

CHEM 1225
Exam III
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April 8, 1999

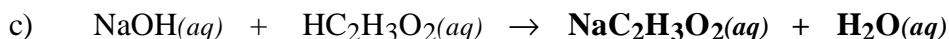
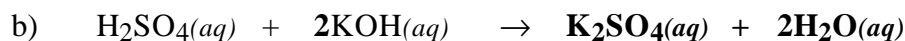
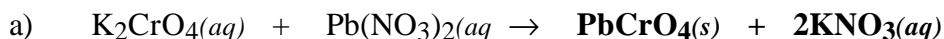
Name _____
TA's Name _____
Lab Section _____

INSTRUCTIONS:

1. This examination consists of a total of 7 different pages. The last two pages includes a periodic table and a solubility table. All work should be done in this booklet.
2. PRINT your name, TA's name and your lab section number now in the space at the top of this sheet. **DO NOT SEPARATE THESE PAGES.**
3. Answer all questions that you can and whenever called for show your work clearly. Your method of solving problems should pattern the approach used in lecture. You do not have to show your work for the multiple choice (if any) or short answer questions.
4. No credit will be awarded if your work is not shown in problems 3 – 5, 7, 8, 10 and 11.
5. Point values are shown next to the problem number.
6. Budget your time for each of the questions. Some problems may have a low point value yet be very challenging. If you do not recognize the solution to a question quickly, skip it, and return to the question after completing the easier problems.
7. Look through the exam before beginning; plan your work; then begin.
8. ~~Relax~~ and do well.

	Page 2	Page 3	Page 4	Page 5	Page 6	TOTAL
SCORES	<u> </u> (20)	<u> </u> (22)	<u> </u> (22)	<u> </u> (18)	<u> </u> (18)	<u> </u> (100)

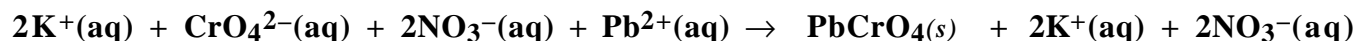
(12) 1. Write the chemical formula(s) of the product(s) and balance the following reactions. Identify all products phases as either (g)as, (l)iquid, (s)olid or (aq)ueous.



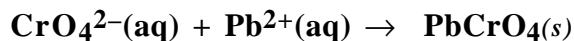
(8) 2. Write the balanced ionic and balanced net ionic chemical equations for any two of the reactions in Problem 1. (Remember to include the correct charges on all ions and the phase of each species.)

1a, 1b, 1c or 1d)

Ionic equation:

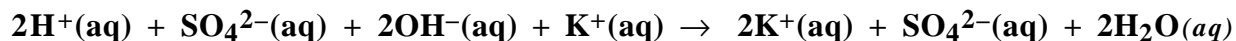


Net Ionic equation:

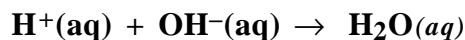


1a, 1b or 1c)

Ionic equation:

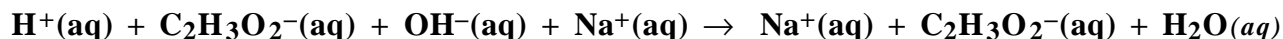


Net Ionic equation:

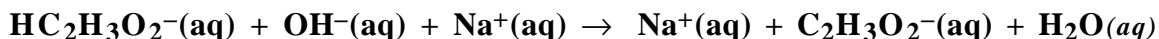


1a, 1b or 1c)

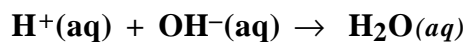
Ionic equation:



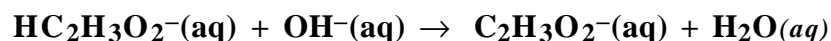
Or more correct



Net Ionic equation:



Or more correct



(12) 3. Describe how you would prepare;

a) 500.00 mls of a 1.25 M Na₂SO₄ solution.

$$0.500 \text{ L} \left(\frac{1.25 \text{ mol}}{1 \text{ Liter}} \right) = 0.625 \text{ mol Na}_2\text{SO}_4$$

$$0.625 \text{ mol} \left(\frac{142 \text{ g}}{1 \text{ mol}} \right) = 88.8 \text{ gm Na}_2\text{SO}_4$$

Wearing your safety goggles, add the Na₂SO₄ solid to approximately 300 mL of water and be sure the solid has completely dissolved. Then add enough water to obtain 500.0 mL solution. (Note: we do not have to worry about how much water is added, only the final volume.)

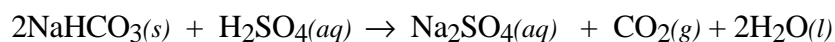
b) 1 liter of 0.733 M KMnO₄ from a solution which is 1.39 M KMnO₄.

$$M_1 V_1 = M_2 V_2$$

$$V_1 = \left(\frac{M_2 V_2}{M_1} \right) = \left(\frac{0.733 \text{ M} \cdot 1 \text{ L}}{1.39 \text{ M}} \right) = 527 \text{ mLs}$$

Add enough water to 527 mLs of 1.39 M KMnO₄ to get 1 L of 0.733 M solution.

(10) 4. Some sulfuric acid is spilled on a bench top in the laboratory. Sodium hydrogen carbonate is sprinkled on the spill. The balanced equation describing the reaction which takes place,

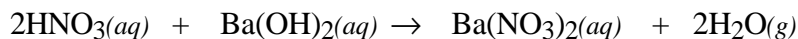


Calculate the mass of sodium hydrogen carbonate that must be weighed out to react with 400. mLs of 6.00 M H₂SO₄ that was spilled.

$$400.0 \text{ mLs} \left(\frac{1 \text{ L}}{1000 \text{ mL}} \right) \left(\frac{6.00 \text{ mol H}_2\text{SO}_4}{1 \text{ L}} \right) = 2.40 \text{ mol H}_2\text{SO}_4$$

$$2.40 \text{ mol H}_2\text{SO}_4 \left(\frac{2 \text{ mol NaHCO}_3}{1 \text{ mol H}_2\text{SO}_4} \right) \left(\frac{84 \text{ g NaHCO}_3}{1 \text{ mol NaHCO}_3} \right) = 403 \text{ g NaHCO}_3$$

(10) 5. Nitric acid reacts with barium hydroxide according to the equation;



Calculate the volume of 0.259 M nitric acid required to exactly neutralize 18.0 mLs of 0.185 M barium hydroxide.

$$0.0180 \text{ L} \left(\frac{0.185 \text{ mol Ba}(\text{OH})_2}{1 \text{ L}} \right) \left(\frac{2 \text{ mol HNO}_3}{1 \text{ mol Ba}(\text{OH})_2} \right) \left(\frac{1 \text{ L}}{0.259 \text{ mol HNO}_3} \right) = 0.0260 \text{ L HNO}_3$$

(4) 6. Write the equilibrium expression for each of the following chemical equations;

a)



$$K = \frac{[\text{NCl}_3]^2}{[\text{N}_2][\text{Cl}_2]^3}$$

b)



$$K = \frac{[\text{CO}_2]^8[\text{H}_2\text{O}]^{18}}{[\text{O}_2]^{17}}$$

(8) 7. The equation describing the industrial preparation of ammonia is;



Suppose that a reaction mixture at a given temperature, at equilibrium, was analyzed and found to contain 3.45×10^{-4} M NH_3 , 8.17×10^{-4} M N_2 , and 0.580 M H_2 . Calculate the magnitude of the equilibrium constant for the reaction.

$$K = \frac{[\text{NH}_3]^2}{[\text{N}_2][\text{H}_2]^3}$$

$$K = \frac{[3.45 \times 10^{-4}]^2}{[8.17 \times 10^{-4}][0.580]^3}$$

$$K = 7.47 \times 10^{-4}$$

(10) 8. When 0.981 moles of NO, 0.483 moles of Cl₂ and 0.400 moles of NOCl are sealed in a 1.00 L flask at 220 °C, the following equilibrium is established,



After the mixture achieves equilibrium analysis shows the concentration of NOCl to be 0.222 M. Calculate K for the reaction.

	$2\text{NO}(g) + \text{Cl}_2(g) \rightleftharpoons 2\text{NOCl}(g)$		
Initial	0.981	0.483	0.400
Change			
Equilibrium			0.222

Since 0.222 moles of NOCl are formed at equilibrium, 0.178 moles of NOCl must have reacted. So 0.178 moles is the change in NOCl. We now use stoichiometry to calculate the change of NO and Cl₂.

$$0.178 \text{ mol NOCl} \left(\frac{2 \text{ mol NO}}{2 \text{ mol NOCl}} \right) = 0.178 \text{ mol NO}$$

$$0.178 \text{ mol NOCl} \left(\frac{1 \text{ mol Cl}_2}{2 \text{ mol NOCl}} \right) = 0.089 \text{ mol Cl}_2$$

Remember since NOCl reacted, NO and Cl₂ are formed. Now the ICE table looks like

	$2\text{NO}(g) + \text{Cl}_2(g) \rightleftharpoons 2\text{NOCl}(g)$		
Initial	0.981	0.483	0.400
Change	+0.178	+0.089	-0.178
Equilibrium	1.16	0.661	0.222

$$K = \frac{[\text{NOCl}]^2}{[\text{Cl}_2][\text{NO}]^2}$$

$$K = \frac{[0.222]^2}{[0.661][1.16]^2}$$

$$K = 0.055$$

(8) 9. For the system



How will the [NH₃] be effected (increase, decrease or no change) when the equilibrium is disturbed by;

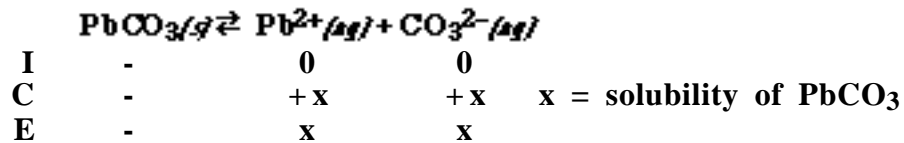
a) Removal of O₂ **increase**

b) Addition of H₂O **increase**

c) Increase in temperature **increase**

d) Decrease in the volume of the reaction container **increase**

- (9) 10. Calculate the solubility of PbCO_3 in pure water. $K_{\text{sp}} = 1.0 \times 10^{-13}$



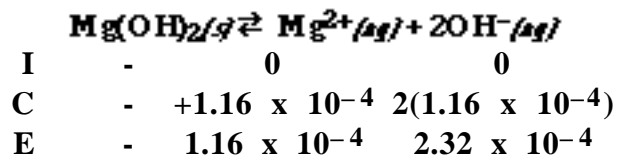
$$K_{\text{sp}} = [\text{Pb}^{2+}][\text{CO}_3^{2-}]$$

$$1.0 \times 10^{-13} = (x)(x)$$

$$1.0 \times 10^{-13} = x^2$$

$$3.16 \times 10^{-7} \text{ M} = x = \text{solubility of } \text{PbCO}_3$$

- (9) 11. The concentration of Mg^{2+} in a saturated solution of $\text{Mg}(\text{OH})_2$ is $1.16 \times 10^{-4} \text{ M}$. Calculate the magnitude of the equilibrium constant, K_{sp} , for $\text{Mg}(\text{OH})_2$.



$$K_{\text{sp}} = [\text{Mg}^{2+}][\text{OH}^{-}]^2$$

$$K_{\text{sp}} = [1.16 \times 10^{-4}][2.32 \times 10^{-4}]^2$$

$$K_{\text{sp}} = 6.24 \times 10^{-12}$$

Periodic Table of the Elements

	IA																VIII A	
1	1 H 1.008	IIA										III A	IVA	VA	VIA	VII A	2 He 4.00	
2	3 Li 6.94	4 Be 9.01										5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18	
3	11 Na 22.99	12 Mg 24.30	IIIB	IVB	VB	VIB	VIIB	VIII	IB	IIB		13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.06	17 Cl 35.45	18 Ar 39.95	
4	19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.88	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.38	31 Ga 69.72	32 Ge 72.59	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
5	37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc (98)	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3
6	55 Cs 132.9	56 Ba 137.3	57 La 138.9	72 Hf 178.5	73 Ta 180.9	74 W 183.8	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209.0	84 Po (209)	85 At (210)	86 Rn (222)
7	87 Fr (223)	88 Ra 226.0	89 Ac 227.0	104 Rf (261)	105 Db (262)	106 Sg (263)	107 Bh (262)	108 Hs (265)	109 Mt (266)									

Lanthanides	58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm (145)	62 Sm 150.4	63 Eu 152.0	64 Gd 157.2	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 175.0
Actinides	90 Th 232.0	91 Pa 231.0	92 U 238.0	93 Np 237.0	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 (260)

Solubility Table

Ion	Solubility	Exceptions
NO_3^-	soluble	none
ClO_4^-	soluble	none
Cl^-	soluble	except Ag^+ , Hg_2^{2+} , Pb^{2+}
SO_4^{2-}	soluble	except Ca^{2+} , Ba^{2+} , Sr^{2+} , Hg^{2+} , Pb^{2+} , Ag^+
CO_3^{2-}	insoluble	except Group IA and NH_4^+
PO_4^{3-}	insoluble	except Group IA and NH_4^+
CrO_4^{2-}	insoluble	except Group IA, IIA and NH_4^+
-OH	insoluble	except Group IA, Ca^{2+} , Ba^{2+} , Sr^{2+}
S^{2-}	insoluble	except Group IA, IIA and NH_4^+
Na^+	soluble	none
NH_4^+	soluble	none
K^+	soluble	none

*slightly soluble

