

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. (8 pts) The rate law for the decomposition of  $\text{AB}_2$  ( $\text{AB}_2 \rightarrow \text{AB} + \frac{1}{2} \text{B}_2$ ) is

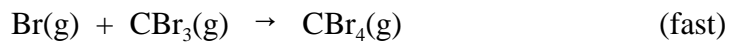
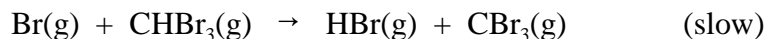
$$r = (0.630 \text{ M}^{-1}\cdot\text{s}^{-1}) [\text{AB}_2]^2.$$

- a) (5 pts) If the initial concentration of  $\text{AB}_2$  is 3.00 M what will the **concentration** of  $\text{AB}_2$  be (in M) after 1.00 minute?

- b) (3 pts) What is the **half-life** (in min) for the reaction based on an initial concentration of 0.0100 M?

2. (3 pts) Explain how **raising** the **temperature increases** the **rate** by using the **Arrhenius Equation**.  
(Show this equation and use it in your explanation!)

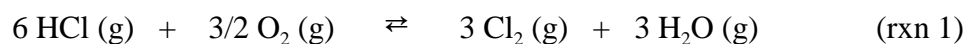
3. (9 pts) The following mechanism has been proposed for the gas-phase reaction of bromoform,  $\text{CHBr}_3$ , and bromine.



- (a) What is the overall reaction?
- (b) What are the **intermediates** in the mechanism?
- (c) What is the **molecularity** of each elementary step?
- Step 1                      Step 2
- (d) What is the **rate-determining step** (explain why)?
- (e) What is the **rate law** predicted by this mechanism?

4. (3 pts) Draw a “reaction coordinate diagram” (energy profile or potential energy diagram) for an exothermic reaction. **Label the axes, activation energy,  $E_a$ , and the transition state** (activated complex) and  $\Delta E$  on the diagram. **Also, show the effect of a catalyst** on this graph (i.e. what is the main way in which a catalyst speeds up a reaction).
5. (3 pts) You are given the general rate law  $r = k[A]^n$ , and concentration and rate data. Convert this to a linear equation and explain how you graphically obtain  $k$  and  $n$  (i.e. what do you plot as  $x$  and  $y$  and how do you obtain  $n$  and  $k$  from the graph)?

6. (6 pts) For the following reaction  $K_p = 48.5$  at  $480.0^\circ\text{C}$

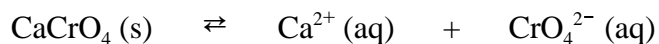


- a) (3 pts) What is the value of  $K_p$  for the following reaction? **Show all work or explain.**



- b) (3 pts) What is the value of  $K_c$  for reaction 1 at  $480.0^\circ\text{C}$ ? **Show all work or explain.**

7. (8 pts) For the following reaction  $K_C$  equals  $7.10 \times 10^{-4}$ , at  $25^\circ\text{C}$ .



a) (5 pts) 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. When appropriate, state any assumptions made and check your percent error.**)

b) (1 pt) For the system at equilibrium, what happens when  $\text{CaCl}_2(\text{s})$ , 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) Assume the above reaction is endothermic. For the system at equilibrium, what happens to the reaction when the temperature increases? (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 when part of the  $\text{CaCrO}_4$  is **removed**? (i.e. does the equilibrium shift and if so in what direction? If no shift then why not.) **EXPLAIN!**

$$\frac{1}{[A]_t} = kt + \frac{1}{[A]_0} \quad [A]_t = -kt + [A]_0 \quad \ln[A]_t = -kt + \ln[A]_0$$

$$t_{\frac{1}{2}} = \frac{0.693}{k} \quad t_{\frac{1}{2}} = \frac{[A]_0}{2k} \quad t_{\frac{1}{2}} = \frac{1}{k[A]_0}$$

	IA	IIA	IIIB	IVB	VB	VIB	VII B	VIII B			IB	IIB	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	81.22 <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)