**UNIVERSITY CEU SAN PABLO**
**SCHOOL OF PHARMACY**
**DEPARTMENT OF CHEMISTRY AND BIOCHEMISTRY**

# COMPLEMENTARY PROBLEMS OF PHYSICAL CHEMISTRY

**2018-19**

## LESSON 5

**29.** ΔG° at 298 K for the decomposition reaction of $NH_4Cl$ is 21,8 kcal·mol-1, calculate the equilibrium constant $K_P^o$ and Kx at 25 ° C and 1 atm

**Data**: R = 0.082 l·atm·$K^{-1}$·$mol^{-1}$ = 1.987 cal·$K^{-1}$·$mol^{-1}$ = 8.314 J·$K^{-1}$·$mol^{-1}$

$$NH_4Cl\,(s) \rightleftarrows NH_{3\,(g)} + HCl_{\,(g)}$$

**Solution:** $K_{P,298}^o = 1.0252\cdot10^{-16}; K_{x,298} = 1.0252\cdot10^{-16}$

**30.** The equilibrium constant for the process:

$$\frac{1}{2}N_2(g)+\frac{1}{2}O_2(g) \rightleftarrows NO\,(g)$$

can be approximately calculated by the expression:

$$\log K_P^o = -\frac{10872.463}{T}+1.2574\,(J)$$

Determine:

**a)** the equilibrium constant at 1000 K and 1200 K.

**b)** $\Delta H^o$, $\Delta S^o$ and $\Delta G^o$ at 1000K

**Data:** R = 0.082 l·atm·$K^{-1}$·$mol^{-1}$ = 1.987 cal·$K^{-1}$·$mol^{-1}$ = 8.314 J·$K^{-1}$·$mol^{-1}$

**Solution: a)** $K_p^o(1000K) = 6.67\cdot10^{-5}$; $K_p^o(1200K) = 4.08\cdot10^{-4}$

**b)** $\Delta H^o$ = 90393.657 J·$mol^{-1}$; ΔSo = 10,454 J·$K^{-1}$·$mol^{-1}$;
$\Delta G^o$ (1000K) = 79939.11 J ·$mol^{-1}$

**31.** Calculate the pH of an aqueous solution of an acid type 1: 1 in a concentration 0.010 m, knowing that its dissociation constant is $6.6 \cdot 10^{-5}$.

**Solution:** pH = 3.108

**32.** For AgCl, the solubility product is $1.78 \cdot 10^{-10}$ at 25 ° C. Calculate the solubility, at 25 ° C, In the following solvents

**a)** pure water
**b)** 0.01 m-$KNO_3$ solution
**c)** 0.01 m-KCl solution

Explain your answer using the appropriate equations.

**Solution:** s = $1.33 \cdot 10^{-5}$ mol $\cdot$ $kg^{-1}$; **b)** s = $1.50 \cdot 10^{-5}$ mol $\cdot$ $kg^{-1}$; **c)** s = $2.55 \cdot 10^{-8}$ mol $kg^{-1}$