Spring 2023 - CIVE
1^{st} **Assignment**
Prof. Chiara Valsecchi

Student ID number and Chinese name: _____

Due at the beginning of the next class. There are two pages! Answer the questions in the spaces provided. If you need extra space for exercise 5 and 6, add a new page (any kind).

Question:	1	2	3	4	5	6	Total
Points:	4	2	2	4	4	4	20
Score:							

1. (4 points) Please answer the following questions in a short phrase (one line or maximum two):
   (a) Which water property causes pipes to break if the weather is freezing?

   Density. Ice is less dense than water, so when it freeze it expands

   (b) What will be the consequences in a lake if ice was denser than water?

   Ice will fell to the bottom, and the water on the surface will freeze again, so all the lake will be frozen.

   (c) How water can form almost spherical drops on hydrophobic surfaces?

   Surface Tension. It does not depend on interaction with air !

   (d) Which type of substances can be dissolved more effectively in water?

   ionic salts and polar molecules. The answer "soluble substance" is not an answer, because I am asking why are they soluble.

   (e) Explain at least one difference between temporary and permanent hardness.

   Temporary can be remove by heating. They have different source as anions, carbonates or chlorides/sulfates

2. (2 points) Calculate the total hardness, temporary and permanent hardness of a solution containing $Mg(CO_3)_2 = 1.43ppm, MgSO_4 = 2.33ppm$ and $NaAlO_2 = 1.55ppm$. (Do the calculation on a different sheet, just mark the correct answer here)
   - ◯ 3.87; 1.92, 1.94
   - ◯ 3.87; 0.98; 2.89 this is the correct one. Only MgCO3 is temporary.
   - ◯ 3.87; 2.91; 0.95
   - ◯ I don't know

3. (2 points) Write here below the correct equilibrium constant for the following two reactions:

a) $CO_2\,(g) + H_2\,(g) \rightleftharpoons CO\,(g) + H_2O\,(l)$

b) $SnO_2\,(s) + 2\,CO\,(g) \rightleftharpoons Sn\,(s) + 2\,CO_2\,(g)$

DO NOT USE C(co) for concentration! it's [ ]

a) $k_c = \frac{[CO]}{[CO_2][H_2]}$ or $k_p = \frac{P(CO)}{P(CO_2)P(H_2)}$

b) $k_c = \frac{[CO_2]^2}{[CO]^2}$ or $k_p = \frac{P^2(CO_2)}{P^2(CO)}$

4. (4 points) For the following reaction:

$$H_2\,(g) + I_2\,(g) \rightleftharpoons 2\,HI\,(g)$$

the $K_p = 420$ at 400 K and the $K_p = 42$ at 273 K.

a) Is the formation of the product more favorite at higher or lower temperature?
More favourite at higher temperature

b) If I increase the temperature, which reaction will occur more to counterbalance the change?
Direct reaction. Temperature is a reagent (product favoured)

c) Calculate K_c at 273 K.
It's the same as K_p because Δn is zero.

5. (4 points) Calculate the partial pressure of NH_3 knowing that the equilibrium partial pressure of H_2 is 0.928 atm and N_2 is 0.432 atm. The K_p of this reaction at 773 K is $1.45 \cdot 10^{-5}$.

$$N_2\,(g) + 3\,H_2\,(g) \rightleftharpoons 2\,NH_3\,(g)$$

1) $k_p = \frac{P^2[NH_3]}{P(N_2)P(H_2)^3}$

2) $P^2(NH_3) = 1.45 \cdot 10^{-5} \cdot (0.432)(0.928)^3$

3) $P(NH_3) = \sqrt{5 \cdot 10^{-6}} = 2.24 \cdot 10^{-3}$ atm.

6. (4 points) Calculate the K_c of the following reaction knowing that the initial concentration of H_2 and I_2 are $1.00 \cdot 10^{-3} M$ and $2.00 \cdot 10^{-3} M$. Also, the concentration at equilibrium for HI is $1.87 \cdot 10^{-3} M$.

$$H_2\,(g) + I_2\,(g) \rightleftharpoons 2\,HI\,(g)$$

1). $k_c = \frac{[HI]^2}{[H_2][I_2]}$

2)

	H_2	I_2	$2HI$
I	$1 \cdot 10^{-3}$	$2 \cdot 10^{-3}$	$\varnothing$
C	$-x$	$-x$	$+2x$
E	$0.065 \cdot 10^{-3}$ M	$1.065 \cdot 10^{-3}$ M	$1.87 \cdot 10^{-3}$ M

so $x = 0.935$

3). $k_c = \frac{(1.87 \cdot 10^{-3})^2}{(0.065 \cdot 10^{-3})(1.065 \cdot 10^{-3})}$

$k_c = 50,5$

In k_c you can only use the equilibrium concentrations, not the INITIALS!