Equilibrium & Ksp: Test 2

1. Given the following equilibrium system:

$2\ CO_2\ (g) <=> 2\ CO(g) + O_2\ (g)$

Calculate the equilibrium constant, K_c, given the following concentrations at equilibrium:

$[CO_2\ (g)] = 1,0$ mol/L $[CO\ (g)] = 0,10$ mol/L $[O_2\ (g)] = 0,40$ mol/L

(A) 0.0040 (B) 0.040 (C) 0.30 (D) 25

2. Consider the following equation

$4\ HCl\ (g) + O_2\ (g) <=> 2\ H_2O\ (l) + 2\ Cl_2\ (g)$

Initially 10 moles of HCl and 4,0 moles of oxygen are allowed to react in a 1,0 litre container. At equilibrium, 4,0 moles of Cl_2 are produced. Calculate the equilibrium constant, K_c, for this reaction.

(A) $4,0 \times 10^{-4}$ (B) $2,6 \times 10^{-2}$ (C) $5,0 \times 10^{-1}$ (D) 8,0

3. In which of the following systems will an increase in entropy favor the formation of products?

(A) $2\ H_2\ (g) + 0_2\ (g) <=> 2H_2O(l)$

(B) $H_2O\ (l) <=> H_2O(s)$

(C) $C1_2H_{22}O_{11}(s) + 12\ O_2\ (g) <=> 11\ H_2O\ (g) + 12\ CO_2\ (g)$

(D) $Ag^+\ (aq) + CI^-\ (aq) <=> AgCl\ (s)$

4 . Which of the following actions will increase the numerical value of the equilibrium constant of the following system?

$N_2\ (g) + 3\ H_2\ (g) <=> 2\ NH_3\ (g) + Energy$

(A) decreasing the temperature of the system
(B) adding nitrogen gas to the system
(C) increasing the pressure on the system
(D) adding a positive catalyst to the system

5. A student adds 3,0 moles of N_2 (g) and 6,0 moles of 0_2 (g) to a 5,0 L container. At equilibrium, 1,0 mole of NO_2 (g) is present. Calculate the equilibrium constant, K_c, for this system.

N_2 (g) + 2 O_2 (g) <=>2 NO_2 (g)

(A) 1 ,0 x 10^{-3} (C) 8,0 x 10^{-2} (B) 9,2 x 10^{-3} (D) 4,0 x 10^{-1}

6. The fact that a substance has a low solubility product constant, K_{sp}, indicates that ...
(A) equilibrium has not been reached
(B) at equilibrium the ionic concentration of products is low
(C) at equilibrium the ionic concentration of products is high
(D) at equilibrium the ionic concentration of reactants is low

7. Identify the factors which can affect the rate of precipitation.

1. temperature of the solution
2. concentration of the solution
3. area of contact of the solid crystals
4. tendency towards maximum disorder
5. agitation of the solution

(A) 1, 2 and 3 (C) 2, 4 and 5 (B) 1, 3 and 4 (D) 2, 3 and 5

8. Identify the factors that will affect the rate of dissolving a solid in a liquid.

1. the concentration of the solution
2. the nature of the solid
3. the temperature of the solution
4. the nature of the liquid
5. the surface area of contact

(A) 1, 3 and 5 (B) 1 , 2 and 4 (C) 2 and 4 only (D) 3 and 5 only

9. Given the solubility product constants, K_{sp}, for the following compounds, which one is the most soluble in water?

Chemical formula	K_{sp}
AgBr (s)	4,8 x 10^{-13}
CuCl (s)	3,2 x 10^{-3}
$Mg(OH)_2$ (s)	5.9 x 10^{-12}
$BaCO_3$(s)	4,9 x 10^{-9}

10. 25 mL of a 4,0 x 10^{-6} mol/L solution of NaBr are mixed with 75 mL of each of the following solutions:

1. 1,0 x 10^{-10} mol/L $CuNO_3$
2. 1.0 x 10^{-6} mol/L $CuNO_3$
3. 1,0 x 10^{-2} mol/L $CuNO_3$
4. 1,0 x 10^{-10} mol/L $AgNO_3$
5. 1,0 x 10^{-6} mol/L $AgNO_3$
6. 1,0 x 10^{-2} mol/L $AgNO_3$

The K_{sp} values are: CuBr 5.9 x 10^{-9}
AgBr 5,0 x 10^{-13}

Which mixtures will result in the formation of precipitates?
(A) 1, 2 and 4 (B) 1, 2 and 5 (C) 3, 4 and 6 (D) 3, 5 and 6

Use the following table for Question 11.

SOLUBILITY OF COMMON COMPOUNDS IN WATER

Negative ions with (Anions)	Positive ions + (Cations)	Form solubility :	Compounds
Chloride, Cl^- Bromide, Br^- Iodide, I^-	Ag^+, Pb^{2+}, Hg^{2+}, Cu^+	Low Solubility	
	All others		
Sulfate, SO_4^{2-}	Ba^{2+}, Sr^{2+}, Pb^{2+}	Low Solubility	
	All others		Soluble
Sulfide, S^{2-}	Alkali ions, H^+ (aq), $NH4^+$, Be^{2+}		Soluble
	Mg^{2+}, Ca^{2+}, Sr^{2+}, Ba^{2+}		Soluble
	All others	Low Solubility	
Hydroxide, OH^-	Alkali ions, H^+ (aq), $NH4^+$, Sr^{2+}, Ba^{2+}		Soluble
	All others	Low Solubility	
Phosphate, PO_4^{3-}	Alkali ions, H^+ (aq), $NH4^+$,		Soluble
Carbonate, CO_3^{2-}			
Sulfite, SO_3^{2-}	All others	Low solubility	

Which of the following solutions could be used to separate Ba^{2+} from Cu^{2+}?

11. NH_4Cl 2. K_2SO_4 3.Na_2CO_3 4. NaOH

(A) 1 and 2 (C) 2 and 4
(B) 1 and 3 (D) 3 and 4

12 . Calculate the K_{sp} for $CaCO_3$ in a saturated solution where its concentration Is$7{,}0 \times 10^{-5}$ mol/L.

(A) 4.9×10^{-11}
(B) 4.9×10^{-9}
(C) 7.0×10^{-5}
(D) 8.3×10^{-3}

13. Calculate the solubility of $BaCO_3$ if the K_{sp} is $4{,}9 \times 10^{-9}$.

$BaCO_3$ (s)<=>Ba^{2+} (aq) + CO_3^{2-} (aq)

(A) $7{,}0 \times 10^{-5}$ mol/L
(B) 2.4×10^{-5} mol/L
(C) $4{,}9 \times 10^{-9}$ mol/L
(D) $2{,}5 \times 10^{-9}$ mol/L

14. Calculate the K_{sp} of SrF_2 if its solubility is $5{,}8 \times 10^{-4}$ mol/L,

SrF_2 (s) <=> Sr^{2+} (aq) + 2 F^-

(A) $7{,}8 \times 10^{-10}$ (B) $3{,}4 \times 10^{-7}$ (C) $6{,}7 \times 10^{-7}$ (D) $5{,}8 \times 10^{-4}$

15. The solubility of $Mg(OH)_2$ is $1{,}5 \times 10^{-4}$ mole per litre at 18°C. The K_{sp} for $Mg(OH)_2$ at 18°C is:

$Mg(OH)_2$ (s) <=> Mg^{2+} (aq) + 2 OH^- (aq)

(A) $3{,}88 \times 10^{-12}$ (B) $1{,}35 \times 10^{-11}$ (C) $2{,}25 \times 10^{-8}$ (D) $4{,}50 \times 10^{-8}$

16. A solution containing Pb^{2+} (aq) ions is mixed with a solution containing Cl^- (aq) ions and a PbCl2 (s) precipitate forms.

Identify the K_{sp} expression for this system:

(A) $K_{sp} = [Pb^{2+}(aq)][Cl^-(aq)]$
(B) $K_{sp} = [Pb^{2+}(aq)][2\ CI^-(aq)]$
(C} $K_{sp} = [Pb^{2+}(aq)][CI^-(aq)]^2$
(D) $K_{sp} = [Pb^{2+}(aq)][2\ CI^-(aq)]^2$

17. Identify the FALSE statement concerning the following two substances.

$BaSO_4$	$K_{sp} = 2{,}2 \times 10^{-10}$
$CaSO_4$	$K_{sp} = 1{,}1 \times 10^{-5}$

(A) $CaSO_4$ is more soluble than $BaSO_4$.
(B) A saturated $CaSO_4$ solution conducts electricity better than a saturated $BaSO_4$ Solution.
(C) A saturated $CaS0_4$ solution will contain a greater concentration of $S0_4^{2-}$ (aq) ions than a saturated BaS04 solution.
(D) A saturated CaSO4 solution contains $1{,}1 \times 10^{-5}$ mole of Ca^{2+} (aq) ions.

18. When two colorless solutions containing Ag^+ (aq) ions and CI^- (aq) ions are mixed, a white precipitate of AgCl (s) forms. After a while, the amount of AgCl (s) remains constant. Which of the following statements explains the equilibrium of this system?

(A) All of the Ag^+ (aq) ions and CI^- (aq) ions reacted to form the precipitate
(B) The solution is saturated and there is no more formation of AgCl (s)
(C) The AgCl (s) formed does not dissociate.
(D) The rates of formation and of dissociation of AgCl (s) are equal.

19. Chemical equilibrium is a compromise between which of the following tendencies?

1-minimum enthalpy
2-minimum entropy
3-maximum entropy
4-maximum enthalpy

(A) 1 -3 (B) 1- 4 (C) 2-3 (D) 2- 4

20. A solution reaches equilibrium when

(A) the solute dissolves completely
(B) the solution is heated
(C) crystals of the solute are added to the solution
(D) particles of the solute remain in the solid state in the solution