SUPeR Chemistry
CH 223 Practice Exam #2

This exam has been designed to provide you with practice solving multiple choice problems over the topics that will be covered on Exam #2. The actual exams for each section of CH 223 will be different and you should not assume that this practice exam is representative of those exams.

1. Find the water solubility of $BaSO_4(s)$, $K_{sp} = 1 \times 10^{-10}$.

   A) 1×10^{-5} M B) 1×10^{-10} C) 1×10^{-7}

2. Choose the best thermodynamic description of the reaction

   $2\ NH_3(g) \rightarrow 3\ H_2(g) + N_2(g)$, $\Delta H^o = 92$ kJ
   $\Delta S^o = 197$ J/K

   A) enthalpy favors reactants, entropy favors reactants
   B) enthalpy favors reactants, entropy favors products
   C) enthalpy favors products, entropy favors reactants
   D) enthalpy favors products, entropy favors products

3. For a reaction at constant temperature, as Q increases

   A) ΔG and $\Delta G°$ increase.
   B) ΔG and $\Delta G°$ decrease.
   C) ΔG increases but $\Delta G°$ remains constant.
   D) ΔG decreases but $\Delta G°$ remains constant.

4. Which statement is correct?

   A) When Q < K then $\Delta G = 1$.
   B) When Q < K then $\Delta G = -\Delta S$.
   C) When Q = K then $\Delta G = 0$.
   D) When Q > K then $\Delta G = 1$.
   E) When Q > K then $\Delta G = -RT$.

5. Which response(s) includes *all* of the following processes that are accompanied by an *increase* in entropy?

   1. $I_2(s) \rightarrow I_2(g)$
   2. $2I(g) \rightarrow I_2(g)$
   3. $2NH_3(g) \rightarrow N_2(g) + 3H_2(g)$
   4. $Mg^{2+}(aq) + 2OH^-(aq) \rightarrow Mg(OH)_2(s)$

   A) 1, 2 B) 1, 3 C) 3, 4 D) 3 E) 2, 4

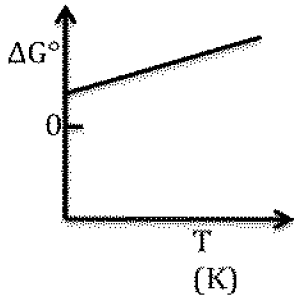
6. What is the minimum temperature required for the spontaneous conversion of $CCl_4(l)$ to $CCl_4(g)$ (at 1 atm) when $\Delta H° = 573$ kJ/mol and $\Delta S° = 1.64$ kJ/mol·K?

   A. 76°C
   B. 89°C
   C. 189°C
   D. 215°C
   E. 349°C

7. The slightly soluble silver carbonate, Ag_2CO_3, would be expected to be most soluble in

   A) 0.10 M $AgNO_3$
   B) 0.10 M Na_2CO_3
   C) 0.10 M $NaHCO_3$
   D) 0.10 M HNO_3
   E) 0.10 M CH_3COOH

8. Consider the figure that shows $\Delta G°$ for a chemical process plotted against absolute temperature.



From this plot, it is reasonable to conclude that:

   A) $\Delta H° > 0, \Delta S° > 0$
   B) $\Delta H° > 0, \Delta S° < 0$
   C) $\Delta H° < 0, \Delta S° > 0$
   D) $\Delta H° < 0, \Delta S° < 0$
   E) none of the above

9. Find ΔG^o at 37 °C: $2H_2O(l) \leftrightarrows H_3O^+(aq) + OH^-(aq)$ $\Delta H° = 55.900$ kJ, $\Delta S° = -80.426$ J/K

   A) 80.8 kJ
   B) 94.0
   C) 76.3

Questions 10 & 11: Titrate 80 mL of 0.25 M HOCl ($K_a = 1 \times 10^{-2}$) with 0.25 M NaOH.

10. The volume of NaOH needed to reach the equivalence point is:
    A) 40 mL
    B) 80 mL
    C) 160 mL

11. At pH = 7 the quotient $[OCl^-] / [HOCl]$ is:
    A) 1×10^3 B) 1×10^2 C) 1×10^5

12. When $\Delta H^o < 0$ and $\Delta S^o > 0$ a reaction equilibrium favors
    A) reactants at low temperature and reactants at high temperature
    B) reactants at low temperature and products at high temperature
    C) products at low temperature and reactants at high temperature
    D) products at low temperature and products at high temperature

Questions 13 – 17:
Titrate 26 mL of 0.10 M weak acid H_2A ($K_{a1} = 1 \times 10^{-5}$, $K_{a2} = 1 \times 10^{-11}$) with 0.10 M NaOH .

FIND:

13. mL of NaOH needed to reach the **second equivalence point**:
    A) 13 B) 26 C) 39 D) 52 E) 65

14. pH at the **first equivalence point**:
    A) 5 B) 8 C) 11 D) 14 E) 7

15. relative concentrations at the **first equivalence point**:

A) $[HA^-] > [H_2A] = [A^{2-}]$ D) $[HA^-] > [A^{2-}] > [H_2A]$
B) $[A^{2-}] = [HA^-] > [H_2A]$ E) $[H_2A] = [HA^-] > [A^{2-}]$
C) $[HA^-] > [H_2A] > [A^{2-}]$

16. relative concentrations at pH = 12:

A) $[A^{2-}] = [HA^-] > [H_2A]$ D) $[HA^-] > [A^{2-}] > [H_2A]$
B) $[HA^-] > [H_2A] = [A^{2-}]$ E) $[H_2A] < [HA^-] < [A^{2-}]$
C) $[HA^-] > [H_2A] > [A^{2-}]$

17. relative concentrations at the **indicated point (arrow)**:

A) $[HA^-] > [H_2A] > [A^{2-}]$ D) $[HA^-] > [A^{2-}] = [H_2A]$
B) $[A^{2-}] > [HA^-] > [H_2A]$ E) $[A^{2-}] > [H_2A] > [HA^-]$
C) $[HA^-] > [A^{2-}] > [H_2A]$

18. The solubility of $Zn(OH)_2$ ($K_{sp} = 1.0 \_10^{-16}$) in solution buffered at pH 8 is:

A) 1×10^{-3} M B) 1×10^{-4} M C) 1×10^{-5} M D) 1×10^{-6} M E) 1 M

19. Calculate the solubility of magnesium sulfate, $MgSO_4$, when placed into a 0.10 M $MgCl_2$ solution. $K_{sp} = 5.9 \times 10^{-3}$

A) 4.2×10^{-2} M D) 3.5×10^{-5} M
B) 5.9×10^{-2} M E) 3.5×10^{-6} M
C) 7.7×10^{-2} M

20. Calculate the equilibrium constant at 25°C for the reaction of methane with water to form carbon dioxide and hydrogen. The data refer to 25°C.

$CH_4(g) + 2H_2O(g) \rightleftharpoons CO_2(g) + 4H_2(g)$

A) 8.2×10^{19} B) 0.96 C) 0.58 D) 1.2×10^{-20} E.) 1.4×10^{-46}

	$CH_4(g)$	$H_2O(g)$	$CO_2(g)$	$H_2(g)$
$\Delta H°_f$ (kJ/mol):	-74.87	-241.8	-393.5	0
$\Delta G°_f$ (kJ/mol):	-50.81	-228.6	-394.4	0
$S°$ (J/K·mol):	186.1	188.8	213.7	130.7