

Formulas and Constants
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$$N_A = 6.022 \times 10^{23} \text{ mol}^{-1} \quad h = 6.626 \times 10^{-34} \text{ J s} \quad c = 2.998 \times 10^8 \text{ m s}^{-1}$$

$$e = 1.602 \times 10^{-19} \text{ C} \quad m_e = 9.109 \times 10^{-31} \text{ kg} \quad 1 \text{ \AA} = 1 \times 10^{-10} \text{ m} = 100 \text{ pm}$$

$$\tilde{\nu} = \frac{1}{\lambda} \quad \Delta E = \frac{hc}{\lambda} = hc\tilde{\nu}$$

$$[\text{gas(aq)}]_{\text{eq}} = K_H (P_{\text{gas}})_{\text{eq}} \quad v_{\text{solution}} = X_{\text{solvent}} v_{\text{pure solvent}}$$

$$\Delta T_f = K_f m \quad \Delta T_b = K_b m \quad \Pi V = nRT \quad \Pi = MRT$$

$$\ln\left(\frac{[A]}{[A]_0}\right) = -kt \quad [A] = [A]_0 e^{-kt} \quad \frac{1}{[A]} - \frac{1}{[A]_0} = kt$$

$$t_{1/2} = \ln 2/k = 0.6931/k \quad t_{1/2} = \frac{1}{[A]_0 k} \quad \Delta E = E_{a,f} - E_{a,r}$$

$$\ln\left(\frac{k_2}{k_1}\right) = -\frac{\Delta E_a}{R} \left(\frac{1}{T_2} - \frac{1}{T_1}\right) \quad \ln\left(\frac{k_1}{k_2}\right) = \frac{\Delta E_a}{R} \left(\frac{1}{T_2} - \frac{1}{T_1}\right) \quad k = A e^{-E_a/RT}$$

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
IA	IIA	IIIB	IVB	VB	VIB	VIIIB	---	VIII	---	IB	IIB	IIIA	IVA	VA	VIA	VIIA	VIIIA
1A	2A	3B	4B	5B	6B	7B	---	8	---	1B	2B	3A	4A	5A	6A	7A	8A

1 <u>H</u> 1.008																	2 <u>He</u> 4.003
3 <u>Li</u> 6.941	4 <u>Be</u> 9.012											5 <u>B</u> 10.81	6 <u>C</u> 12.01	7 <u>N</u> 14.01	8 <u>O</u> 16.00	9 <u>F</u> 19.00	10 <u>Ne</u> 20.18
11 <u>Na</u> 22.99	12 <u>Mg</u> 24.31											13 <u>Al</u> 26.98	14 <u>Si</u> 28.09	15 <u>P</u> 30.97	16 <u>S</u> 32.07	17 <u>Cl</u> 35.45	18 <u>Ar</u> 39.95
19 <u>K</u> 39.10	20 <u>Ca</u> 40.08	21 <u>Sc</u> 44.96	22 <u>Ti</u> 47.88	23 <u>V</u> 50.94	24 <u>Cr</u> 52.00	25 <u>Mn</u> 54.94	26 <u>Fe</u> 55.85	27 <u>Co</u> 58.47	28 <u>Ni</u> 58.69	29 <u>Cu</u> 63.55	30 <u>Zn</u> 65.39	31 <u>Ga</u> 69.72	32 <u>Ge</u> 72.59	33 <u>As</u> 74.92	34 <u>Se</u> 78.96	35 <u>Br</u> 79.90	36 <u>Kr</u> 83.80
37 <u>Rb</u> 85.47	38 <u>Sr</u> 87.62	39 <u>Y</u> 88.91	40 <u>Zr</u> 91.22	41 <u>Nb</u> 92.91	42 <u>Mo</u> 95.94	43 <u>Tc</u> (98)	44 <u>Ru</u> 101.1	45 <u>Rh</u> 102.9	46 <u>Pd</u> 106.4	47 <u>Ag</u> 107.9	48 <u>Cd</u> 112.4	49 <u>In</u> 114.8	50 <u>Sn</u> 118.7	51 <u>Sb</u> 121.8	52 <u>Te</u> 127.6	53 <u>I</u> 126.9	54 <u>Xe</u> 131.3
55 <u>Cs</u> 132.9	56 <u>Ba</u> 137.3	57 <u>La*</u> 138.9	72 <u>Hf</u> 178.5	73 <u>Ta</u> 180.9	74 <u>W</u> 183.9	75 <u>Re</u> 186.2	76 <u>Os</u> 190.2	77 <u>Ir</u> 190.2	78 <u>Pt</u> 195.1	79 <u>Au</u> 197.0	80 <u>Hg</u> 200.5	81 <u>Tl</u> 204.4	82 <u>Pb</u> 207.2	83 <u>Bi</u> 209.0	84 <u>Po</u> (210)	85 <u>At</u> (210)	86 <u>Rn</u> (222)

Chemistry 145
Prof. Shattuck

Practice Test 2

Name _____

$$R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1} = 0.08206 \text{ L atm mol}^{-1} \text{ K}^{-1}$$

$$T(0^\circ\text{C}) = 273.15 \text{ K}$$

Part 1: Answer 8 of the following 10 questions. If you answer more than 8 cross out the one you wish not to be graded, otherwise only the first 8 will be graded. 8 points each.

1. In the following pairs, which substance has the higher boiling point:

a. C_2H_6 or C_6H_{14} ?

b. H_2S or H_2O ?

c. CO_2 or NO_2 ?

2. Which of these statements about benzene is true?

A. All carbon atoms in benzene are sp^3 hybridized.

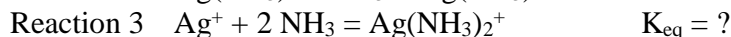
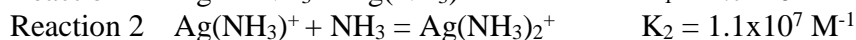
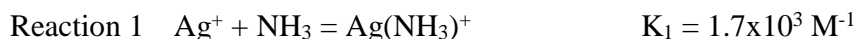
B. Benzene contains only π -bonds between C atoms.

C. The bond order of each C—C bond in benzene is 1.5.

D. Benzene is an example of a molecule that displays ionic bonding.

E. All of these statements are false.

3. From the following information calculate the K_{eq} for reaction 3.

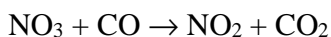
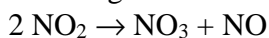


4. Give the hybridization for NH_3 _____ and for SO_2 _____.

5. For the reaction $\text{NO}_2 + \text{CO} \rightarrow \text{NO} + \text{CO}_2$ the experimental rate law is:

$$\text{rate} = k [\text{NO}_2]^2$$

The following mechanism has been proposed:



a. Which step is the rate determining step?

b. Is there a reactive intermediate in this reaction? If so what is it?

6. For a first order reaction, the concentration of the reactant dropped from 0.200 M to 0.100 M in 6.00 minutes. How long does it take for the concentration to drop from 0.200 M to 0.0100 M?

7. The rate law for a third order reaction is

$$\frac{1}{[A]^2} - \frac{1}{[A]_0^2} = 2kt$$

To make a straight line plot to verify third order behavior,

- what do you plot on the vertical axis? _____.
- what do you plot on the horizontal axis? _____.
- what is the slope equal? _____

8. The osmotic pressure of a solution of a protein in water is 1.54 torr at 25.0°. The solution contained 0.700 g of protein per liter of solution. Calculate the molar mass of the protein.

9. Which molecule has a stronger bond, CF or F₂? Explain your answer for credit.

10. Determine the rate law for the reaction $2\text{NO}(\text{g}) + \text{Br}_2(\text{g}) \rightarrow 2\text{NOBr}(\text{g})$ from the following initial rate study (you don't need to get a numerical value for k, just leave it as "k"):

[NO] (mol L ⁻¹)	[Br ₂] (mol L ⁻¹)	rate (L mol ⁻¹ sec ⁻¹)
1.00	1.00	1.00x10 ⁻⁶
2.00	1.00	2.00x10 ⁻⁶
1.00	2.00	4.00x10 ⁻⁶

Part 2. Answer 3 of the following 5 questions. If you answer more than 3 cross out the ones you wish not to be graded, otherwise only the first 3 will be graded. 12 points each.

11. (a.) Draw an energy level diagram for the molecular orbitals for the CN^- ion. (b.) Label each orbital with the type of orbital, sigma, or pi and bonding or anti-bonding. (c.) Fill the levels with the proper number of electrons, and (d.) calculate the bond order.

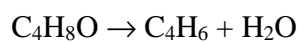
12. NOBr decomposes according to



With $K_p = 0.15$. If 1.0 atm of NOBr, 0.8 atm of NO, and 0.4 atm of Br_2 are mixed, will any reaction occur? If a net reaction is observed, will NO be formed or consumed?

13. What is the molarity of 50.0% by weight NaOH solution? The density of the solution is 1.53 g mL^{-1} . (Molar Mass(NaOH) = 40.0 g mol^{-1})

14. The rate constant for the following reaction is $1.05 \times 10^{-4} \text{ sec}^{-1}$ at 786 K . The rate constant increases to $7.88 \times 10^{-4} \text{ sec}^{-1}$ at 834 K. Calculate the activation energy for the reaction:



15. NOBr decomposes according to



With $K_p = 2.15$. If 1.00 atm of NOBr is placed in a constant volume container, calculate the equilibrium pressure of Br₂.