**Chemistry 12 Acids Unit 4 Test**

**Multiple choice**

1.         Consider the following:

I           H2CO3 +  F-  D  HCO3-  +  HF

II          HCO3-  +  HC2O4-  D  H2CO3  +  C2O42-

III        HCO3- +  H2C6H6O7- D  H2CO3  +  HC6H5O72-

The HCO3- is a base in

A.              I only

B.              I and II only

C.              II and III only

**D.              I, II, and III**

2.         Consider the following equilibrium for an indicator:

            HInd  +  H2O  D  Ind-  +  H3O+

When a few drops of indicator methyl red are added to 1.0 M HCl, the colour of the resulting solution is

A.        red and the products are favoured

**B.        red and the reactants are favoured**

C.        yellow and the products are favoured

D.        yellow and the reactants are favoured

3.         The volume of 0.200 M Sr(OH)2 needed to neutralize 50.0 mL of 0.200 M HI is

            A.        10.0 mL

            **B.        25.0 mL**

            C.        50.0 mL

            D.        100.0 mL

4.         The pOH of 0.050 M HCl is

            A.        0.050

            B.        1.30

            **C.        12.70**

            D.        13.70

5.         The volume of 0.450 M HCl needed to neutralize 40.0 mL of Sr(OH)2 is

            A.        18.0 mL

            B.        20.0 mL

            C.        40.0 mL

            **D.        80.0 mL**

6.         Consider the following

            I           H3PO4              II          H2PO4-             III        HPO42-             IV        PO43-

            Which of the following solutions will have the largest [H30+]?

            A.        I and II only

            **B.        II and III only**

            C.        I, II, and III only

            D.        II, III, and IV only

7.         Which of the following solutions will have the largest [H3O+]?

            A.        1.0 M HNO2

            B.        1.0 M H3BO3

**C.        1.0 M H2C2O4**

D.        1.0 M HCOOH

8.         Consider the following:          H2O  +  57 kJ  D  H3O+  +  OH-

            When the temperature of the system is increased, the equilibrium shifts

            A.        left and the Kw increases

            B.        left and the Kw decreases

            **C.        right and the Kw increases**

            D.        right and the Kw decreases

9.         Normal rainwater has a pH of approximately 6 as a result of dissolved

            A.        oxygen

            **B.        carbon dioxide**

            C.        sulphur dioxide

            D.        nitrogen dioxide

10.       A 1.0 M solution of sodium dihydrogen phosphate is

            **A.        acidic and the pH < 7.00**

            B.        acidic and the pH > 7.00

            C.        basic and the pH < 7.00

            D.        basic and the pH > 7.00

11.       Consider the following equilibrium for an indicator:

            HInd  +  H2O  D  Ind-  +  H3O+

When a few drops of indicator chlorophenol red are added to a colourless solution of pH 4.0, the resulting solution is

A.        red as [HInd] < [Ind-]

B.        red as [HInd] > [Ind-]

C.        yellow as [HInd] < [Ind-]

**D.        yellow as [HInd] > [Ind-]**

12.       A Bronsted-Lowry base is defined as a chemical species that

            **A.        accepts protons**

            B.        neutralizes acids

            C.        donated electrons

            D.        produces hydroxides ions in solution

13.       Which of the following solutions will have the greatest electrical conductivity?

            A.        1.0 M HCN

            **B.        1.0 M H2SO4**

            C.        1.0 M H3PO4

            D.        1.0 M CH3COOH

14.       Consider the following equilibrium:  HC6H5O72-  +  HIO3  D  H2C6H5O7-  +  IO3-

            The order of Bronsted-Lowry acids and bases is

            A.        acid, base, acid, base

            B.        acid, base, base, acid

            **C.        base, acid, acid, base**

            D.        base, acid, base acid

15.       Consider the following: H2O(l)  D  H+  +  OH-

When a small amount of 1.0 M KOH is added to the above system, the equilibriu

**A.        shifts left and [H+] decreases**

B.        shifts left and [H+] increases

C.        shifts right and [H+] decreases

D.        shifts right and [H+] increases

16.       Which of the following has the highest pH?

            A.        1.0 M NaIO3

            B.        1.0 M Na2CO3

**C.        1.0 M Na3PO4**

D.        1.0 M Na2SO4

17.       In a 100.0 mL sample of 0.0800 M NaOH the [H3O+] is

            **A.        1.25  x  10-13 M**

            B.        1.25  x  10-12 M

            C.        8.00  x  10-3 M

            D.        8.00  x  10-2 M

18.       Consider the following:

I           ammonium nitrate        II          calcium nitrate             III        iron III nitrate

When dissolved in water, which of these salts would form a neutral solution?

**A.        II only**

B.        III only

C.        I and III only

D.        I, II, and III

19.       Consider the following:  SO42-  +  HNO2  D  HSO4-  +  NO2-

            Equilibrium would favour the

            A.        the products since HSO4- is a weaker acid than HNO2

            B.        the reactants since HSO4- is a weaker acid than HNO2

C.        the products since HSO4- is a stronger acid than HNO2

            **D.        the reactants since HSO4- is a stronger acid than HNO2**

20.       The net ionic equation for the hydrolysis of Na2CO3 is

            A.        H2O  +  Na+  D  NaOH  + H+

            B.        H2O  +  2Na+  D  Na2O  + 2H+

            C.        H2O  +  CO32-  D  H2CO3  +  O2-

            **D.        H2O  +  CO32-  D  HCO3-  +  OH-**

21.       Consider the following equilibrium:

2H2O(l)  D  H3O+ +  OH-

            A few drops of 1.0 M HCl are added to the above system. When equilibrium is

re-established, the

**A.        [H3O+] has increased and the [OH-] has decreased**

B.        [H3O+] has increased and the [OH-] has increased

C.        [H3O+] has decreased and the [OH-] has increased

D.        [H3O+] has decreased and the [OH-] has decreased

22.       A basic solution

            A.        tastes sour

            **B.        feels slippery**

            C.        does not conduct electricity

            D.        reacts with metals to release oxygen gas

23.       The balanced formula equation for the neutralization of H2SO4 by KOH is

            A.        H2SO4  +  KOH  →  KSO4  +  H2O

            B.        H2SO4  +  KOH  →  K2SO4  +  H2O

            C.        H2SO4  +  2KOH  →  K2SO4  +  H2O

            **D.        H2SO4  +  2KOH  →  K2SO4  +  2H2O**

24.       An Arrhenius base is defined as a substance which

            A.        donates protons

            B.        donates electrons

            C.        produces H+ in solution

            **D.        produces OH- in solution**

25.       Consider the following equilibrium:  HS-  +  H3PO4  D  H2S  +  H2PO4-

            The order of Bronsted-Lowry acids and bases is

            A.        acid, base, acid, base.

            B.        acid, base, base, acid

            **C.        base, acid, acid, base**

            D.        base, acid, base, acid

26.       The equation representing the reaction of ethanoic acid with water is

            A.        CH3COO-  +  H2O  D  CH3COOH  +  OH-

            B.        CH3COO-  +  H2O  D  CH3COO2-  +  H3O+

            **C.        CH3COOH  +  H2O  D  CH3COO-  +  H3O+**

            D.        CH3COOH  +  H2O  D  CH3COOH2+  +  OH-

27.       Consider the following equilibrium:  2H2O  +  57kJ  D  H3O+  +  OH-

            When the temperature is decreased, the water

            A.        stays neutral and the [H3O+] increases

            **B.        stays neutral and the [H3O+] decreases**

            C.        becomes basic and [H3O+] decreases

            D.        becomes acidic and [H3O+] increases

28.       The equation for the reaction of Cl2O with water is

            **A.        Cl2O  +  H2O  D  2HClO**

            B.        Cl2O  +  H2O  D  2ClO  +  H2

            C.        Cl2O  +  H2O  D  Cl2  +  H2O2

            D.        Cl2O  +  H2O  D  Cl2  +  O2  +  H2

29.       The conjugate acid of C6H50- is

            A.        C6H4O-

            **B.        C6H5OH**

            C.        C6H4O2-

            D.        C6H5OH+

30.       Which of the following solutions will have the greatest electrical conductivity?

            **A.        1.0 M HCl**

            B.        1.0 M HNO2

C.        1.0 M H3BO3

D.        1.0 M HCOOH

31.       A solution of 1.0 M HF has

            A.        a lower pH than a solution of 1.0 M HCl

            B.        a higher pOH than a solution of 1.0 M HCl

            **C.        a higher [OH-] than a solution of 1.0 M HCl**

            D.        a higher [H3O+] than a solution of 1.0 M HCl

32.       Which of the following is the weakest acid

            A.        HIO3

            **B.        HCN**

            C.        HNO3

            D.        C6H5COOH

33.       Considering the following data

            H3AsO4            Ka  =  5.0  x  10-5

            H2AsO4-           Ka  =  8.0  x  10-8

            HAsO42-           Ka  =  6.0  x  10-10

            The Kb value for H2AsO4-is

            **A.        2.0  x  10-10**

            B.        8.0  x  10-8

            C.        1.2  x  10-7

D.        1.7  x  10-5

34.       In a solution at 25oC, the [H3O+] is 3.5  x  10-6 M. The [OH-] is

A.        3.5  x  10-20 M

            **B.        2.9  x  10-9 M**

C.        1.0  x  10-7 M

            D.        3.5  x  10-6 M

35.       In a solution with a pOH of 4.22, the [OH-] is

A.        1.7  x  10-10 M

            **B.        6.0  x  10-5 M**

C.        6.3  x  10-1 M

            D.        1.7  x  104 M

36.       An aqueous solution of NH4CN is

            **A.        basic because Ka  <  Kb**

            B.        basic because Ka  >  Kb

            C.        acidic because Ka  <  Kb

            D.        acidic because Ka  >  Kb

37.       The net ionic equation for the predominant hydrolysis reaction of KHSO4 is

            **A.        HSO4-  +  H2O  D  SO42-  +  H3O+**

            B.        HSO4-  +  H2O  D  H2SO4  +  OH-

            C.        KHSO4  +  H2O  D  K+  +  SO42-  +  H3O+

            D.        KHSO4  +  H2O  D  K+  +  H2SO4  +  OH-

38.       The [OH-] in an aqueous solution always equals

            A.        Kw  x  [H3O+]

            B.        Kw  -  [H3O+]

            **C.        Kw/[H3O+]**

            D.        [H3O+]/Kw

39.       The [H3O+] in a solution with pH of 0.253 is

A.        5.58  x  10-15 M

            **B.        1.79  x  10-14 M**

C.        5.58  x  10-1 M

            D.        5.97  x  10-1 M

40.       The equilibrium expression for the hydrolysis reaction of 1.0 M K2HPO4 is

            **A.        [H2PO4-][OH-]**                       B.        [H3PO4][OH-]

                        **[HPO4-]**                                  [H2PO4-]

C.        [K+] [KHPO4-]             D.        [K+]2 [HPO42-]

                            [K2HPO4]                                [K2HPO4]

41.       The solution with the highest pH is

            A.        1.0 M NaCl

            **B.        1.0 M NaCN**

            C.        1.0 M NaIO3

            D.        1.0 M Na2SO4

42.       The pH of 100.0 mL of 0.0050 M NaOH is

            A.        2.30

            B.        3.30

            C.        10.70

**D.        11.70**

43.       Consider the following equilibrium for an indicator: HInd + H2O D Ind- + H3O+

            At the transition point,

            A.        [HInd]  >  [Ind-]

            **B.        [HInd]  =  [Ind-]**

            C.        [HInd]  <  [Ind-]

            D.        [HInd]  =  [H3O+]

**Short Answer**

1.         a)         Write the net ionic equation for the reaction between NaHSO3 and NaHC2O4.

                        **HSO3-  +  HC2O4-  D  H2SO3  +  C2O42-**

            b)         Explain why the reactants are favoured in the above reaction.

                        **H2SO3 is a stronger acid than HC2O4-**

2.         What is the [H3O+] in a solution formed by adding 60.0 mL of water to 40.0 mL of 0.400 mL of KOH?

**KOH                →                   K+        +          OH-**

**40      x  0.40 M                      0.16 M            0.16 M**

**100**

**[H+][OH-]  =  1.00  x  10-14                [H+]  =  6.25  x  10-14 M**

3.         A solution of 0.100 M HOCN has a pH of 2.24. Calculate the Ka value for the acid.

**Ka       =          10-2.24              =          0.005754 M**

**HOCN                        D                    H+                    +          OCN-**

**I           0.100 M                                  0                                  0**

**C         0.005754 M                            0.005754 M                0.005754 M**

**E         0.094245 M                            0.005754 M                0.005754 M**

**Ka       =          (0.005754 )2    =          3.5  x  10-4**

**0.094245**

4.         Calculate the pH in 100.0 mL M H3BO3.

**H3B03                          D                    H+                    +          H2BO3-**

**I           0.400 M                                  0                                  0**

**C         x                                              x                                  x**

**E         0.400  -  x                                x                                  x**

            

**0       small Ka approximation**

**(x)2                  =                      7.3  x  10-10**

**0.400**

**x          =          1.709  x  10-5 M**

**pH       =          4.77**

5.         Calculate the pH of the solution formed by mixing 20.0 mL of 0.500 M HCl with 30.0 mL of 0.300 M NaOH.

**HCl                                         +                      NaOH                         →            NaCl               +                      H2O**

**0.0200 L  x  0.500 mole            =   0.01000 mole HCl          0.0300 L  x  0.500 mole            =   0.01000 mole NaOH**

**L                                                                                 L**

**I                                   0.00100   mole                                                0.000900 mole**

**C                                 0.000900  mole                                               0.000900 mole**

**E                                 0.00010    mole**



**Note the loss of significant figures!            Total new volume = 20.0 mL + 30.0 mL =  50.0 mL  =  0.0500 L**

**[H+]   =  0.00010 moles   =    0.0020 M**

**0.0500 L**

**pH  =  1.70 M**

6.         a)         Write the balanced equation representing the reaction of HF with H2O.

            **HF  +  H2O   D  H3O+  +  F-**

            b)         Identify the Bronsted-Lowry bases in the above equation.

                        **H2O    and      F-**

7.         Consider the following data:

            Barbituric acid                        HC4H3N2O3                 Ka  =  9.8  x  10-5

            Sodium propanoate     NaC3H5O2                    Kb  =  7.5  x  10-10

            Propanoic acid                        HC3H5O2                     Ka  =  ?

**Which is the stronger acid, propanoic acid or babituric acid? Explain using calculations.**

**Ka (HC4H3N2O3)  =                           Kw                              =          1.0  x  10-14     =            1.3  x  10-5**

**Kb(C3H5O2-)                          7.5  x  10-10**

**Barbituric acid is a stronger acid because it has a larger Ka.**

8.         A solution of 0.0100 M lactic acid, HC3H5O3, has a pH of 2.95. Calculate the Ka value.

**HC3H5O3                    D                    H+                    +                      C3H5O3-**

**I           0.0100 M                                            0                                              0**

**C         0.001122                                             0.001122                                 0.001122**

**E         0.008878                                             0.001122                                 0.001122**

**Ka       =          (0.001122)2     =          1.4  x  10-4**

**0.008878**

9.         a)         Write equations showing the amphiprotic nature of water as it reacts with HCO3-.

**HCO3-    +   H2O   D    H3O+  +  CO32-**

**HCO3-    +   H2O   D    H2CO3   +  OH-**

            b)         Calculate the Kb for HCO3-.

                        **Kb (HCO3-)  =                        Kw                              =          1.0  x  10-14         =          2.3  x  10-8**

**Ka(H2CO3)                             4.3  x  10-7**

10.       Calculate the [H3O+] in 0.550 M C6H5COOH.

            **C6H5COOH               D                    H+                    +              C6H5COO-**

**I           0.550 M                                              0                                  0**

**C         x                                                          x                                  x**

**E         0.550  -  x                                            x                                  x**



**0       small Ka approximation**

**(x)2                  =                      6.5  x  10-5**

**0.550**

**x          =          [H3O+]            =          6.0  x  10-3 M**