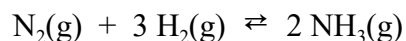


Name \_\_\_\_\_ Rec. TA/time \_\_\_\_\_

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Show **ALL** your work or **EXPLAIN** to receive full credit.  $R = 0.08206 \text{ L}\cdot\text{atm/mol}\cdot\text{K} = 8.314 \text{ J/mol}\cdot\text{K}$

1. The equilibrium constant for the following reaction is 70 at  $350^\circ\text{C}$ . A system at equilibrium has  $[\text{N}_2] = 0.200 \text{ M}$  and  $[\text{NH}_3] = 0.118 \text{ M}$ . What is the  $[\text{H}_2]$ ?



2. The properly written heterogeneous  $K_c$  expression for the following reaction as written is:



3. (3 pts) At equilibrium, which of the following is(are) **TRUE**?
- a) All chemical processes have ceased.
  - b) The rate constant for the forward reaction equals that of the reverse.
  - c) The rate of the forward reaction equals that of the reverse.
  - d) Both the rate of the forward reaction equals that of the reverse and the rate constant for the forward reaction equals that of the reverse.
  - e) The concentrations of reactants and products are constant.

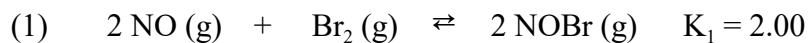
4. (3 pts) For the following reaction  $K_p = 3.14 \times 10^{-10}$  at  $727.0^\circ\text{C}$ .



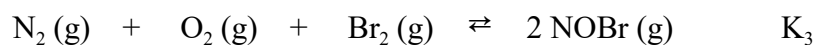
What is the value of  $K_p$  for the following reaction, **Rxn 2**? **Show all work or explain.**



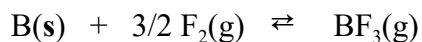
5. Given the following two equilibrium reactions,



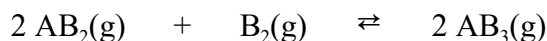
What is the equilibrium constant,  $K_3$ , for the reaction below?



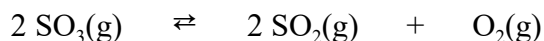
6. The equilibrium constant  $K_c$  for the following reaction at  $1100^\circ\text{C}$  is  $6.80 \times 10^{51}$ . What is  $K_p$ ?



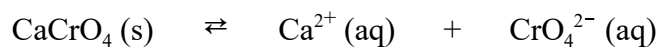
7. (3 pts) For the following reaction  $K_c = 25.8$ . The reaction is started with 1.000 mole of  $\text{AB}_3$ , 2.000 moles of  $\text{AB}_2$  and 1.000 mole of  $\text{B}_2$  in a 2.000-L container. Determine if the reaction is at equilibrium or not? If not, which direction will it proceed to reach equilibrium? **Show work and explain!**



8. (5 pts) The following reaction is started with 2.000 moles of  $\text{SO}_3$  in a 2.000-L container. When equilibrium is reached there are 1.645 moles of  $\text{SO}_3$  in the container. What is the value of the equilibrium constant,  $K_c$ ? (Show the ICE table. You can use numbers or variables in your ICE table.)



9. (4 pts) For the following reaction  $K_c$  equals  $7.10 \times 10^{-4}$ , at  $25^\circ\text{C}$ .



What are the **equilibrium** concentrations of  $\text{Ca}^{2+}$  and  $\text{CrO}_4^{2-}$  if solid  $\text{CaCrO}_4$  is placed in water to form a saturated solution at  $25^\circ\text{C}$ ? (**Show the ICE table.**)

10. (3 pts) A plot of  $\ln(r)$  vs.  $\ln[A]$  has a slope of -2.5 and an intercept of -10.55. Determine the **rate constant** and **order** of the reaction for the rate law,  $r = k[A]^n$ .

# USEFUL INFORMATION

$$R = 0.08206 \text{ L-atm/mol-K} = 8.3145 \text{ J/mol-K}$$

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

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

A PERIODIC CHART OF THE ELEMENTS  
(Based on <sup>12</sup>C)