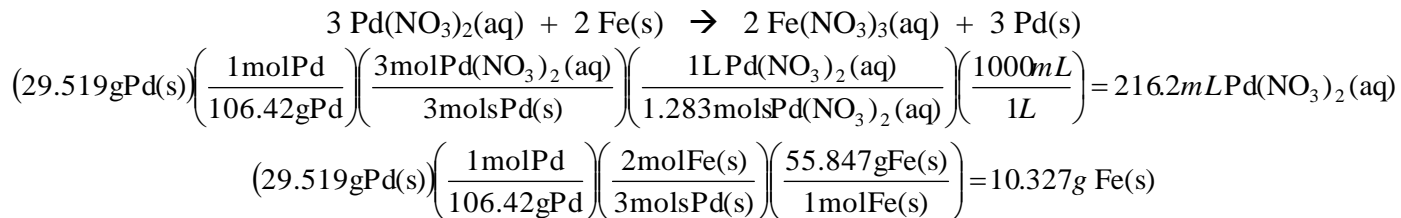
12. You have titrated 25.00mL of an unknown stock magnesium hydroxide solution to the second equivalence point with 44.18mL of 1.117M perchloric acid. What is the concentration of the stock magnesium hydroxide solution? (15pts)



13. You would like to produce 29.519g of solid palladium metal by the following reaction:



How many milliliters of 1.283M palladium nitrate solution are required to produce 29.519g of Pd(s)? How many grams of Fe(s) are required to produce 29.519g of Pd(s)? (20pts)



14. 75.0mL of 0.934M lead(II) acetate solution is combined with 75.0mL of 1.284M potassium carbonate solution. Write a correctly balanced equation and net ionic equation for the reaction that takes place. How many grams of precipitate can this reaction form? You recover 14.938g of precipitate. What is the percent yield? (25pts)

