

# 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

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

1 foot = 12 inches

1 inch = 2.54cm (exactly)

1 pound = 453.6 g = 16 ounces

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

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

$PV=nRT$

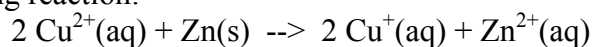
1 <b>H</b> 1.0079																	2 <b>He</b> 4.0026
3 <b>Li</b> 6.941	4 <b>Be</b> 9.0122											5 <b>B</b> 10.811	6 <b>C</b> 12.011	7 <b>N</b> 14.007	8 <b>O</b> 15.999	9 <b>F</b> 18.998	10 <b>Ne</b> 20.180
11 <b>Na</b> 22.990	12 <b>Mg</b> 24.305											13 <b>Al</b> 26.982	14 <b>Si</b> 28.086	15 <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	57 <b>La</b> 138.91	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	89 <b>Ac</b> 227.03	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>Hs</b> (269)	111 <b>Hs</b> (272)	112 <b>Hs</b> (277)		114 <b>Hs</b> (279)		116 <b>Hs</b> (281)		

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	71 <b>Lu</b> 174.97
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)	103 <b>Lr</b> (260)

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

- Which of the following would you expect to be insoluble in water?
  - $\text{Ca}(\text{NO}_3)_2$
  - $\text{BaSO}_4$**
  - $\text{Hg}(\text{C}_2\text{H}_3\text{O}_2)_2$
  - $\text{Na}_3\text{PO}_4$
  - $(\text{NH}_4)_2\text{CO}_3$
- Under which of the following conditions is a gas most likely to **not** be “ideal”?
  - Room temperature, 25°C
  - High temperature, high pressure
  - High volume, low pressure
  - High pressure, high volume
  - High pressure, low temperature**
- Consider the following reaction:
$$a \text{KBr}(\text{aq}) + b \text{AgNO}_3(\text{aq}) \rightarrow c \text{AgBr}(\text{s}) + d \text{KNO}_3(\text{aq})$$
For every mol of  $\text{KBr}(\text{aq})$  that reacts, how many mols of  $\text{AgBr}(\text{s})$  are formed?
  - 0.25 mols
  - 0.5 mols
  - 1 mol**
  - 2 mols
  - 3 mols
- Which of the following is **not** a correct gas law relationship?
  - $PV = nRT$
  - $n_1T_1 = n_2T_2$
  - $V_1n_1 = V_2n_2$**
  - $P_1 / T_1 = P_2 / T_2$
  - $P_1V_1 = P_2V_2$
- In which of the following formulas does sulfur have the lowest oxidation number?
  - $\text{S}(\text{s})$
  - $\text{SO}_2(\text{g})$
  - $\text{Na}_2\text{SO}_3(\text{s})$
  - $(\text{NH}_4)_2\text{S}(\text{aq})$**
  - $\text{BaSO}_4$
- Which of the following is a redox reaction?
  - $\text{NH}_4\text{NO}_3(\text{aq}) + \text{NaC}_2\text{H}_3\text{O}_2(\text{aq}) \rightarrow \text{NH}_4\text{C}_2\text{H}_3\text{O}_2(\text{aq}) + \text{NaNO}_3(\text{aq})$
  - $\text{HCl}(\text{aq}) + \text{KOH}(\text{aq}) \rightarrow \text{KCl}(\text{aq}) + \text{H}_2\text{O}(\text{l})$
  - $\text{CH}_4(\text{g}) + 2 \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 2 \text{H}_2\text{O}(\text{g})$**
  - $\text{AgNO}_3(\text{aq}) + \text{NaCl}(\text{aq}) \rightarrow \text{AgCl}(\text{s}) + \text{NaNO}_3(\text{aq})$
  - $\text{H}_2\text{CO}_3(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l}) + \text{CO}_2(\text{g})$

7. Consider the following reaction:



What is **oxidized** in this reaction?

- a.  $\text{Cu}^{2+}(\text{aq})$
- b.  $\text{Zn}(\text{s})$**
- c.  $\text{Cu}^{+}(\text{aq})$
- d.  $\text{Zn}^{2+}(\text{aq})$
- e. This is not a redox reaction

**Multiple Choice Calculations (12pts each):**

8. What is the volume of 1.675mols of ideal gas at 0.787atm pressure and 39.61°C?

- a. 6.92 L
- b. 4.28 L
- c. 19.5 L
- d. 54.6 L**
- e. 13.6 L

9. A steel tank contains an ideal gas at 31.82°C and 1.88atm. If the tank is cooled to 3.19°C, what is the pressure of the gas in the tank?

- a. 0.188 atm
- b. 1.70 atm**
- c. 1.88 atm
- d. 2.07 atm
- e. 18.8 atm

10. How many mols of sodium ions are present in 75.00mL of a 3.181M sodium sulfate solution?

- a. 0.4772 mols**
- b. 0.02121 mols
- c. 0.1193 mols
- d. 0.2386 mols
- e. 42.41 mols

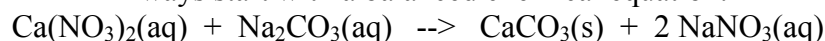
11. You have dissolved 8.216g of calcium chloride in enough water to make 250.00mL of solution. What is the concentration of the resulting solution?

- a. 0.01851 M
- b. 0.03286 M
- c. 0.4351 M
- d. 0.02719 M
- e. 0.2961 M**

**Problems: (30pts each)**

12. 150.0mL of 1.264M calcium nitrate solution is combined with 125.0mL of 1.328 M sodium carbonate solution.
- Write a correctly balanced equation for the reaction that takes place.
  - How many grams of precipitate will this reaction form?
  - If you collect 11.272g of solid, what is your percent yield?

Always start with a balanced chemical equation:



If  $\text{Ca}(\text{NO}_3)_2(\text{aq})$  is the limiting reagent, the yield would be:

$$(0.1500\text{L}) \left( \frac{1.264\text{mol Ca}(\text{NO}_3)_2(\text{aq})}{\text{L}} \right) \left( \frac{1\text{mol CaCO}_3}{1\text{mol Ca}(\text{NO}_3)_2} \right) \left( \frac{100.086\text{g CaCO}_3}{\text{mol CaCO}_3} \right) = 18.98\text{g CaCO}_3(\text{s})$$

If  $\text{Na}_2\text{CO}_3(\text{aq})$  is the limiting reagent, the yield would be:

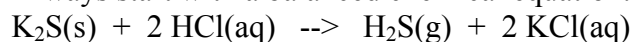
$$(0.1250\text{L}) \left( \frac{1.328\text{mol Na}_2\text{CO}_3(\text{aq})}{\text{L}} \right) \left( \frac{1\text{mol CaCO}_3}{1\text{mol Na}_2\text{CO}_3} \right) \left( \frac{100.086\text{g CaCO}_3}{\text{mol CaCO}_3} \right) = 16.61\text{g CaCO}_3(\text{s})$$

Since  $\text{Na}_2\text{CO}_3(\text{aq})$  produces less product, it is the limiting reagent. The percent yield is:

$$\left( \frac{11.272\text{g}}{16.61\text{g}} \right) \times 100\% = 67.85\% \text{ yield}$$

13. You have reacted 23.713g of potassium sulfide solid with 250.0mL of 5.318M HCl(aq). If all of the gas produced by this reaction is collected in a 4.000L vessel, what will the pressure be in that vessel? {Assume that the vessel contains only the gas produced in the reaction.}

Always start with a balanced chemical equation:



If  $\text{K}_2\text{S}(\text{s})$  is the limiting reagent, the pressure would be:

$$(23.713\text{g K}_2\text{S}(\text{s})) \left( \frac{1\text{mol K}_2\text{S}}{110.262\text{g K}_2\text{S}} \right) \left( \frac{1\text{mol H}_2\text{S}}{1\text{mol K}_2\text{S}} \right) \left( \frac{(0.08206 \frac{\text{L}\cdot\text{atm}}{\text{mol}\cdot\text{K}})(298.15\text{K})}{4.000\text{L}} \right) = 1.315\text{atm}$$

If  $\text{HCl}(\text{aq})$  is the limiting reagent, the yield would be:

$$(0.2500\text{L HCl}(\text{aq})) \left( \frac{5.318\text{mol HCl}}{\text{L HCl}(\text{aq})} \right) \left( \frac{1\text{mol H}_2\text{S}}{2\text{mol HCl}} \right) \left( \frac{(0.08206 \frac{\text{L}\cdot\text{atm}}{\text{mol}\cdot\text{K}})(298.15\text{K})}{4.000\text{L}} \right) = 4.066\text{atm}$$

Since  $\text{K}_2\text{S}(\text{s})$  produces less product, it is the limiting reagent. The pressure in the vessel is 1.315atm.