

Chem12 Acids : M.C. 3 - 260

1) The equation showing the acid form of an indicator reacting with a basic solution is :

- a) $\text{In}^-(\text{aq}) + \text{OH}^-(\text{aq}) \rightarrow \text{HIn}(\text{aq}) + \text{O}^{2-}(\text{aq})$
- b) $\text{HIn}(\text{aq}) + \text{OH}^-(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l}) + \text{In}^-(\text{aq})$
- c) $\text{In}^-(\text{aq}) + \text{H}_3\text{O}^+(\text{aq}) \rightarrow \text{HIn}(\text{aq}) + \text{H}_2\text{O}(\text{l})$
- d) $\text{HIn}(\text{aq}) + \text{H}_2\text{O}(\text{l}) \rightarrow \text{H}_3\text{O}^+(\text{aq}) + \text{In}^-(\text{aq})$

2) Which of the following gases will give the most basic solution on dissolving in water ?

- a) $\text{H}_2\text{S}(\text{g})$
- b) $\text{NH}_3(\text{g})$
- c) $\text{CO}_2(\text{g})$
- d) HCl

3) A formula for a salt is :

- a) Na_2HPO_4
- b) H_3PO_4
- c) $\text{C}_6\text{H}_5\text{COOH}$
- d) $\text{Cu}(\text{NH}_3)_4^{2+}$

4) The salt which will undergo hydrolysis in water is :

- a) K_2I^+
- b) KNO_3
- c) KCN
- d) K_2SO_4

5) Data : $\text{H}_2\text{C}_2\text{O}_4(\text{aq}) + \text{H}_2\text{O}(\text{l}) \rightleftharpoons \text{H}_3\text{O}^+(\text{aq}) + \text{HC}_2\text{O}_4^-(\text{aq})$: $K_1 = 0.0540$

$\text{HC}_2\text{O}_4^-(\text{aq}) + \text{H}_2\text{O}(\text{l}) \rightleftharpoons \text{H}_3\text{O}^+(\text{aq}) + \text{C}_2\text{O}_4^{2-}(\text{aq})$: $K_2 = 5.40 \times 10^{-5}$

The value of K_{eq} for $\text{H}_2\text{C}_2\text{O}_4(\text{aq}) + 2\text{H}_2\text{O}(\text{l}) \rightleftharpoons 2\text{H}_3\text{O}^+(\text{aq}) + \text{C}_2\text{O}_4^{2-}(\text{aq})$ is

- a) 2.92×10^{-3}
- b) 1.00×10^6
- c) 1.00×10^{-6}
- d) 2.92×10^{-6}

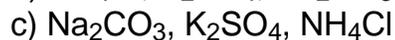
6) Which one of the following equations does not represent a hydrolysis reaction ?

- a) $\text{HI}(\text{g}) + \text{H}_2\text{O}(\text{l}) \rightleftharpoons \text{I}^-(\text{aq}) + \text{H}_3\text{O}^+(\text{aq})$
- b) $\text{CuSO}_4(\text{s}) + 5\text{H}_2\text{O}(\text{l}) \rightleftharpoons \text{CuSO}_4 \cdot 5\text{H}_2\text{O}(\text{s})$
- c) $\text{C}_6\text{H}_5\text{COOH}(\text{aq}) + \text{H}_2\text{O}(\text{l}) \rightleftharpoons \text{C}_6\text{H}_5\text{COO}^-(\text{aq}) + \text{H}_3\text{O}^+(\text{aq})$
- d) $\text{NH}_4^+(\text{aq}) + \text{H}_2\text{O}(\text{l}) \rightleftharpoons \text{NH}_3(\text{aq}) + \text{H}_3\text{O}^+(\text{aq})$

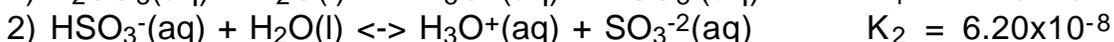
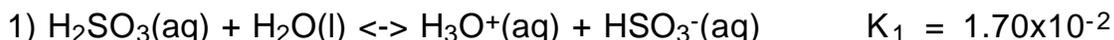
7) The indicator methyl red has a K_a value of 4.00×10^{-6} . If a 1.00×10^{-3} M solution of the indicator is used, what will be the $[\text{H}_3\text{O}^+]$ at the endpoint, where the color change is orange (i.e. intermediate between red and yellow) ?

- a) 4.00×10^{-9} M
- b) 4.00×10^{-6} M
- c) 2.00×10^{-3}
- d) 4.00×10^{-3}

8) Which one of the following sets shows the correct order of increasing pH of the aqueous solutions of the three salts if equal concentrations are used ?



9) What is the value of the equilibrium constant K_{eq} , for the reaction $\text{H}_2\text{SO}_3(\text{aq}) + 2\text{H}_2\text{O}(\text{l}) \rightleftharpoons 2\text{H}_3\text{O}^+(\text{aq}) + \text{SO}_3^{2-}(\text{aq})$ given that :



10) Which one of the following statements explains why oxalic acid, $\text{H}_2\text{C}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$ is useful as a primary standard in acid-base titrations ?

a) It contains two replaceable hydrogen ions.

b) It can be obtained very pure and is a crystalline solid.

c) It has a large K_a and so gives better results in titrations.

d) A stoichiometric point of its titrations is on the basic side of neutral pH 7, which is better for titrations involving strong bases.

11) Which one of the following oxyacids of chlorine has the smallest K_a ?



12) The indicator quinaldine red has a colorless acid form and a pink base form. Its K_a is 2.5×10^{-2} . Which one of the following descriptions of an aqueous solution of quinaldine red at a pH of 7 is correct ?

a) The solution is pink

b) The solution is colorless

c) The $[\text{acid form}] > [\text{base form}]$

d) The $[\text{acid form}] = [\text{base form}]$

13) A dilute solution of NH_4Cl will contain :

a) undissociated NH_4Cl

b) more $\text{NH}_4^+(\text{aq})$ than $\text{NH}_3(\text{aq})$

c) more $\text{OH}^-(\text{aq})$ than $\text{H}_3\text{O}^+(\text{aq})$

d) strongly hydrolyzed $\text{Cl}^-(\text{aq})$

14) Which of the following salts will produce a basic solution when it dissolves in water ?

- a) KClO_4 b) $\text{Fe}(\text{NO}_3)_3$ c) NaCH_3COO d) AlBr_3

15) Which one of the following equations represents the hydrolysis of the acetate ion ?

- a) $\text{CH}_3\text{COO}^-(\text{aq}) + \text{H}_3\text{O}^+(\text{aq}) \rightleftharpoons \text{CH}_3\text{COOH}(\text{aq}) + \text{H}_2\text{O}(\text{l})$
b) $\text{CH}_3\text{COO}^-(\text{aq}) + \text{H}_2\text{O}(\text{l}) \rightleftharpoons \text{CH}_3\text{COOH}(\text{aq}) + \text{OH}^-(\text{aq})$
c) $\text{CH}_3\text{COO}^-(\text{aq}) + \text{H}_2\text{O}(\text{l}) \rightleftharpoons \text{CH}_2\text{COO}^{2-}(\text{aq}) + \text{H}_3\text{O}^+(\text{aq})$
d) $\text{CH}_3\text{COOH}(\text{aq}) + \text{H}_2\text{O}(\text{l}) \rightleftharpoons \text{CH}_3\text{COO}^-(\text{aq}) + \text{H}_3\text{O}^+(\text{aq})$

16) Which one of the 1.0 M aqueous solutions is basic ?

- a) KCl b) NH_4NO_3 c) NaClO_4 d) Na_2CO_3

17) The pH of an aqueous solution of Na_2CO_3 is most likely to be :

- a) 3.5 b) 5.5 c) 7.0 d) 10.5

18) Which of the following equations best illustrates the hydrolysis of Na_2CO_3 ?

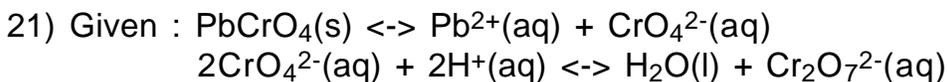
- a) $\text{Na}_2\text{CO}_3(\text{s}) + \text{H}_2\text{O}(\text{l}) \rightarrow \text{Na}_2\text{O}(\text{aq}) + \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{l})$
b) $\text{CO}_3^{2-}(\text{aq}) + \text{H}_2\text{O}(\text{l}) \rightarrow \text{HCO}_3^-(\text{aq}) + \text{OH}^-(\text{aq})$
c) $\text{Na}_2\text{CO}_3(\text{s}) + \text{H}_2\text{O}(\text{l}) \rightarrow 2\text{Na}^+(\text{aq}) + \text{CO}_3^{2-}(\text{aq})$
d) $\text{Na}_2\text{CO}_3(\text{s}) + \text{H}_2\text{O}(\text{l}) \rightarrow \text{Na}_2\text{CO}_4(\text{aq}) + \text{H}_2(\text{g})$

19) Which one of the following equations shows the basic form of an indicator HIn reacting in an acidic solution ?

- a) $\text{In}^-(\text{aq}) + \text{H}_3\text{O}^+(\text{aq}) \rightleftharpoons \text{HIn}(\text{aq}) + \text{H}_2\text{O}(\text{l})$
b) $\text{HIn}(\text{aq}) + \text{H}_3\text{O}^+(\text{aq}) \rightleftharpoons \text{H}_2\text{In}^+(\text{aq}) + \text{H}_2\text{O}(\text{l})$
c) $\text{In}^-(\text{aq}) + \text{H}_2\text{O}(\text{l}) \rightleftharpoons \text{HIn}(\text{aq}) + \text{OH}^-(\text{aq})$
d) $\text{HIn}(\text{aq}) + \text{OH}^-(\text{aq}) \rightleftharpoons \text{In}^-(\text{aq}) + \text{H}_2\text{O}(\text{l})$

20) Which one of the following ions is the conjugate base of $\text{Al}(\text{H}_2\text{O})_6^{3+}(\text{aq})$?

- a) $\text{Al}(\text{H}_2\text{O})_6^{4+}(\text{aq})$ b) $\text{Al}(\text{H}_2\text{O})_6^{2+}(\text{aq})$ c) $\text{Al}(\text{H}_2\text{O})_5\text{OH}^{2+}(\text{aq})$
d) $\text{Al}(\text{H}_2\text{O})_6\text{OH}^{2+}(\text{aq})$



A precipitate of $\text{PbCrO}_4(\text{s})$ is formed by mixing solutions of K_2CrO_4 and $\text{Pb}(\text{NO}_3)_2$. It would be possible to redissolve by adding a concentrated solution of :

- a) Na_2CrO_4 b) $\text{Na}_2\text{Cr}_2\text{O}_7$ c) a strong acid d) a strong base

22) $\text{Sn}(\text{OH})_2$ is insoluble in water but reacts with and is soluble in both dilute NaOH and dilute HCl . On the basis of this information, $\text{Sn}(\text{OH})_2$ could best be described as

- a) basic b) neutral c) acidic d) amphoteric

23) Of the following of oxyacids, which is the strongest acid ?

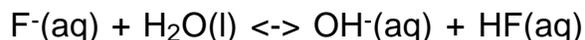
- a) HOI b) HOAt c) HOBr d) HOCl

24) Based on trends in atom size and electronegativity, which of the following acids is strongest ?

- a) H_2Se b) H_2S c) H_2O d) H_2Te

25) Combustion of coal which contains sulfur produces a gaseous sulfur compound. This compound, when released into the atmosphere undergoes a series of reactions eventually forming acid rain. Explain the process using the appropriate equations.

26) Which term best describes the process represented by the following equation :



- a) titration b) hydrolysis c) oxidation-reduction
d) neutralization

27) Give a formula for each of the following :

- a) a third row amphoteric hydroxide
b) a third row basic hydroxide

28) $\text{Cr}(\text{OH})_3$ is insoluble in water but will dissolve in both acidic and basic solutions. This indicates that it is

- a) amphoteric b) diprotic c) isomeric d) polymorphic

29)a) Compare the ease with which the first hydrogen ion (proton) is removed from a diprotic acid in relation to the ease of removal of the second hydrogen ion.

b) Use as an example from the table of acids to illustrate the above situation.

c) Explain your answer to b).

30) In a solution with a pH of 3, the color of

- a) litmus is red b) litmus is blue
c) phenolphthalein is red d) phenolphthalein is blue

31) Which salt hydrolyzes in water to form a solution that is acidic ?

- a) KCl b) NH_4Cl c) NaCl d) LiCl

32) Which compound is an electrolyte ?

- a) $\text{C}_6\text{H}_{12}\text{O}_6$ b) $\text{C}_{12}\text{H}_{22}\text{O}_{11}$ c) $\text{C}_2\text{H}_5\text{OH}$ d) CH_3COOH

33) Which one of the following gases will give the most acidic solution on dissolving in water ?

- a) $\text{CO}_2(\text{g})$ b) $\text{HBr}(\text{g})$ c) $\text{H}_2\text{S}(\text{g})$ d) $\text{NH}_3(\text{g})$

34) Which one of the following 0.10 M solutions will have the highest $[\text{OH}^-]$?

- a) NaCl b) K_3PO_4 c) $\text{Cr}(\text{NO}_3)_3$ d) CH_3COOH

Answers : 1) b, 2) b, 3) a, 4) c, 5) d, 6) b, 7) b, 8) a, 9) b, 10) d, 11) a, 12) a, 13) b, 14) c, 15) b, 16) d, 17) d, 18) b, 19) a, 20) c, 21) c, 22) d, 23) d, 24) d, 25) See Heath pg. 611, 26) b, 27)a) $\text{Al}(\text{OH})_3$, b) NaOH, 28) a, 29)a) The first H^+ is removed most easily. b) See the table. The acids : H_3PO_4 , H_2PO_4^- , and HPO_4^{2-} , are listed in order of decreasing

strength. c) It becomes more difficult to remove a proton from a negatively charged ion., 30) a, 31) b, 32) d, 33) b, 34) b.