

Quiz 10 – Due at the start of class Monday, December 3, 2018

Complete the following problems. Write your final answers in the blanks provided. You must show your work to receive full credit. Show your answers to the correct number of significant figures with the correct units.

Rules for this take-home quiz.

DO NOT OPEN THE QUIZ UNTIL YOU ARE READY TO TAKE IT!

- You may allocate a maximum of **50 continuous minutes** for this quiz, split in to two 25-minute segments.
- For the first 25-minute segment, you will take the quiz using only the materials on these pages, a calculator and a **pencil**. Treat this time as though you were taking the quiz in the classroom. You may not use your book, notes, electronic sources or anyone else to help. Record the start and end of the first 25 minutes below.
- For the second 25 minutes, you may use your book, notes or electronic resources to make any corrections to your work. **Make these corrections in blue or red pen.** You **MAY NOT** ask anyone else for help. Record the end of the second 25 minute block below.
- Once you have completed the quiz, sign below to affirm that the quiz was taken following the rules above. This signature is your pledge that the quiz was completed in an ethical manner!

Start time: _____ End of 1st 25 minutes: _____ End of 2nd 25 minutes: _____

Signature _____ Date _____

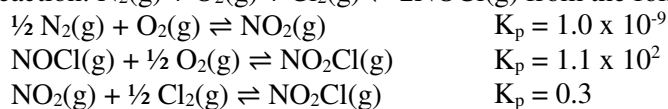
Periodic Table of the Elements																	
1 IA H Hydrogen 1.008																	2 VIIIA He Helium 4.003
3 IIA Li Lithium 6.941	4 IIA Be Beryllium 9.012											5 IIIA B Boron 10.811	6 IVA C Carbon 12.011	7 VA N Nitrogen 14.007	8 VIA O Oxygen 15.999	9 VIIA F Fluorine 18.998	10 VIIA Ne Neon 20.180
11 IA Na Sodium 22.990	12 IIA Mg Magnesium 24.305	13 IIIB Al Aluminum 26.982	14 IIIB Si Silicon 28.086	15 IIIB P Phosphorus 30.974	16 IIIB S Sulfur 32.066	17 IIIB Cl Chlorine 35.453	18 IIIB Ar Argon 39.948										
19 IA K Potassium 39.098	20 IIA Ca Calcium 40.078	21 IIIB Sc Scandium 44.956	22 IIIB Ti Titanium 47.867	23 IIIB V Vanadium 50.942	24 IIIB Cr Chromium 51.996	25 IIIB Mn Manganese 54.938	26 IIIB Fe Iron 55.845	27 IIIB Co Cobalt 58.933	28 IIIB Ni Nickel 58.693	29 IIIB Cu Copper 63.546	30 IIIB Zn Zinc 65.38	31 IIIB Ga Gallium 69.723	32 IIIB Ge Germanium 72.631	33 IIIB As Arsenic 74.922	34 IIIB Se Selenium 78.971	35 IIIB Br Bromine 79.904	36 IIIB Kr Krypton 83.798
37 IA Rb Rubidium 85.468	38 IIA Sr Strontium 87.62	39 IIIB Y Yttrium 88.906	40 IIIB Zr Zirconium 91.224	41 IIIB Nb Niobium 92.906	42 IIIB Mo Molybdenum 95.95	43 IIIB Tc Technetium 98.907	44 IIIB Ru Ruthenium 101.07	45 IIIB Rh Rhodium 102.906	46 IIIB Pd Palladium 106.42	47 IIIB Ag Silver 107.868	48 IIIB Cd Cadmium 112.414	49 IIIB In Indium 114.818	50 IIIB Sn Tin 118.711	51 IIIB Sb Antimony 121.760	52 IIIB Te Tellurium 127.6	53 IIIB I Iodine 126.904	54 IIIB Xe Xenon 131.294
55 IA Cs Cesium 132.905	56 IIA Ba Barium 137.328	57-71 Lanthanide Series	72 IIIB Hf Hafnium 178.49	73 IIIB Ta Tantalum 180.948	74 IIIB W Tungsten 183.84	75 IIIB Re Rhenium 186.207	76 IIIB Os Osmium 190.23	77 IIIB Ir Iridium 192.217	78 IIIB Pt Platinum 195.085	79 IIIB Au Gold 196.967	80 IIIB Hg Mercury 200.592	81 IIIB Tl Thallium 204.383	82 IIIB Pb Lead 207.2	83 IIIB Bi Bismuth 208.980	84 IIIB Po Polonium [208.982]	85 IIIB At Astatine 209.987	86 IIIB Rn Radon 222.018
87 IA Fr Francium 223.020	88 IIA Ra Radium 226.025	89-103 Actinide Series	104 IIIB Rf Rutherfordium [261]	105 IIIB Db Dubnium [262]	106 IIIB Sg Seaborgium [266]	107 IIIB Bh Bohrium [264]	108 IIIB Hs Hassium [269]	109 IIIB Mt Meitnerium [278]	110 IIIB Ds Darmstadtium [281]	111 IIIB Rg Roentgenium [280]	112 IIIB Cn Copernicium [285]	113 IIIB Nh Nihonium [286]	114 IIIB Fl Flerovium [289]	115 IIIB Mc Moscovium [289]	116 IIIB Lv Livermorium [293]	117 IIIB Ts Tennessine [294]	118 IIIB Og Oganesson [294]
		57 La Lanthanum 138.905	58 Ce Cerium 140.116	59 Pr Praseodymium 140.908	60 Nd Neodymium 144.243	61 Pm Promethium 144.913	62 Sm Samarium 150.36	63 Eu Europium 151.964	64 Gd Gadolinium 157.25	65 Tb Terbium 158.925	66 Dy Dysprosium 162.500	67 Ho Holmium 164.930	68 Er Erbium 167.259	69 Tm Thulium 168.934	70 Yb Ytterbium 173.055	71 Lu Lutetium 174.967	
		89 Ac Actinium 227.028	90 Th Thorium 232.038	91 Pa Protactinium 231.036	92 U Uranium 238.029	93 Np Neptunium 237.048	94 Pu Plutonium 244.064	95 Am Americium 243.061	96 Cm Curium 247.070	97 Bk Berkelium 247.070	98 Cf Californium 251.080	99 Es Einsteinium [254]	100 Fm Fermium 257.095	101 Md Mendelevium 258.1	102 No Nobelium 259.101	103 Lr Lawrencium [262]	

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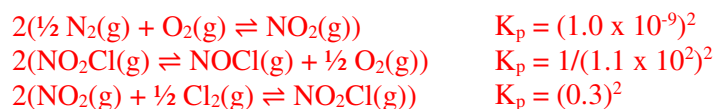
Possibly Useful Information

$(a + b)(c + d) = ac + ad + bc + bd$	$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$	$R = 0.08206 \text{ L atm mol}^{-1} \text{ K}^{-1}$ $R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1}$
$pV = nRT$	$\Delta G = -RT \ln K$	$K_p = K_c(RT)^{\Delta n}$

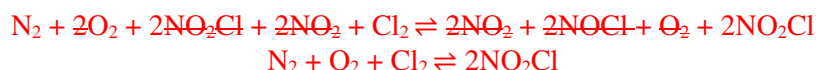
1. Determine K_p for the reaction: $N_2(g) + O_2(g) + Cl_2(g) \rightleftharpoons 2NOCl(g)$ from the following data at 298K: (8 pts)



We need to rearrange reactions to make our target reaction:



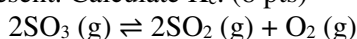
So, the sum of the reactions is:



$$K_p = \frac{(1.0 \times 10^{-9})^2(0.3)^2}{(1.1 \times 10^2)^2} = 7.4 \times 10^{-24}$$

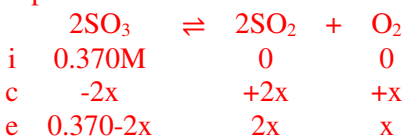
Answer 7 x 10⁻²⁴

2. Consider the equilibrium below. At a certain temperature, 0.740 mol of SO_3 is placed in a 2.00-L container. At equilibrium, 0.180 mol of O_2 is present. Calculate K_c . (8 pts)



The initial concentration of $SO_3 = (0.740 \text{ mol})/2.00 \text{ L} = 0.370 \text{ M } SO_3$

We need to determine equilibrium concentrations for all species. Since we have no SO_2 or O_2 initially, we know the reaction must produce more products and consume reactants. Mapping out the chemistry:



We are told that there is 0.180 mol of O_2 present at equilibrium. Therefore, x must be $0.180 \text{ mol}/2.00 \text{ L} = 0.0900\text{M}$

And:

$$[SO_3] = 0.370\text{M} - 2(0.0900\text{M}) = 0.190\text{M}$$

$$[SO_2] = 2(0.0900\text{M}) = 0.180\text{M}$$

Plugging in to K_c :

$$K_c = \frac{[SO_2]^2[O_2]}{[SO_3]^2} = \frac{(0.180)^2(0.0900)}{(0.190)^2} = 0.0808$$

Answer 0.0808

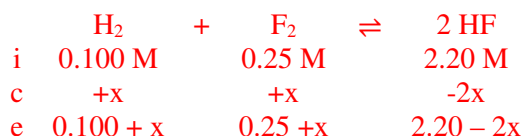
3. Consider the reaction below. If the initial concentrations of H₂, F₂, and HF are 0.100M, 0.250 M, and 2.20 M, respectively, is the system at equilibrium? If not, which way will the reaction go to achieve the equilibrium condition? Set up, but do not complete the calculation you would use to determine the equilibrium concentrations of each of the species in the reaction. You DO NOT need to arrive at a numerical answer, just get to the point where you have one algebraic expression you could solve, given additional time. **Be sure to tell me what you would do with the result of your calculation.** (9 pts)



Since we have initial concentrations of all species, we need to calculate Q first to determine the direction the reaction must go to get to equilibrium.

$$Q = \frac{[\text{HF}]^2}{[\text{H}_2][\text{F}_2]} = \frac{(2.20 \text{ M})^2}{(0.100 \text{ M})(0.25 \text{ M})} = 194$$

Since $Q > K$, the reaction is product heavy and more reactants will be formed on the way to equilibrium.



Insert these values into the equilibrium constant expression:

$$K = \frac{[\text{HF}]^2}{[\text{H}_2][\text{F}_2]} = \frac{(2.20 - 2x)^2}{(0.100 + x)(0.25 + x)} = 115$$

The boldface expression can now be solved for x, giving two possible solutions (quadratic). This is as far as you needed to go. If you did continue and solve the expression, after choosing the chemically sensible solution, equilibrium concentrations can be calculated:

$$[\text{HF}] = (2.20 - 2x)\text{M}, [\text{H}_2] = (0.100 + x)\text{M}, [\text{F}_2] = (0.25 + x)\text{M}$$