**Quiz 6**

# Directions: Answer each of the following questions. Be sure to use complete sentences where appropriate. For full credit be sure to show all of your work. Where appropriate answers should be boxed for clarity, written to the correct number of significant figures, and, include the proper units.

|  |  |  |
| --- | --- | --- |
| Substance | ΔH°f (kJ/mol) | S° (J/mol · K) |
| KCl (s) | -436.7 | 82.6 |
| KClO3 (s) | -397.7 | 143.1 |
| KClO4 (s) | -432.75 | 151.0 |

1. Potassium chlorate, a common oxidizing agent in fireworks and match heads, undergoes a solid-state disproportionation reaction when heated (15 points):

4 KClO3 (s) $→$ 3 KClO4 (s) + KCl (s)

Use the following ΔH°f and S° values to calculate ΔG°sys (which is ΔG°rxn) at 25 °C for this reaction (15 points).

$$∆H\_{f}^{°}=Σn\_{p}ΔH\_{f p}^{°}-Σn\_{r}ΔH\_{f r}^{°}$$

$$∆H\_{f}^{°}=\left[\left(3 mol\right)\left(∆H\_{f KClO\_{4}}^{°}\right)+\left(1 mol\right)\left(∆H\_{f KCl}^{°}\right)\right]-[\left(4 mol\right)\left(∆H\_{f KClO\_{3}}^{°}\right)]$$

$$∆H\_{f}^{°}=\left[\left(3 mol\right)\left(-432.75\frac{kJ}{mol}\right)+\left(1 mol\right)\left(-436.7\frac{kJ}{mol}\right)\right]-\left[\left(4 mol\right)\left(-397.7\frac{kJ}{mol}\right)\right]$$

$$∆H\_{f}^{°}=\left[-1298.25 kJ-436.7 kJ\right]-\left[-1590.8 kJ\right]=-144.15 kJ$$

$$S^{°}=Σn\_{p}S\_{p}^{°}-Σn\_{r}S\_{r}^{°}$$

$$∆H\_{f}^{°}=\left[\left(3 mol\right)\left(S\_{KClO\_{4}}^{°}\right)+\left(1 mol\right)\left(S\_{KCl}^{°}\right)\right]-[\left(4 mol\right)\left(S\_{KClO\_{3}}^{°}\right)]$$

$$∆H\_{f}^{°}=\left[\left(3 mol\right)\left(151.0\frac{J}{mol K}\right)+\left(1 mol\right)\left(82.6\frac{J}{mol K}\right)\right]-\left[\left(4 mol\right)\left(143.1\frac{J}{mol K}\right)\right]$$

$$∆H\_{f}^{°}=\left[453.0\frac{J}{K}+82.6\frac{J}{K}\right]-\left[572.4\frac{J}{K}\right]=-36.8\frac{J}{K}$$

$$∆G\_{rxn}^{°}=∆H\_{rxn}^{°}-TS\_{rxn}^{°}$$

$$∆G\_{rxn}^{°}=\left(-144.15 kJ\right)-\left(298 K\right)\left(-36.8\frac{J}{K}\right)×\frac{1 kJ}{1000 J}$$

$$∆G\_{rxn}^{°}=-133.2 kJ $$

1. Complete the following sentence (2 points):

When K < 1, the system will move to the left/right to reach equilibrium and ∆G° > 0 or endergonic/exergonic.

1. What are the three types of reaction in the Analysis of a Cation Mixture (3 points)?
2. Formation of an insoluble salt (precipitation reaction)
3. Formation of ammine complex ion
4. Formation of hydroxide complex ion (amphoteric cations)