Dr. Zellmer | Chemistry 1220 | Thursday
Time: 40 min | Summer Semester 2017 | June 22, 2017
Quiz II

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. (8 pts) The rate law for the decomposition of AB_2 ($AB_2 \rightarrow AB + \frac{1}{2} B_2$) is

$$r = (0.630\ M^{-1} \bullet s^{-1})\ [AB_2]^2.$$

a) (5 pts) If the initial concentration of AB_2 is 3.00 M what will the **concentration** of 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!**)

OVER ...

3. (9 pts) The following mechanism has been proposed for the gas-phase reaction of bromoform, $CHBr_3$, and bromine.

$$Br_2(g) \rightleftarrows 2\ Br(g) \qquad \text{(fast, equilibrium)}$$

$$Br(g) + CHBr_3(g) \rightarrow HBr(g) + CBr_3(g) \qquad \text{(slow)}$$

$$Br(g) + CBr_3(g) \rightarrow CBr_4(g) \qquad \text{(fast)}$$

(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**, $\mathbf{E_a}$, and the **transition state** (activated complex) and **ΔE** 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 °C

$$6\ HCl\ (g) + 3/2\ O_2\ (g) \rightleftarrows 3\ Cl_2\ (g) + 3\ H_2O\ (g) \qquad \text{(rxn 1)}$$

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

$$2\ Cl_2\ (g) + 2\ H_2O\ (g) \rightleftarrows 4\ HCl\ (g) + O_2\ (g) \qquad \text{(rxn 2)}$$

b) (3 pts) What is the value of K_C for reaction 1 at 480.0 °C? **Show all work or explain.**

OVER ...

7. (8 pts) For the following reaction K_C equals 7.10×10^{-4}, at 25 °C.

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

a) (5 pts) What are the **<u>equilibrium</u>** 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. When appropriate, state any assumptions made and check your percent error.**)

b) (1 pt) 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) 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 $CaCrO_4$ is **removed**? (i.e. does the equilibrium shift and if so in what direction? If no shift then why not.) **EXPLAIN!**

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

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

	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	81.22 **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)