

Name _____
July 7, 2016

Part 0: Warmup. 4 points each

1. For a fixed amount of gas at a fixed pressure, changing the temperature from 100°C to 200K causes the gas volume to:
- a. double c. decrease
b. increase d. stay the same
- Answer _____
2. To precipitate Zn²⁺ from a solution of Zn(NO₃)₂, add
- a. NH₄Cl c. K₂CO₃
b. MgBr₂ d. (NH₄)₂SO₄
- Answer _____

3. Complete the chart below: (12 points)

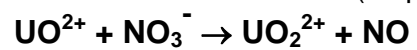
Species	Name	Oxidation States			Water Soluble? (Y/N)
$\text{Al}_2(\text{SO}_4)_3$		Al =	S =	O =	
$\text{Zn}_3(\text{PO}_4)_2$		Zn =	O =	P =	

- (2) Net ionic equation:

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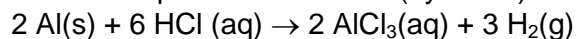
5. Ammonia can be generated by heating together the solids NH_4Cl and $\text{Ca}(\text{OH})_2$ to produce NH_3 , water, and CaCl_2 . If a mixture containing 33.0 g each of ammonium chloride and calcium hydroxide is heated, how many grams of ammonia will form? (10 points)

6. Balance the following redox reaction in acidic solution. (10 points)



7. In order for your car battery to function properly, the sulfuric acid in the battery must be between 4.8 and 5.3 M H_2SO_4 . A 5.00 mL sample of acid from a battery requires 49.74 mL of 0.935 M NaOH to be completely neutralized in a titration. Does the concentration of this battery acid fall within the desired range? (10 points)

8. A 2.89 g aluminum ore sample is reacted with excess HCl in the reaction below, and the liberated H_2 is collected over water at 25°C at a pressure of 744 mm Hg. If 322 mL of hydrogen is collected, what is the percent aluminum (by mass) in the sample? (10 points)



Part II. Answer three (3) of problems 9-12. Clearly mark the problem you do not want graded. 10 points each.

9. In a combustion reaction, 5.00 g of ethanol ($\text{C}_2\text{H}_6\text{O}$) is allowed to react in a 2.00 L container filled with oxygen gas at a pressure of 2.08 atm and a temperature of 100°C , producing water and carbon dioxide. If 1.53 g water forms, what is the percent yield for the reaction?

10. The ideal gas law works best under a very limited set of conditions. What are these conditions? What assumptions of the ideal gas law fail as you deviate from these conditions?

11. A student puts 50.0 grams each of dry ice (solid carbon dioxide) and liquid nitrogen into a 500.0 mL soda bottle and quickly closes the lid. After a short time, all of the CO_2 and N_2 have been converted into gas and allowed to reach a temperature of 27.2°C .
- What is the total pressure in the container? (7 points)

- What is the partial pressure of CO_2 in the container? (3 points)

12. You dissolve 2.83 g of a copper-containing mixture in water in a 100.0 mL volumetric flask and dilute it to the mark to prepare solution A. You then pipet 5.00 mL of solution A into a 25.00 mL volumetric flask and dilute it to the mark to make solution B. Finally, you pipet 1.00 mL of solution B into a 25.00 mL flask and dilute it to the mark to make solution C. You then determine the copper concentration in solution C to be $6.62 \times 10^{-4}\text{M}$. What is the percent copper by mass in your original solid mixture?

Possibly Useful Information

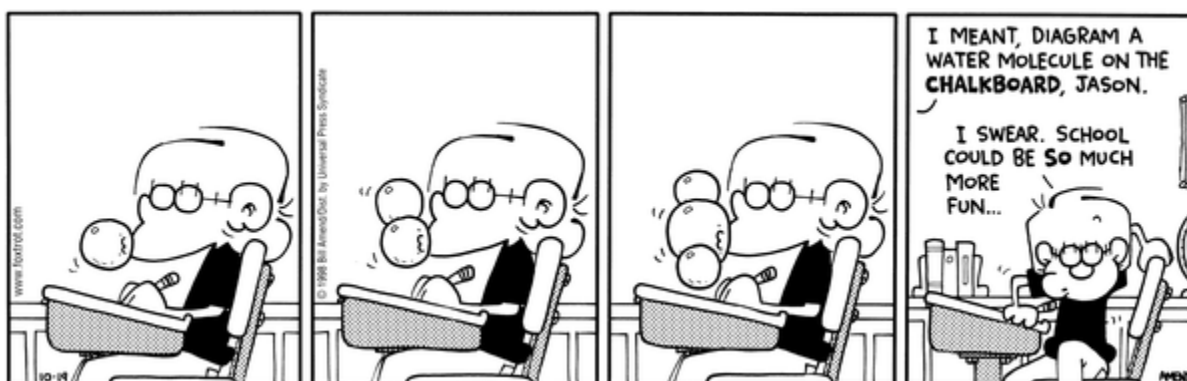
$R = 0.08206 \text{ L atm mol}^{-1} \text{ K}^{-1}$	$K = ^\circ\text{C} + 273.15$
1 atmosphere = 760 Torr = 760 mm Hg	$\left(P + a\left(\frac{n}{V}\right)^2\right)(V - bn) = nRT$
$P_{\text{total}} = n_{\text{total}}RT/V$	$P_A = X_a P_{\text{total}}$
$N_a = 6.02214 \times 10^{23} \text{ mol}^{-1}$	$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$

Molar Masses	
Compound	Molar Mass (g/mol)
AlCl_3	133.3396
$\text{C}_2\text{H}_6\text{O}$	46.0684
$\text{Ca}(\text{OH})_2$	74.093
CaCl_2	110.983
CO_2	44.010
H_2	2.01588
H_2O	18.0153
HCl	36.4606
H_2SO_4	98.079
NaOH	39.9971
NH_3	17.0356
NH_4Cl	53.4912
N_2	28.0134
O_2	31.9988

Vapor Pressure of Water at Various Temperatures

Temperature ($^\circ\text{C}$)	Vapor Pressure (mmHg)
15.0	12.79
17.0	14.53
19.0	16.48
21.0	18.65
23.0	21.07
25.0	23.76
30.0	31.82
50.0	92.51

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1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1A	2A	3B	4B	5B	6B	7B	8	9B	10	1B	2B	3A	4A	5A	6A	7A	8A
1 H 1.00794	2 He 4.00260	3 Li 6.941	4 Be 9.01218	5 B 10.811	6 C 12.011	7 N 14.0067	8 O 15.9994	9 F 18.9984	10 Ne 20.1797	11 Na 22.9898	12 Mg 24.3050	13 Al 26.9815	14 Si 28.0855	15 P 30.9738	16 S 32.066	17 Cl 35.4527	18 Ar 39.948
19 K 39.0983	20 Ca 40.078	21 Sc 44.9559	22 Ti 47.88	23 V 50.9415	24 Cr 51.9961	25 Mn 54.9381	26 Fe 55.847	27 Co 58.9332	28 Ni 58.693	29 Cu 63.546	30 Zn 65.39	31 Ga 69.723	32 Ge 72.61	33 As 74.9216	34 Se 78.96	35 Br 79.904	36 Kr 83.80
37 Rb 85.4678	38 Sr 87.62	39 Y 88.9059	40 Zr 91.224	41 Nb 92.9064	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.906	46 Pd 106.42	47 Ag 107.868	48 Cd 112.411	49 In 114.818	50 Sn 118.710	51 Sb 121.757	52 Te 127.60	53 I 126.904	54 Xe 131.29
55 Cs 132.905	56 Ba 137.327	57 *La 138.906	72 Hf 178.49	73 Ta 180.948	74 W 183.84	75 Re 186.207	76 Os 190.23	77 Ir 192.22	78 Pt 195.08	79 Au 196.967	80 Hg 200.59	81 Tl 204.383	82 Pb 207.2	83 Bi 208.980	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra 226.025	89 †Ac 227.028	104 Rf (261)	105 Db (262)	106 Sg (266)	107 Bh (264)	108 Hs (277)	109 Mt (268)	110 Ds (271)	111 Rg (272)							

*Lanthanide series	58 Ce 140.115	59 Pr 140.908	60 Nd 144.24	61 Pm (145)	62 Sm 150.36	63 Eu 151.965	64 Gd 157.25	65 Tb 158.925	66 Dy 162.50	67 Ho 164.930	68 Er 167.26	69 Tm 168.934	70 Yb 173.04	71 Lu 174.967
†Actinide series	90 Th 232.038	91 Pa 231.036	92 U 238.029	93 Np 237.048	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (262)