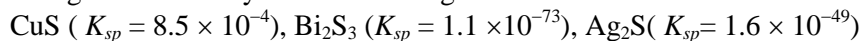


1. What is the pH of a mixture containing 0.100 M  $\text{HC}_3\text{H}_5\text{O}_2$  ( $K_a = 1.3 \times 10^{-5}$ ) and 0.100 M  $\text{NaC}_3\text{H}_5\text{O}_2$ ?
  - A) 4.89
  - B) 7.00
  - C) 2.47
  - D) 9.41
2. Which of the following mixtures would result in buffered solutions when 1.0 L of each of the two solutions are mixed?
  - A) 0.10 M KOH and 0.20 M  $\text{CH}_3\text{NH}_3\text{Cl}$
  - B) 0.10 M KOH and 0.10 M  $\text{CH}_3\text{NH}_3\text{Cl}$
  - C) 0.10 M KOH and 0.20 M  $\text{CH}_3\text{NH}_2$
  - D) 0.20 M KOH and 0.10 M  $\text{CH}_3\text{NH}_3\text{Cl}$
3. Calculate the pH at the equivalence point when a 100.0 mL of 0.10 M  $\text{HC}_7\text{H}_5\text{O}_2$  ( $K_a = 6.4 \times 10^{-5}$ ) titrated by 0.10 M NaOH.
  - A) 5.96
  - B) 4.19
  - C) 8.45
  - D) 2.32
4. Two drops of indicator  $\text{HIn}$  ( $K_a = 1.0 \times 10^{-9}$ ), where  $\text{HIn}$  is yellow and  $\text{In}^-$  is blue, are placed in 100.0 mL of 0.10 M HCl. The solution is titrated with 0.10 M NaOH. At what pH will the color change occur?
  - A) 5.25
  - B) 8.00
  - C) 9.83
  - D) 12.1
5. The concentration of  $\text{Pb}^{2+}$  in a solution saturated with  $\text{PbBr}_2(\text{s})$  is  $2.14 \times 10^{-2}$  M. What is the value of  $K_{sp}$  for  $\text{PbBr}_2$ ?
  - A)  $2.33 \times 10^{-9}$
  - B)  $8.24 \times 10^{-6}$
  - C)  $2.42 \times 10^{-7}$
  - D)  $3.92 \times 10^{-5}$

6. Arrange the solubility of the following salts from least soluble to most soluble.

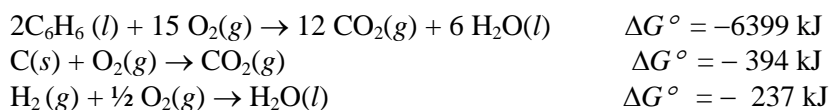


- A)  $\text{Ag}_2\text{S}$ ,  $\text{Bi}_2\text{S}_3$ ,  $\text{CuS}$   
B)  $\text{Bi}_2\text{S}_3$ ,  $\text{Ag}_2\text{S}$ ,  $\text{CuS}$   
C)  $\text{CuS}$ ,  $\text{Ag}_2\text{S}$ ,  $\text{Bi}_2\text{S}_3$   
D)  $\text{Bi}_2\text{S}_3$ ,  $\text{CuS}$ ,  $\text{Ag}_2\text{S}$

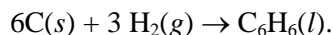
7. Which of the following processes will be spontaneous at temperature greater than 300K?

- A)  $\Delta H = -18 \text{ kJ}$  and  $\Delta S = -60 \text{ J/K}$   
B)  $\Delta H = +18 \text{ kJ}$  and  $\Delta S = +60 \text{ J/K}$   
C)  $\Delta H = +18 \text{ kJ}$  and  $\Delta S = -60 \text{ J/K}$   
D)  $\Delta H = -18 \text{ kJ}$  and  $\Delta S = +60 \text{ J/K}$

8. Given the following data;

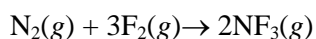


Calculate  $\Delta G^\circ$  for the reaction:



- A) 125 kJ  
B) 464 kJ  
C) 56 kJ  
D) 250 kJ

9. Calculate  $\Delta G^\circ$  for the following reaction at 800. K.



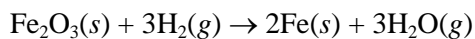
An equilibrium mixture contains the following partial pressures:  $P(\text{N}_2) = 0.021 \text{ atm}$ ,  $P(\text{F}_2) = 0.063 \text{ atm}$ ,  $P(\text{NF}_3) = 0.48 \text{ atm}$ .

- A) +71 kJ/mol  
B) -71 kJ/mol  
C) 130 kJ/mol  
D) -35 kJ

10. A plot of  $\ln K$  versus  $(1/T)$  yields a slope of  $-1.3 \times 10^4 \text{ K}$  and an intercept of 40.. Determine the values of  $\Delta H^\circ$  and  $\Delta S^\circ$ .

- A)  $\Delta H^\circ = 110 \text{ kJ}$  and  $\Delta S^\circ = 330 \text{ J/K}\cdot\text{mol}$
- B)  $\Delta H^\circ = 330 \text{ kJ}$  and  $\Delta S^\circ = 110 \text{ J/K}\cdot\text{mol}$
- C)  $\Delta H^\circ = 57.5 \text{ kJ}$  and  $\Delta S^\circ = -75.6 \text{ J/K}\cdot\text{mol}$
- D)  $\Delta H^\circ = 245 \text{ kJ}$  and  $\Delta S^\circ = -335 \text{ J/K}\cdot\text{mol}$

11. Consider the reaction;



Assuming  $\Delta H^\circ$  and  $\Delta S^\circ$  do not depend on temperature, calculate the temperature where  $K = 1.00$  for this reaction.

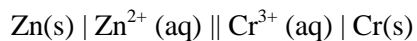
- A) 367 K
- B) 125 K
- C) 725 K
- D) 56 K

12. Which of the following statements is always true for a spontaneous process?

- I.  $\Delta S_{\text{sys}} > 0$     II.  $\Delta S_{\text{surr}} > 0$     III.  $\Delta S_{\text{univ}} > 0$     IV.  $\Delta G_{\text{sys}} > 0$

- A) I
- B) III
- C) IV
- D) I and III

13. Which of the following is true for the cell shown here?

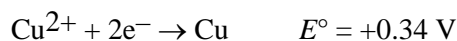


- A) The electrons flow from the cathode to the anode.
- B) The electrons flow from the zinc to the chromium.
- C) The electrons flow from the chromium to the zinc.
- D) The chromium is oxidized.

14. Which of the following species cannot function as an oxidizing agent?

- A)  $\text{MnO}_4^- (aq)$
- B)  $\text{NO}_3^- (aq)$
- C)  $\text{Cr}_2\text{O}_7^{2-} (aq)$
- D)  $\text{I}^- (aq)$

15. Consider the following reduction potentials:



For a galvanic cell employing the Cu,  $\text{Cu}^{2+}$  and Pb,  $\text{Pb}^{2+}$  couples, calculate the maximum amount of work that would accompany the reaction of one mole of lead under standard conditions.

- A) -40.5 kJ
- B) -45.3 kJ
- C) -90.7 kJ
- D) + 40.5 kJ

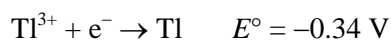
16. Consider the following concentration cell at 25°C;



Calculate the cell potential at the same temperature.

- A) 0.059 V
- B) 0.018 V
- C) 0.118 V
- D) 0.435 V

17. Calculate the equilibrium constant (K) for the cell reaction at 25°C. Given that;



- A)  $1.6 \times 10^{13}$
- B)  $7.8 \times 10^{18}$
- C)  $6.2 \times 10^{83}$
- D)  $2.52 \times 10^{93}$

18. Tables of standard reduction potentials are usually given at 25°C.  $E^\circ$  depends on temperature. Which of the following equations describes the temperature dependence of  $E^\circ$ ?

A)  $E^\circ = \frac{nF}{RT} - \ln k$

B)  $E^\circ = \Delta H^\circ - T\Delta S^\circ$

C)  $E^\circ = -\frac{\Delta H^\circ}{nF} + \frac{T\Delta S^\circ}{nF}$

D)  $\ln E^\circ = -\frac{\Delta H^\circ}{RT} + \frac{\Delta S^\circ}{R}$

19. For the dissociation reaction of the acid HF;



$\Delta S$  is observed to be negative. The best explanation is:

- A) This is the expected result since each HF molecule produces two ions when it dissociates.
- B) Hydration of the ions produces the negative value of  $\Delta S$ .
- C) The reaction is expected to be exothermic and thus  $\Delta S$  should be negative.
- D) The reaction is expected to be endothermic and thus  $\Delta S$  should be negative.
20. Which statement is correct?
- A) It is necessary that the concentration of the weak acid and weak base in a buffered solution must be equal.
- B) A common ion is an ion that appears in an equilibrium reaction but came from a source other than that reaction.
- C) The equivalence point is defined by the change in color of the indicator.
- D) The end point is defined by the reaction stoichiometry.