

chm152 sp09 Exam 3 KEY
True/False Section (4 pts each)

- 1) F An effective buffer is prepared from a strong acid and its conjugate base.
1) T An effective buffer is prepared from a weak acid and its conjugate base.
- 2) T AgBr will be more soluble in pure water than in a solution containing the common ion Ag^+ .
2) F AgBr will be less soluble in pure water than in a solution containing the common ion Ag^+ .
- 3) T The net ionic equation for a strong acid / strong base titration is always $\text{H}^+ + \text{OH}^- \rightarrow \text{H}_2\text{O}$.
- 4) F The oxidation number of Nitrogen in NH_4^+ is +1.
4) T The oxidation number of Nitrogen in NH_4^+ is -3.
- 5) F Only electrochemical cells with $E^\circ_{\text{cell}} < 0$ can perform work.
5) T Only electrochemical cells with $E^\circ_{\text{cell}} > 0$ can perform work.

Multiple Choice Section (4 pts each)

- 6) Each of the following mixtures can produce an effective buffer solution EXCEPT

HCl and NaCl

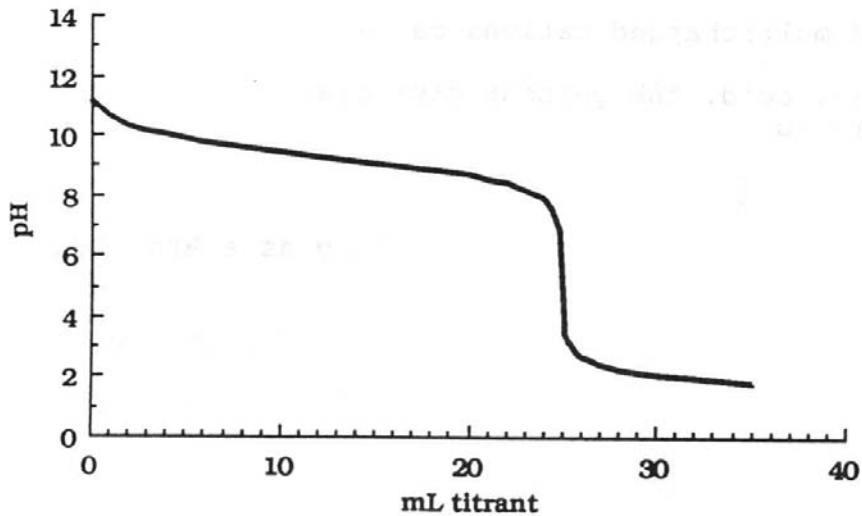
- 7) A buffer solution is prepared from 0.05 M HCOOH ($K_a = 1.8 \times 10^{-4}$) and 0.15 M NaCOOH . What is the pH of the solution?

4.22

- 8) For the titration of a weak base with a strong acid, which indicator should be used?

methyl red ($\text{p}K_a = 5.00$)

9) For the following titration curve, which statement(s) below is/are TRUE?



- i. A strong acid is titrated with a strong base
- ii. A weak base is titrated with a strong acid
- iii. A weak acid is titrated with a strong base
- iv. The equivalence point is reached at a pH ~ 5.0
- v. At the equivalence point $[OH^-] > [H^+]$

ii and iv

10) Which of the following is the solubility product expression for $MgCO_3$?

$$K_{sp} = [Mg^{2+}][CO_3^{2-}]$$

11) What is the K_{sp} expression (in terms of molar solubility) for $Ca_3(PO_4)_2$?

$$K_{sp} = 108s^5$$

12) The molar solubility (s) of lead bromide ($PbBr_2$) is 2.2×10^{-2} M. Calculate the K_{sp} .

$$4.26 \times 10^{-5}$$

13) Considering the molar solubility (s) of $Mg(OH)_2$ in pure water. Which statement is TRUE?

More salt will dissolve at pH = 5.0

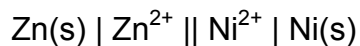
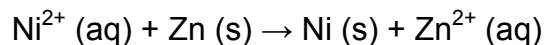
14) What is the oxidation number of Phosphorous (P) in PO_4^{3-} ?

+5

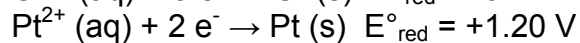
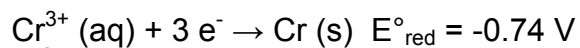
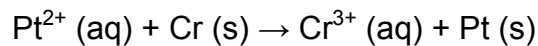
15) Which statement about electrochemical cells (galvanic cells) is FALSE?

Electrons flow through the salt bridge

16) What is the cell notation for the galvanic cell based on the following reaction?



17) Determine the cell potential for the following reaction.



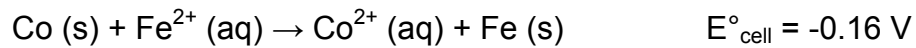
+1.94 V

18) Which of the following electrochemical cell reactions proceed spontaneously?

i. $E^{\circ}_{\text{cell}} = -2.07 \text{ V}$ ii. $E^{\circ}_{\text{cell}} = -0.07 \text{ V}$ iii. $E^{\circ}_{\text{cell}} = 0.0 \text{ V}$ iv. $E^{\circ}_{\text{cell}} = +2.07 \text{ V}$ v. $E^{\circ}_{\text{cell}} = +0.07 \text{ V}$

iv and v

19) Calculate the cell potential (E_{cell}) made from 0.27 M Co^{2+} and 1.5 M Fe^{2+} at 298 K.



-0.14 V

20) Which of the following is a mnemonic for REDOX reactions?

OIL RIG

Short Answer / Calculation Section (Show all work!!!)

21) (10 pts) Consider the solution made by mixing 300 mL of $5.0 \times 10^{-5} \text{ M AgNO}_3$ with 200 mL of $2.5 \times 10^{-7} \text{ M NaBr}$. $K_{sp}(\text{AgBr}) = 7.7 \times 10^{-13}$

Calculate Q and state whether a precipitate forms or not.

$$\text{moles Ag}^+ = \frac{5.0 \times 10^{-5} \text{ mol}}{1.0 \text{ L}} \times 0.300 \text{ L} = 1.5 \times 10^{-5} \text{ mol}$$

$$[\text{Ag}^+] = \frac{1.5 \times 10^{-5} \text{ mol}}{0.500 \text{ L}} = 3 \times 10^{-5} \text{ M}$$

$$\text{moles Br}^- = \frac{2.5 \times 10^{-7} \text{ mol}}{1.0 \text{ L}} \times 0.200 \text{ L} = 5.0 \times 10^{-8} \text{ mol}$$

$$[\text{Br}^-] = \frac{5.0 \times 10^{-8} \text{ mol}}{0.500 \text{ L}} = 1 \times 10^{-7} \text{ M}$$

$$Q = [\text{Ag}^+][\text{Br}^-] = (3 \times 10^{-5})(1 \times 10^{-7}) = 3 \times 10^{-12}$$

Q > K_{sp}, Supersaturated (precipitate forms)

21) (10 pts) Consider the solution made by mixing 300 mL of $5.0 \times 10^{-4} \text{ M AgNO}_3$ with 300 mL of $2.5 \times 10^{-6} \text{ M NaBr}$. $K_{sp}(\text{AgBr}) = 7.7 \times 10^{-10}$

Calculate Q and state whether a precipitate forms or not.

$$\text{moles Ag}^+ = \frac{5.0 \times 10^{-4} \text{ mol}}{1.0 \text{ L}} \times 0.300 \text{ L} = 1.5 \times 10^{-4} \text{ mol}$$

$$[\text{Ag}^+] = \frac{1.5 \times 10^{-4} \text{ mol}}{0.600 \text{ L}} = 2.5 \times 10^{-4} \text{ M}$$

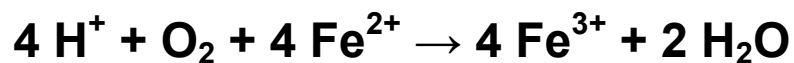
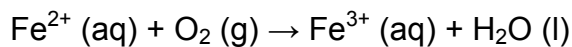
$$\text{moles Br}^- = \frac{2.5 \times 10^{-6} \text{ mol}}{1.0 \text{ L}} \times 0.300 \text{ L} = 7.5 \times 10^{-7} \text{ mol}$$

$$[\text{Br}^-] = \frac{7.5 \times 10^{-7} \text{ mol}}{0.600 \text{ L}} = 1.25 \times 10^{-6} \text{ M}$$

$$Q = [\text{Ag}^+][\text{Br}^-] = (2.5 \times 10^{-4})(1.25 \times 10^{-6}) = 3.125 \times 10^{-10}$$

Q < K_{sp}, Unsaturated (NO precipitate forms)

22) (6 pts) Balance the equation for the oxidation of $\text{Fe}^{2+} (\text{aq})$ to $\text{Fe}^{3+} (\text{aq})$ by molecular oxygen, $\text{O}_2 (\text{g})$, in an acidic solution.



23) (4 pts) On the diagram of the galvanic cell below, clearly label the following 4 items:

1) Salt Bridge 2) Anode Side 3) Cathode Side 4) Flow of Electrons (direction) (anode to cathode)

