

# 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 =  $6.022 \times 10^{23}$  units/mol

$h = 6.626 \times 10^{-34}$  Jsec

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

$\lambda = h/mv$

1 foot = 12 inches

$1 \text{ J} = 1 \text{ kg (m/sec)}^2$

1 inch = 2.54cm (exactly)

$c = \lambda\nu = 3.00 \times 10^8 \text{ m/sec}$

1 pound = 453.6 g = 16 ounces

$E_{\text{photon}} = h\nu$

1 amu =  $1.6605 \times 10^{-24}$  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 =  $1.000^{\text{g}}/\text{mL}$

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

$PV = nRT$

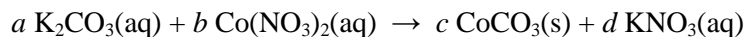
1 calorie = 4.184 J = 0.001 Calorie

1 <b>H</b> 1.0079																	2 <b>He</b> 4.0026
3 <b>Li</b> 6.941	4 <b>Be</b> 9.0122											5 <b>B</b> 10.811	6 <b>C</b> 12.011	7 <b>N</b> 14.007	8 <b>O</b> 15.999	9 <b>F</b> 18.998	10 <b>Ne</b> 20.180
11 <b>Na</b> 22.990	12 <b>Mg</b> 24.305											13 <b>Al</b> 26.982	14 <b>Si</b> 28.086	15 <b>P</b> 30.974	16 <b>S</b> 32.066	17 <b>Cl</b> 35.453	18 <b>Ar</b> 39.948
19 <b>K</b> 39.098	20 <b>Ca</b> 40.078	21 <b>Sc</b> 44.956	22 <b>Ti</b> 47.88	23 <b>V</b> 50.942	24 <b>Cr</b> 51.996	25 <b>Mn</b> 54.938	26 <b>Fe</b> 55.847	27 <b>Co</b> 58.933	28 <b>Ni</b> 58.69	29 <b>Cu</b> 63.546	30 <b>Zn</b> 65.39	31 <b>Ga</b> 69.723	32 <b>Ge</b> 72.61	33 <b>As</b> 74.922	34 <b>Se</b> 78.96	35 <b>Br</b> 79.904	36 <b>Kr</b> 83.80
37 <b>Rb</b> 85.468	38 <b>Sr</b> 87.62	39 <b>Y</b> 88.906	40 <b>Zr</b> 91.224	41 <b>Nb</b> 92.906	42 <b>Mo</b> 95.94	43 <b>Tc</b> (98)	44 <b>Ru</b> 101.07	45 <b>Rh</b> 102.91	46 <b>Pd</b> 106.42	47 <b>Ag</b> 107.87	48 <b>Cd</b> 112.41	49 <b>In</b> 114.82	50 <b>Sn</b> 118.71	51 <b>Sb</b> 121.76	52 <b>Te</b> 127.60	53 <b>I</b> 126.90	54 <b>Xe</b> 131.29
55 <b>Cs</b> 132.91	56 <b>Ba</b> 137.33	71 <b>Lu</b> 174.97	72 <b>Hf</b> 178.49	73 <b>Ta</b> 180.95	74 <b>W</b> 183.84	75 <b>Re</b> 186.21	76 <b>Os</b> 190.23	77 <b>Ir</b> 192.22	78 <b>Pt</b> 195.08	79 <b>Au</b> 196.97	80 <b>Hg</b> 200.59	81 <b>Tl</b> 204.38	82 <b>Pb</b> 207.2	83 <b>Bi</b> 208.98	84 <b>Po</b> (209)	85 <b>At</b> (210)	86 <b>Rn</b> (222)
87 <b>Fr</b> (223)	88 <b>Ra</b> 226.03	103 <b>Lr</b> (260)	104 <b>Rf</b> (261)	105 <b>Db</b> (262)	106 <b>Sg</b> (263)	107 <b>Bh</b> (262)	108 <b>Hs</b> (265)	109 <b>Mt</b> (266)	110 <b>Ds</b> (269)	111 <b>Rg</b> (272)	112 <b>Cn</b> (277)	113	114	115	116	117	118

57 <b>La</b> 138.91	58 <b>Ce</b> 140.12	59 <b>Pr</b> 140.91	60 <b>Nd</b> 144.24	61 <b>Pm</b> (145)	62 <b>Sm</b> 150.36	63 <b>Eu</b> 151.97	64 <b>Gd</b> 157.25	65 <b>Tb</b> 158.93	66 <b>Dy</b> 162.50	67 <b>Ho</b> 164.93	68 <b>Er</b> 167.26	69 <b>Tm</b> 168.94	70 <b>Yb</b> 173.04
89 <b>Ac</b> 227.03	90 <b>Th</b> 232.04	91 <b>Pa</b> 231.04	92 <b>U</b> 238.03	93 <b>Np</b> 237.05	94 <b>Pu</b> (244)	95 <b>Am</b> (243)	96 <b>Cm</b> (247)	97 <b>Bk</b> (247)	98 <b>Cf</b> (251)	99 <b>Es</b> (252)	100 <b>Fm</b> (258)	101 <b>Md</b> (258)	102 <b>No</b> (259)

**Multiple Choice:** Circle the letter of the most correct response. (5pts per question)

1. Consider the following reaction:



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

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

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

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

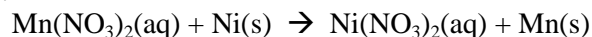
- a.  $\text{H}_3\text{As}(\text{g})$
- b.  $\text{As}(\text{s})$
- c.  $\text{AsO}_4^{3-}(\text{aq})$**
- d.  $\text{Na}_3\text{AsO}_3(\text{s})$
- e.  $\text{AsF}_5(\text{l})$**

Oops, there are 2 equally correct answers for this one.

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

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

6. Consider the following reaction:

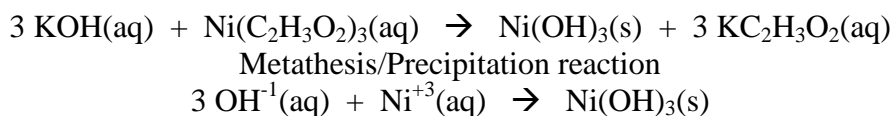


What is being *reduced* in this reaction?

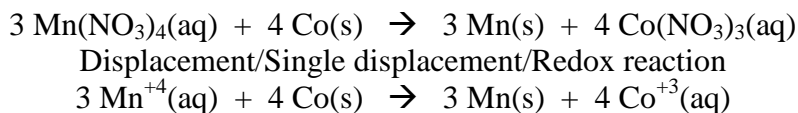
- a.  $\text{Mn}(\text{NO}_3)_2(\text{aq})$**
- b.  $\text{Ni}(\text{s})$
- c.  $\text{Ni}(\text{NO}_3)_2(\text{aq})$
- d.  $\text{Mn}(\text{s})$
- e. This is not a redox reaction

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

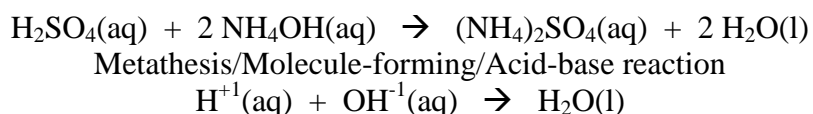
Potassium hydroxide (aq) + Nickel(III) acetate(aq) → Nickel(III) hydroxide + Potassium acetate  
{Nickel atomic # = 28}



Manganese(IV) nitrate(aq) + Cobalt(s) → Manganese(s) + Cobalt(III) nitrate  
{Manganese atomic # = 25; Cobalt atomic # = 27}



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



**Problems:**

10. You have diluted 25.0mL of a 0.6375M solution of sucrose with enough water to make 150.0mL of solution. What is the new concentration of sucrose in this solution? (10pts) {Sucrose is table sugar,  $\text{C}_{12}\text{H}_{22}\text{O}_{11}$ }

$$C_1V_1 = C_2V_2$$
$$(25.0\text{mL})(0.6375\text{M}) = (150.0\text{mL}) C_2$$
$$C_2 = 0.106\text{M}$$

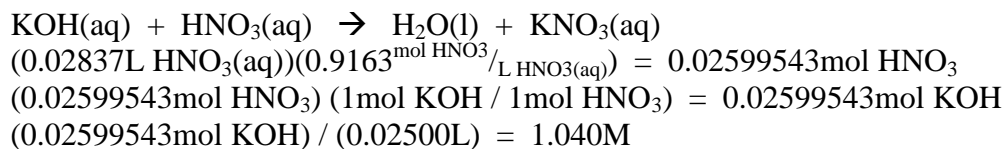
Answer 10:

11. You have dissolved 12.604g of strontium perchlorate in enough water to make 150.00mL of solution. What is the concentration of the resulting solution? (10pts) {Strontium atomic # = 38}

$$\text{Sr(ClO}_4)_2 = 286.518\text{g/mol}$$
$$(12.604\text{g Sr(ClO}_4)_2) / (286.518\text{g/mol}) = 0.043990255\text{mol}$$
$$(0.043990255\text{mol}) / (0.15000\text{L}) = 0.29327\text{M}$$

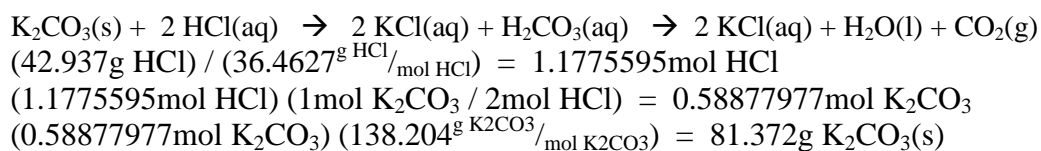
Answer 11:

12. You have titrated 25.00mL of an unknown stock potassium hydroxide solution to the equivalence point with 28.37mL of 0.9163M nitric acid. What is the concentration of the stock potassium hydroxide solution? (15pts)



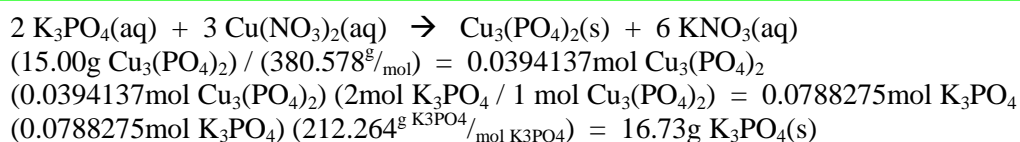
Answer 12:

13. How many grams of potassium carbonate solid are required to react with 42.937g of hydrochloric acid? (15pts)



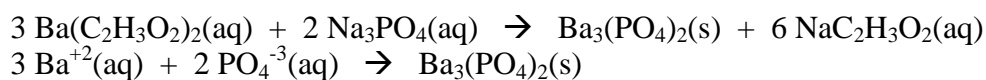
Answer 13:

14. You would like to prepare 15.00g of copper(II) phosphate solid. How many grams of potassium phosphate are required if you have unlimited copper(II) nitrate solution? (15pts) {Copper atomic # = 29}

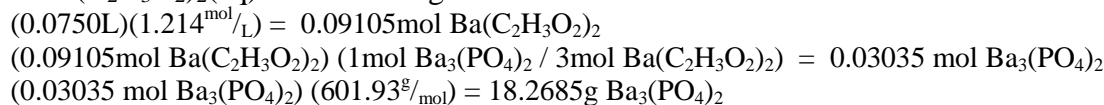


Answer 14:

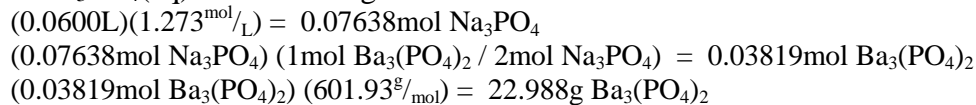
15. 75.0mL of 1.214M barium(II) acetate solution is combined with 60.0mL of 1.273M sodium phosphate solution. Write a correctly balanced equation and net ionic equation for the reaction that takes place. How many grams of precipitate can this reaction form? You recover 15.183g of precipitate. What is the percent yield? (20pts)



If  $\text{Ba}(\text{C}_2\text{H}_3\text{O}_2)_2(\text{aq})$  is the limiting reactant:



If  $\text{Na}_3\text{PO}_4(\text{aq})$  is the limiting reactant:



Since using up all the  $\text{Ba}(\text{C}_2\text{H}_3\text{O}_2)_2(\text{aq})$  produces less product,  $\text{Ba}(\text{C}_2\text{H}_3\text{O}_2)_2(\text{aq})$  is the limiting reactant and the theoretical yield of product is 18.3g

$$(15.183\text{g} / 18.2685\text{g}) \times 100\% = 83.0\% \text{ yield}$$