Dr. Zellmer | Chemistry 1220 | All sections
Time: 7 PM Sun. | Spring Semester 2023 | February 19, 2023
30 min | Quiz V

Name _____ Rec. TA/time _____

Show **ALL** your work or **EXPLAIN** to receive full credit. R = 0.08206 L•atm/mol•K = 8.314 J/mol•K

1. (9 pts) For the following reaction K_C equals 7.10×10^{-4}, at 25 °C.

$$CaCrO_4\,(s) \rightleftarrows Ca^{2+}\,(aq) + CrO_4^{2-}\,(aq)$$

a) (4 pts) What are the **equilibrium** concentrations of Ca^{2+} and CrO_4^{2-} if solid $CaCrO_4$ is placed in water to form a saturated solution at 25°C? (**Show the ICE table. State any assumptions made and check your percent error.**) **This part was on quiz 4.**

b) (1 pts) For the system at equilibrium, what happens when $CaCl_2(s)$, a soluble compound, is added?? (i.e. does the equilibrium shift and if so in what direction? If no shift then why not.) **EXPLAIN!**

c) (1 pts) For the system at equilibrium, what happens when **water** is **added** to the system? (i.e. does the equilibrium shift and if so in what direction? If no shift then why not.) **EXPLAIN!**

d) (1 pts) For the system at equilibrium, what happens when part of the $CaCrO_4$ is **removed**? (i.e. does the equilibrium shift and if so in what direction? If no shift then why not.) **EXPLAIN!**

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1. (Cont.)

e) (2 pts) Assuming the above reaction is endothermic, what happens when the temperature increases? (i.e. does the equilibrium shift and if so in what direction? If no shift then why not.) Also, what happens to the value of K? **EXPLAIN!**

2. (9 pts) For the following reaction K_C equals 5.35×10^2 at 80 °C.

$$PH_3\,(g) \quad + \quad BCl_3\,(g) \quad \rightleftarrows \quad PH_3BCl_3\,(s)$$

a) (4pts) What are the **equilibrium** concentrations of PH_3 and BCl_3 if 1.000 mole of each is placed in a 0.500-L vessel and allowed to react until equilibrium is reached? (**Show the ICE table. When appropriate, state any assumptions made and check your percent error.**) **This part was on quiz 4.**

b) (1 pt) For the system at equilibrium, what happens to the reaction when the **pressure** is **increased** by adding Ne (an inert gas) at **constant temperature** and **volume**? (i.e. does the equilibrium shift and if so in what direction? If no shift then why not.) **EXPLAIN!**

c) (1 pt) For the system at equilibrium, what happens to the reaction when PH_3 is **added**? (i.e. does the equilibrium shift and if so in what direction? If no shift then why not.) **EXPLAIN!**

d) (1 pt) For the system at equilibrium, what happens to the reaction when **all** the PH_3BCl_3 is **removed**? (i.e. does the equilibrium shift and if so in what direction? If no shift then why not.) **EXPLAIN!**

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2. (Cont.)

e) (2 pts) Assuming the above reaction is exothermic, what happens when the temperature decreases? (i.e. does the equilibrium shift and if so in what direction? If no shift then why not.) Also, what happens to the value of K? **EXPLAIN!**

3. (2 pts) What is(are) the difference(s) between the **Arrhenius** and **Bronsted-Lowry** definitions of a **base**? **Not on quiz.**

4. (3 pts) What is the **conjugate <u>acid</u>** of $H_2P_2O_7^{2-}$?

5. (4 pts) Predict the products of the following acid-base reaction and whether the equilibrium lies to the left (more reactants at equilibrium) or the right (more products at equilibrium). **EXPLAIN!**

a)

$$HF + OH^- \rightleftarrows$$

b)

$$CH_3CO_2^- + H_3O^+ \rightleftarrows$$

6. (2 pts) Which of the following are **strong** acids or **strong** bases? (Circle all that apply.)

HNO_3	$HClO_2$	$HClO_4$	RbOH	NH_3
$HBrO_2$	N^{3-}	HSO_4^-	HF	C_6H_5OH

7. (5 pts) A saturated solution of $Ca(OH)_2$ has a $[Ca^{2+}]$ of 0.15 M. What is the pH of the solution? (atomic weights: Ca = 40.08, O = 16.00, H = 1.008)

8. (5 pts) Calculate the pH of an aqueous solution that is 0.0030 M in HCl(aq) and 0.0060 M in HBr(aq).

9. (4 pts) $D_2O(\ell)$ is deuterium oxide, or better known as "heavy water". $D_2O(\ell)$ has an equilibrium dissociation constant, K_D (along the lines of K_w for water) of 8.90×10^{-16} at 20.0°C. Answer the following using this information.

a) Calculate $[D^+]$ and $[OD^-]$ for D_2O at this temperature.

b) What is the pD of this liquid? (Hint: pD is a pX function, like pH)?

c) What is the pK_D of D_2O?

10. (5 pts) The K_w for water is 9.6×10^{-14} at 60°C. Answer the following **TWO** questions.

a) What is the pH of a neutral solution at 60°C? **Show all work or explain!**

b) If a solution at 60°C has pH = 7.00 is it acidic, basic, or neutral? **Explain!**

USEFUL INFORMATION

R = 0.08206 L-atm/mol-K = 8.3145 J/mol-K

	IA	IIA	IIIB	IVB	VB	VIB	VIIB	VIIIB			IB	IIB	IIIA	IVA	VA	VIA	VIIA	VIIIA
1	1.008 **H** 1																	4.003 **He** 2
2	6.941 **Li** 3	9.012 **Be** 4											10.811 **B** 5	12.011 **C** 6	14.007 **N** 7	15.999 **O** 8	18.998 **F** 9	20.179 **Ne** 10
3	22.990 **Na** 11	24.305 **Mg** 12											26.98 **Al** 13	28.09 **Si** 14	30.974 **P** 15	32.06 **S** 16	35.453 **Cl** 17	39.948 **Ar** 18
4	39.098 **K** 19	40.08 **Ca** 20	44.96 **Sc** 21	47.88 **Ti** 22	50.94 **V** 23	52.00 **Cr** 24	54.94 **Mn** 25	55.85 **Fe** 26	58.93 **Co** 27	58.69 **Ni** 28	63.546 **Cu** 29	65.38 **Zn** 30	69.72 **Ga** 31	72.59 **Ge** 32	74.92 **As** 33	78.96 **Se** 34	79.904 **Br** 35	83.80 **Kr** 36
5	85.47 **Rb** 37	87.62 **Sr** 38	88.91 **Y** 39	91.22 **Zr** 40	92.91 **Nb** 41	95.94 **Mo** 42	98 **Tc** 43	101.07 **Ru** 44	102.91 **Rh** 45	106.42 **Pd** 46	107.87 **Ag** 47	112.41 **Cd** 48	114.82 **In** 49	118.69 **Sn** 50	121.75 **Sb** 51	127.60 **Te** 52	126.90 **I** 53	131.39 **Xe** 54
6	132.91 **Cs** 55	137.33 **Ba** 56	138.91 **La** 57	178.39 **Hf** 72	180.95 **Ta** 73	183.85 **W** 74	186.21 **Re** 75	190.23 **Os** 76	192.22 **Ir** 77	195.08 **Pt** 78	196.97 **Au** 79	200.59 **Hg** 80	204.38 **Tl** 81	207.2 **Pb** 82	208.98 **Bi** 83	209 **Po** 84	210 **At** 85	222 **Rn** 86
7	223 **Fr** 87	226.03 **Ra** 88	227.03 **Ac** 89	261 **Rf** 104	262 **Ha** 105	263 **Sg** 106	262 **Ns** 107	265 **Hs** 108	266 **Mt** 109	269 110	272 111	277 112						

Lanthanide Series	140.12 **Ce** 58	140.91 **Pr** 59	144.24 **Nd** 60	145 **Pm** 61	150.36 **Sm** 62	151.96 **Eu** 63	157.25 **Gd** 64	158.93 **Tb** 65	162.50 **Dy** 66	164.93 **Ho** 67	167.26 **Er** 68	168.93 **Tm** 69	173.04 **Yb** 70	173.04 **Lu** 71
Actinide Series	232.04 **Th** 90	231.04 **Pa** 91	238.03 **U** 92	237.05 **Np** 93	**Pu** 94	**Am** 95	**Cm** 96	**Bk** 97	**Cf** 98	**Es** 99	**Fm** 100	**Md** 101	**No** 102	**Lr** 103

A PERIODIC CHART OF THE ELEMENTS
(Based on ^{12}C)