

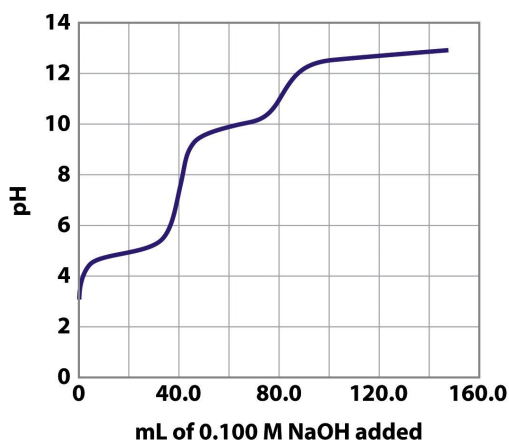
Exam III – Chapters 15 & 16

Important information

Some K_a values:

Acetic acid (CH_3COOH)	1.8×10^{-5}
Nitrous acid (HNO_2)	4.5×10^{-4}
Hypochlorous acid (HOCl)	3.0×10^{-8}
Hydrocyanic acid (HCN)	4.9×10^{-10}
Ammonia (NH_3)	5.6×10^{-10}
Methylamine (CH_3NH_2)	2.7×10^{-11}

1. (8 pts) The following graph represents the titration of a diprotic acid, H_2A^+ , with 0.100 M NaOH.



Problem 15-43 Chemistry, 5/e
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- a. Write the reaction of the diprotic acid, H_2A^+ in water including all steps.

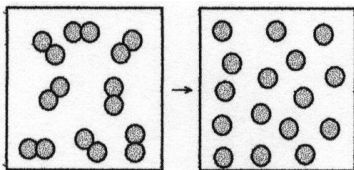
 - b. Indicate on the graph with the letter B where you have 50% HA and 50% A^- .

 - c. Indicate with the letter C on the graph where you have 100% HA.
2. (6 pts) Which of the following titrations results in an acidic solution at the equivalence point?
- a. CH_3COOH titrated with NaOH
 - b. KF titrated with KOH
 - c. HCl titrated with NaOH
 - d. $\text{CH}_3\text{CH}_2\text{CH}_2\text{NH}_2$ titrated with HCl

14. (6 pts) At 25°C, $\Delta G^\circ = -198 \text{ kJ}$ for the reaction, $\text{NO}(g) + \text{O}_3(g) \rightleftharpoons \text{NO}_2(g) + \text{O}_2(g)$. Calculate ΔG under the following conditions: the partial pressure of NO is $1.0 \times 10^{-6} \text{ atm}$, O_3 is $1.0 \times 10^{-7} \text{ atm}$, NO_2 is $3.0 \times 10^{-6} \text{ atm}$, O_2 is 0.20 atm . (Show work for partial credit)

- a. -159 kJ
- b. -167 kJ
- c. -198 kJ
- d. -236 kJ

15. (8 pts) The figure below represents the nonspontaneous reaction $\text{O}_2(g) \rightarrow 2 \text{O}(g)$. What are the signs (+ or -) of ΔH , ΔS , and ΔG for this process?



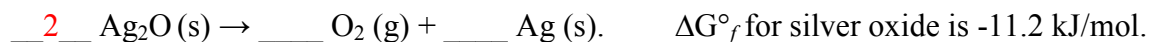
ΔH ____ + ____

ΔS ____ + ____

ΔG ____ + ____

Is the value for K less than (<), greater than (>), or equal to (=) 1? ____ < ____

16. (6 pts) Calculate K for the decomposition of silver oxide into oxygen gas and silver metal represented by the following *unbalanced* equation:



$$\Delta G^\circ_{\text{rxn}} = [0 + 0] - [(2 \text{ mol Ag}_2\text{O})(-11.2 \text{ kJ/mol})] = +22.4 \text{ kJ/mol}$$

$$\Delta G^\circ = -RT \ln K$$

$$K = e^{-[22.4 \text{ kJ/mol}] / [(8.314 \text{ J/mol K})(1 \text{ kJ}/1000 \text{ J})(298 \text{ K})]}$$

$$K = 1.18 \times 10^{-4}$$

Extra credit:

(2 pts) Which pair of ions can be separated by the addition of sulfide ion?

- a. Ag^+ and Cu^{2+}
- b. Cu^{2+} and Bi^{3+}
- c. Ca^{2+} and Ba^{2+}
- d. Pb^{2+} and Ca^{2+}

(3 pts) Indicate all chemical species present in a beaker containing a solution of 0.100 M HF and 0.100 M KF .