Name:_____

Unit 5 Hand-In Assignment #1 (5.1-5.3)

When using a formula (including keq), write down the formula then substitute values with units. Show all of your work. **Your answer must have the correct units and significant figures in all of your final answers.**

1. Below you can see two graphs that show the concentration of the reactants and products as a function of time. On each graph, draw a vertical line at the point at which equilibrium has been reached.

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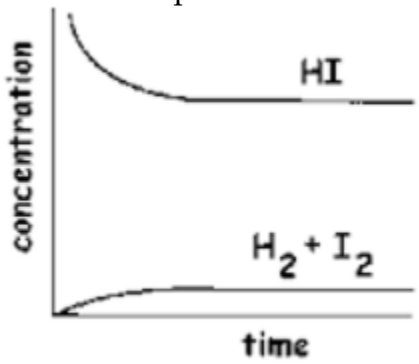
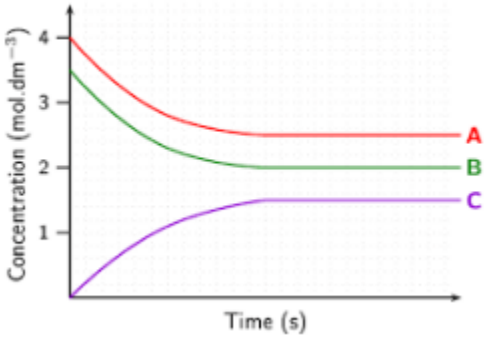
a.



b.



2. Write the equilibrium expression for each of the following reactions. If you are not given a chemical equation, you must first write out a balanced chemical equation. (4 marks)

a) $4\ HCl_{(aq)} + O_{2(g)} \rightleftarrows 2\ H_2O_{(g)} + 2\ Cl_{2(g)}$

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b) $5\ Fe^{+2}_{(aq)} + MnO_4^-{}_{(aq)} + 8\ H^+_{(aq)} \rightleftarrows 5\ Fe^{+3}_{(aq)} + Mn^{+2}_{(aq)} + 4\ H_2O_{(l)}$

c) Bromine and fluorine participate in a synthesis reaction to produce gaseous bromine pentafluoride.

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3. For each of the following, state whether the value of the equilibrium constant favours the formation of reactants, products, or both sides equally. Explain, referencing the ratio of products to reactants, how you know.

a) $K_{eq} = 45.0$

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b) $K_{eq} = 1$

c) $K_{eq} = 2.1 \times 10^{-5}$

4. Molecular chlorine decomposes into atoms according to the reaction:

$Cl_{2\,(g)} \rightleftharpoons 2\,Cl_{\,(g)}$

The equilibrium constant for the reaction at 25°C is 1.4×10^{-38}. Would many chlorine atoms be present at this temperature? How do you know?

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5. The following table give some values for reactant and product equilibrium concentrations for 700K for the Shift reaction, an important method for the commercial production of hydrogen gas:

$$CO_{(g)} + H_2O_{(g)} \leftrightarrow CO_{2(g)} + H_{2(g)} + \text{heat}$$

Trial	[CO2]	[H2]	[CO]	[H2O]
1	0.600	0.600	0.266	0.266
2	0.600	0.800	0.330	0.286
3	2.00	2.00	0.887	0.887
4	1.00	1.50	0.450	0.655
5	1.80	2.00	0.590	1.20

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All concentrations are in moles per litre. Using the data **show that the ratio of the concentration of the products to that of the reactants, is a constant value at equilibrium.**

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6. Calculate K_{eq} for the following. The concentration of species at equilibrium is shown below.

$H_{2(g)} + Cl_{2(g)} \rightleftarrows 2\ HCl_{(g)}$

$[H_2] = 1.0 \times 10^{-2}$ M

$[Cl_2] = 2.5 \times 10^{-2}$ M

$[HCl] = 3.0 \times 10^{-2}$ M

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7. The equilibrium constant for the equilibrium $CO_{(g)} + H_2O_{(g)} \leftrightarrow CO_{2(g)} + H_{2(g)}$ is 302 at 600K. Show the keq expression for the reverse reaction then calculate <u>the value</u> of the equilibrium constant reaction at the same temperature.

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8. For the following reaction at equilibrium at 2000°C, the concentration of N_2 and O_2 are both 5.2 M.

$N_{2(g)} + O_{2(g)} \rightleftarrows 2\ NO_{(g)}$ $\quad K_{eq} = 6.2 \times 10^{-4}$

Calculate the concentration of NO at equilibrium.

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9. Sulfur dioxide forms sulfur trioxide according to the following equation:

$2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)}$

If initially $[SO_2] = 0.200$ M and $[O_2] = 0.250$ M, and at equilibrium $[SO_3] = 0.130$ M, what is the equilibrium constant? All mole to mole ratios that are not 1:1 must be shown.

[Initial]			
[Change]			
[Equilibrium]			

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10. A certain amount of NO_2 was initially put into a 5.00 L flask. When equilibrium was attained according to the equation:
$2NO_{(g)} + O_{2(g)} \leftrightarrow 2NO_{2(g)}$,

The concentration of NO at equilibrium was 0.800 M. If K_{eq} for this system is 24.0, what was the initial concentration of the NO_2?

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[Initial]			
[Change]			
[Equilibrium]			