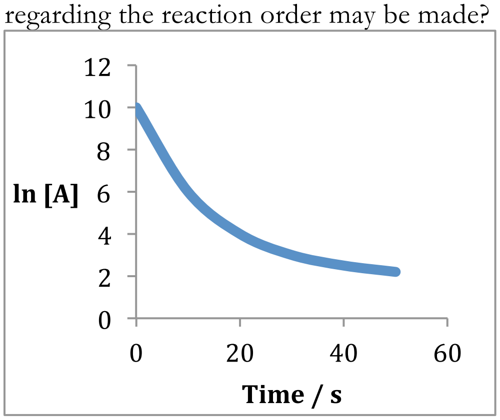
Exam 2A
Chem 1142
Spring 2013

Name:______________________

MULTIPLE CHOICE. [5 pts ea.] Choose the best response on the scantron sheet. [**60 pts total.**]

Q1. For the gaseous reaction, $2A \longrightarrow B$ the results of a plot of ln[A] vs. time is shown below. What conclusion regarding the reaction order may be made?



a) The reaction is first order
b) the reaction is not first order
c) the reaction is second order
d) the reaction is not second order
e) the reaction is third order

Q2. For the reaction: $A \longrightarrow B + C$, the reaction order is:

a) third order
b) second order
c) first order
d) zero order
e) impossible to predict without more information

Q3. What are the units for *k*, the rate constant, in a second order reaction?

a) s^{-1}
b) $M \cdot s^{-1}$
c) $M^{-1}s^{-1}$
d) s/M
e) M^2

Q4. What is unique about the half-life of any first order reaction?

a) the units are always s^{-1}
b) the value only depend on the rate constant, *k*
c) the value depends only on the initial concentration of reactant
d) $\Delta[A_0]/\Delta t = 1$
e) $\Delta[A_0]/\Delta t = \frac{1}{2}$

Q5. The Arrhenius equation may be used to calculate the activation energy from the slope of a line plotted with what parameters?

a) ln *k* vs. 1/Temperature
b) ln *k* vs. 1/time
c) 1/*k* vs. Temperature
d) 1/*k* vs. 1/time
e) ln *k* vs. e^{-T}

Q6. The reaction: $A + 2B \longrightarrow C$ is thought to proceed via the mechanism:

$B + B \longrightarrow I$ (slow)

$I + A \longrightarrow C$ (fast)

The predicted rate law for this process would be:

a) rate = $k[A][B]^2$
b) rate = $k[A][2B]$
c) rate = $k[2B]$
d) rate = $k[B]^2$
e) rate = $k[I][A]$

Q7. The chemical equilibrium: $2A(s) + 3B(g) \rightleftharpoons 4C(g)$ has an equilibrium constant equal to:

a) $K_c = \frac{[4C]}{[2A][3B]}$ b) $K_c = \frac{[2A][3B]}{[4C]}$ c) $K_c = \frac{[C]^4}{[A]^2[B]^3}$

d) $K_c = \frac{[C]}{[A][B]}$ e) $K_c = \frac{[C]^4}{[B]^3}$

Q8. For which of the following chemical equilibria would K_c equal K_p?

a) $A(g) \rightleftharpoons A(l)$ b) $2A(g) \rightleftharpoons 3B(g)$ c) $2A(s) \rightleftharpoons B(g) + C(s)$

d) $2A(g) + B(s) \rightleftharpoons C(g) + D(g)$ e) $3A(s) \rightleftharpoons C(g)$

Q9. For the chemical equilibrium: $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$, which direction would the equilibrium shift if the total reaction volume was decreased?

a) Left b) No-Change c) Right

d) Not enough information given

Q10. For the chemical equilibrium: $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$, which direction would the equilibrium shift if some NH_3 was removed?

a) Left b) No-Change c) Right

d) Not enough information given

Q11. How does the addition of a catalyst affect the equilibrium constant?

a) Increases its value b) No change to its value c) Decreases its value

d) Impossible to answer without more information

Q12. If the equilibrium constant *increases* as the reaction temperature is increased from 10.0 ºC to 20.0 ºC, then:

a) temperature is acting as a catalyst b) the reaction is exothermic

c) the activation energy is being lowered d) the activation energy is being raised

e) the reaction is endothermic

Short Response.

Show ALL work to receive credit.

Q13. [20 pts.] Consider the reaction

$$X + Y \longrightarrow Z$$

These data are obtained at 360 K:

Experiment #	[X] (M)	[Y] (M)	Initial Rate (M/s)
1	0.40	0.60	4.064
2	0.20	0.60	1.016
3	0.40	0.30	0.508

(a) Determine the rate law, and the value of the rate constant.

(b) Determine the initial rate when the concentration of X is 0.30 M and that of Y is 0.40 M.

Q14. [20 pts.] K_p for the reaction: $I_2(g) \rightleftharpoons 2I(g)$ is 0.10 at a temperature of 203 ºC. Imagine you started with a mixture of $I_2(g)$ and I(g) with partial pressures of 1.00 atm and 1.00 atm respectively. Calculate the total pressure of the system when it reached equilibrium.

Useful Information

Periodic Table of the Elements

IA 1	IIA 2	3	4	5	6	7	8	9	10	11	12	IIIA 13	IVA 14	VA 15	VIA 16	VIIA 17	VIIIA 18
1 **H** 1.01																	2 **He** 4.00
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
11 **Na** 22.99	12 **Mg** 24.31											13 **Al** 26.98	14 **Si** 28.09	15 **P** 30.97	16 **S** 32.07	17 **Cl** 35.45	18 **Ar** 39.95
19 **K** 39.10	20 **Ca** 40.08	21 **Sc** 44.96	22 **Ti** 47.87	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** 65.39	31 **Ga** 69.72	32 **Ge** 72.61	33 **As** 74.92160	34 **Se** 78.96	35 **Br** 79.90	36 **Kr** 83.80
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** 101.07	45 **Rh** 102.91	46 **Pd** 106.42	47 **Ag** 107.87	48 **Cd** 112.41	49 **In** 114.82	50 **Sn** 118.71	51 **Sb** 121.76	52 **Te** 127.60	53 **I** 126.90	54 **Xe** 131.29
55 **Cs** 132.91	56 **Ba*** 137.33	71 **Lu** 174.97	72 **Hf** 178.49	73 **Ta** 180.95	74 **W** 183.84	75 **Re** 186.21	76 **Os** 190.23	77 **Ir** 192.22	78 **Pt** 195.08	79 **Au** 196.97	80 **Hg** 200.59	81 **Tl** 204.38	82 **Pb** 207.20	83 **Bi** 208.98	84 **Po** [210]	85 **At** [210]	86 **Rn** [222]
87 **Fr** [223]	88 **Ra**** [226]	103 **Lr** [262]	104 **Rf** [261]	105 **Db** [262]	106 **Sg** [266]	107 **Bh** [264]	108 **Hs** [265]	109 **Mt** [268]	110 [269]	111 [272]	112 [277]	113	114 [285]	115	116 [289]	117	118 [293]

*	57 **La** 138.91	58 **Ce** 140.12	59 **Pr** 140.91	60 **Nd** 144.24	61 **Pm** [145]	62 **Sm** 150.36	63 **Eu** 151.96	64 **Gd** 157.25	65 **Tb** 158.93	66 **Dy** 162.50	67 **Ho** 164.93	68 **Er** 167.26	69 **Tm** 168.93	70 **Yb** 173.04
**	89 **Ac** [227]	90 **Th** 232.04	91 **Pa** 231.04	92 **U** 238.03	93 **Np** [237]	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]

R = 8.3145 J/mol·K = 0.08206 (L·atm)/(mol·K)

$k = Ae^{-E_a/RT}$ $\ln k = (-E_a/R)(1/T) + \ln A$

$$\ln\left(\frac{k_2}{k_1}\right) = \frac{E_a}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

•<u>1-order</u>: $\ln[A]_t = -kt + \ln[A]_0$ $\ln\left(\frac{[A]_t}{[A]_0}\right) = -kt$ $t_{1/2} = 0.693 / k$

•<u>2-order</u>: $1/[A]_t = kt + 1/[A]_0$ $t_{1/2} = 1 / ([A]_0 \cdot k)$

$K_p = K_c(RT)^{\Delta n_g}$

Given: $ax^2 + bx + c = 0$, then $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$