

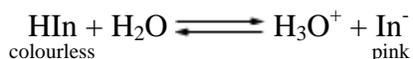
Acids, Bases & Redox 2

- Practice Problems for Assignment 9

1. What do a chemical indicator and a buffer solution typically both contain?

- (a) A strong acid and its conjugate acid
- (b) A strong acid and its conjugate base
- (c) A weak acid and its conjugate acid
- (d) A weak acid and its conjugate base

2. The indicator phenolphthalein can be described by the following equilibrium equation:



HCl is added to a slightly pink sample of this indicator. After equilibrium has been re-established, how do the $[\text{H}_3\text{O}^+]$ and the colour of the solution **compare with the original equilibrium**?

- (a) $[\text{H}_3\text{O}^+]$: decreases
Colour of Solution: turns more pink
- (b) $[\text{H}_3\text{O}^+]$: decreases
Colour of Solution: turns colourless
- (c) $[\text{H}_3\text{O}^+]$: increases
Colour of Solution: turns more pink
- (d) $[\text{H}_3\text{O}^+]$: increases
Colour of Solution: turns colourless

3. A chemical indicator has a $K_a = 4.0 \times 10^{-6}$. What is the pH at the transition point and the identity of the indicator?

- (a) pH: 5.4
Indicator: methyl red
- (b) pH: 5.4
Indicator: bromcresol green
- (c) pH: 8.6
Indicator: phenolphthalein
- (d) pH: 8.6
Indicator: thymol blue

4. Which of the following chemical indicators has a $K_a = 2.5 \times 10^{-5}$?
- methyl orange
 - phenolphthalein
 - thymolphthalein
 - bromocresol green
5. When performing a titration experiment, the indicator must always have
- a distinct colour change at $\text{pH} = 7.0$.
 - the ability to change from colourless to pink.
 - a transition point that is close to the equivalence point.
 - an equivalence point that is close to the stoichiometric point.
6. Which of the following is the net ionic equation for the neutralization of HNO_3 (aq) with $\text{Sr}(\text{OH})_2$ (aq) ?
- H^+ (aq) + OH^- (aq) \rightarrow H_2O (l)
 - Sr^{2+} (aq) + 2NO_3^- (aq) \rightarrow $\text{Sr}(\text{NO}_3)_2$ (s)
 - 2HNO_3 (aq) + $\text{Sr}(\text{OH})_2$ (aq) \rightarrow $\text{Sr}(\text{NO}_3)_2$ (aq) + $2\text{H}_2\text{O}$ (l)
 - 2H^+ (aq) + 2NO_3^- (aq) + Sr^{2+} (aq) + 2OH^- (aq) \rightarrow Sr^{2+} (aq) + 2NO_3^- (aq) + $2\text{H}_2\text{O}$ (l)
7. Which of the following is **not** a good use for an acid-base titration curve?
- to determine the concentration of the base
 - to select a suitable indicator for the titration
 - to determine whether the acid is strong or weak
 - to select a suitable primary standard for the titration
8. A 25.0 mL sample of H_2SO_4 (aq) is titrated with 15.5 mL of 0.50 M NaOH (aq) . What is the concentration of the H_2SO_4 (aq) ?
- 0.078 M
 - 0.16 M
 - 0.31 M
 - 0.62 M

9. Consider the following buffer equilibrium:



What happens when a small amount of NaOH (aq) is added?

- $[\text{H}_3\text{O}^+]$ increases, then the equilibrium shifts to the left.

- (b) $[\text{H}_3\text{O}^+]$ decreases, then the equilibrium shifts to the left.
- (c) $[\text{H}_3\text{O}^+]$ increases, then the equilibrium shifts to the right.
- (d) $[\text{H}_3\text{O}^+]$ decreases, then the equilibrium shifts to the right.

10. Which of the following acids could **not** be present in a buffer solution?

- (a) HF
- (b) HNO_2
- (c) H_2SO_3
- (d) HClO_4

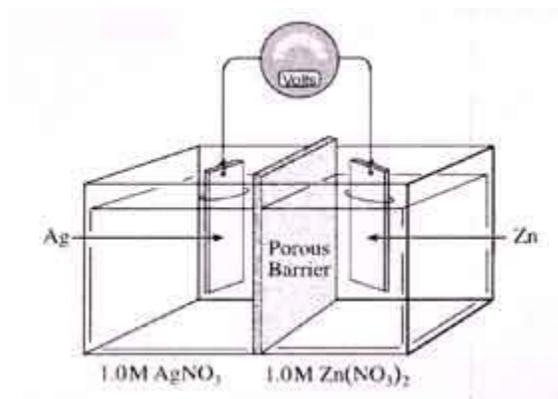
11. Which of the following pairs of chemicals could be used to make a buffer solution?

- (a) NH_3 and H_2O
- (b) HCl and NaCl
- (c) NH_3 and NH_4Cl
- (d) CH_3COOH and HCl

12. Carbon dioxide gas in the atmosphere dissolves in normal rainwater.
This causes normal rainwater to

- (a) be slightly basic.
- (b) have a pH slightly less than 7.0 .
- (c) be unaffected and remain neutral.
- (d) have a pH slightly greater than 7.0 .

13. Consider the following electrochemical cell:



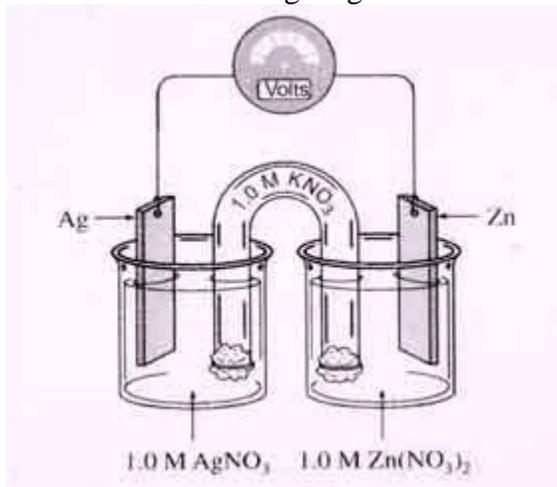
What is the anode half-reaction?

- (a) $\text{Ag} \rightarrow \text{Ag}^+ + \text{e}^-$
- (b) $\text{Ag}^+ + \text{e}^- \rightarrow \text{Ag}$
- (c) $\text{Zn} \rightarrow \text{Zn}^{2+} + 2\text{e}^-$
- (d) $\text{Zn}^{2+} + 2\text{e}^- \rightarrow \text{Zn}$

14. As a standard Zn / Ag electrochemical cell operates, in which direction do anions move and how does the mass of the cathode change?

- (a) Anion Direction: towards Zn electrode
 Mass of Cathode: increases
- (b) Anion Direction: towards Ag electrode
 Mass of Cathode: increases
- (c) Anion Direction: towards Zn electrode
 Mass of Cathode: decreases
- (d) Anion Direction: towards Ag electrode
 Mass of Cathode: decreases

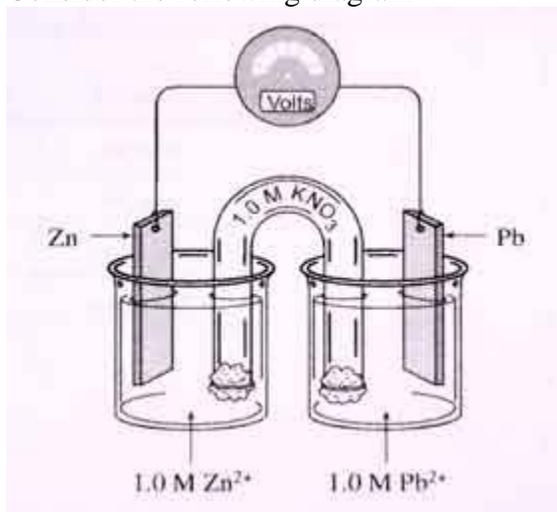
15. Consider the following diagram



What is the equation for the half-reaction that occurs at the cathode?

- (a) $\text{Ag} \rightarrow \text{Ag}^+ + \text{e}^-$
- (b) $\text{Ag}^+ + \text{e}^- \rightarrow \text{Ag}$
- (c) $\text{Zn} \rightarrow \text{Zn}^{2+} + 2\text{e}^-$
- (d) $\text{Zn}^{2+} + 2\text{e}^- \rightarrow \text{Zn}$

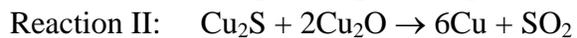
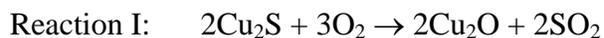
16. Consider the following diagram



As the cell operates, the electrons flow towards the

- (a) Zn electrode and the cell voltage increases over time.
- (b) Pb electrode and the cell voltage decreases over time
- (c) Zn electrode and the cell voltage decreases over time.
- (d) Pb electrode and the cell voltage remains constant over time.

17. Two separate reactions involved in the refining of copper ore are:



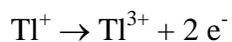
What happens to the copper ions during this process?

- (a) They are reduced in Reaction I.
- (b) They are reduced in Reaction II.
- (c) They are oxidized in Reaction I.
- (d) They are oxidized in Reaction II.

18. Consider the following:

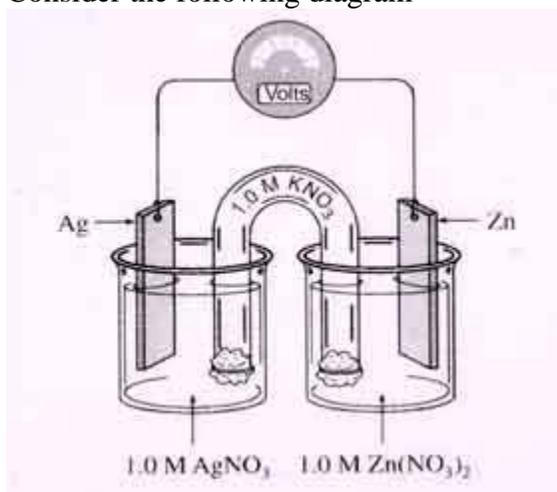


Identify the standard potential for the half-cell reaction:



- (a) -0.78 V
- (b) +1.60 V
- (c) +0.78 V
- (d) +1.19 V

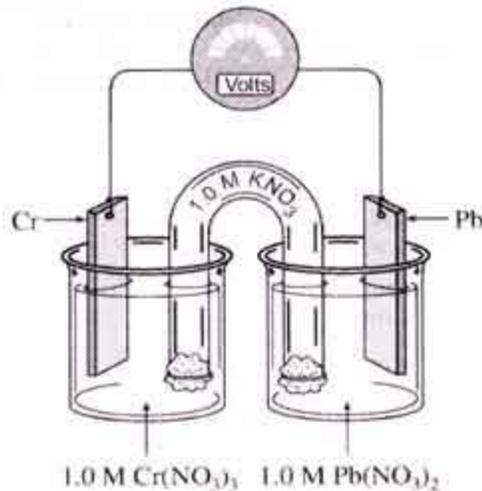
19. Consider the following diagram



Which of the following is correct?

- (a) Electrons Flow Towards: Zn
Anions Move Towards: Zn
- (b) Electrons Flow Towards: Zn
Anions Move Towards: Ag
- (c) Electrons Flow Towards: Ag
Anions Move Towards: Zn
- (d) Electrons Flow Towards: Ag
Anions Move Towards: Ag

20. Consider the following cell:



What is the initial cell voltage?

- (a) +0.87 V
- (b) +0.61 V
- (c) +0.54 V
- (d) +0.28 V

21. Hypochlorite ion, OCl^- , is a weak base. When OCl^- reacts with water, the products are

- (a) $\text{HOCl}^+ + \text{OH}^-$
- (b) $\text{HOCl} + \text{OH}^-$
- (c) $\text{HOCl}^- + \text{OH}^-$
- (d) $\text{H}_2\text{OCl}^+ + \text{OH}^-$

22. Calculate the concentration of H^+ and pH for 0.10 M propionic acid, $\text{HC}_3\text{H}_5\text{O}_2$. K_a for propionic acid is 1.34×10^{-5} .

23. Are the solutions

- (a) NaNO_3 (b) $\text{Na}_2\text{C}_2\text{O}_4$ (c) NH_4NO_3

acidic, basic or neutral?

24. An acid-base reaction occurs between $\text{HSO}_3^- + \text{IO}_3^-$.

- (a) Write the equation for the equilibrium that results.
- (b) Identify the conjugate acid-base pairs in the reaction.
- (c) State whether the reactants or products are favoured. Explain.

Answers:

1. d
2. d
3. a
4. d
5. c
6. a
7. d
8. b
9. d
10. d
11. c
12. b
13. c
14. a
15. b
16. b
17. b
18. a
19. c
20. b
21. b

22. $[\text{H}^+] = 1.2 \times 10^{-3} \text{ M}$
 $\text{pH} = 2.92$

23. a: neutral
b: basic
c: acidic

24. a: $\text{HSO}_3^- + \text{IO}_3^- \rightleftharpoons \text{SO}_3^{2-} + \text{HIO}_3$
b: HSO_3^- and SO_3^{2-} , IO_3^- and HIO_3
c: Reactants favoured.

Explanation: IO_3^- is a weaker base than SO_3^{2-} ; HSO_3^- is weaker acid than HIO_3