Science Department

Chemistry ATAR - Year 12

Acids & Bases Test

Name: _____

Instructions to Students:

1. 50 minutes permitted
2. Attempt all questions
3. Write in the spaces provided
4. Show all working when required
5. All answers to be in blue or black pen, diagrams in pencil.

Multiple Choice	Short Answer	TOTAL	Final Percentage
/10	/40	/50	

**Multiple Choice Section:**

1.   A Brönsted-Lowry acid is defined as a substance that

      a.   accepts a proton
      b.   accepts an electron
      c.   donates a proton
      d.   donates an electron

2.   Given the following equation: $HF + HCO_3^- \rightleftharpoons F^- + H_2CO_3$

      Identify the two bases in the reaction.

      a. F^- and H_2CO_3
      b.   HF and H_2CO_3
      c F^- and HCO_3^-
      d.   HF and F^-

3.   The value of K_w at 25°C is

      a. 1.0×10^{-14}
      b. 1.0×10^{-7}
      c.   7.00
      d.   14.00

4.   What volume of 0.1 mol.L^{-1} of hydrochloric acid is needed to react completely with 40.0 mL of 0.20 mol.L^{-1} barium hydroxide?

      a.   20 mL
      b.   40 mL
      c.   80 mL
      d.   160 mL

5.   A chemist added 20.0 mL of $0.0010 \text{ mol.L}^{-1}$ hydrochloric acid to 100.0 mL of 0.100 mol.L^{-1} potassium chloride solution. Which one of the following is the correct pH of the resulting solution?

      a.   2.6
      b.   3.0
      c.   3.8
      d.   5.2

6.   Which of the following is both a strong electrolyte and a weak acid?

   a. Na_2CO_3
   b. NH_4NO_3
   c. CH_3COOH
   d. HCl

7.   Which of the following could function as an amphiprotic species in water solution?

   a. HCl
   b. Al_2O_3
   c. HSO_4^-
   d. NH_4^+

8.   Which of the following pairs of compounds could be used to prepare a buffer solution?

   a. HCl and KCl
   b. NH_3 and NH_4Cl
   c. H_2S and Na_2SO_4
   d. Na_2CO_3 and $NaOH$

9.   When the pH of a 0.01 mol.L^{-1} solution of sulfuric acid is measured it is found to be significantly lower than the pH of a 0.01 mol.L^{-1} solution of phosphoric acid. What is the reason for this?

   a.   Phosphoric acid is a triprotic acid, while sulfuric acid is only diprotic, therefore the concentration of hydrogen ions is higher in the phosphoric acid solution than in the sulfuric acid solution.

   b.   Phosphoric acid is a stronger acid than sulfuric acid, so the phosphoric acid is more likely to produce hydrogen ions in solution than the sulfuric acid.

   c.   Sulfuric acid is a stronger acid than phosphoric acid, so there are more hydrogen ions in the sulfuric acid solution than the phosphoric acid solution.

   d.   The sulfuric acid solution is more concentrated than the phosphoric acid solution, therefore there will be more hydrogen ions in the sulfuric acid solution than the phosphoric acid solution.

10.   Each of the following salts is dissolved in water. Which answer correctly classifies the salts as acidic, basic or neutral?

|	$Na_2CO_{3(aq)}$	$NH_4Cl_{(aq)}$	$K_3PO_{4(aq)}$
a.	neutral	acidic	basic
b.	acidic	basic	neutral
c.	basic	acidic	basic
d.	basic	basic	acidic

End of Multiple Choice Section

Short Answer Questions

1. Rewrite the following equations and show how each of the species are acting either as a Lowry-Bronsted acid or base. State the conjugate acid/base and base/acid pairs for each reaction.
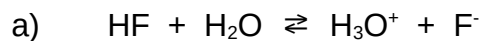
    a) $HF + H_2O \rightleftharpoons H_3O^+ + F^-$

    Conjugate acid/base pair: _____
    Conjugate base/acid pair: _____

    b) $H_3O^+ + SO_4^{2-} \rightleftharpoons HSO_4^- + H_2O$
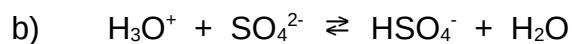
    Conjugate acid/base pair: _____
    Conjugate base/acid pair: _____

                                                                    [4 marks]

2. Write equations to show that in aqueous solution:

    a) CH_3COOH is an **acid**.

    b) Na_2S is **basic**.

    c)   Carbonate ions are **basic**.

                                                                    [3 marks]

3.   a)   Write two equations to show how bicarbonate ions and acetate ions could be considered basic in aqueous solution.

        i.   _____

        ii.   _____

                                                    [2 marks]

    b)   Write the K_b expression for these two ions.

        i.   _____

        ii.   _____

                                                    [2 marks]

    c)   The K values for these two equations are given in the table below:

Base	K_b @ 25˚C
HCO_3^{-1}	4.2×10^{-7}
CH_3COO^{-1}	5.6×10^{-10}

        For the two solutions 0.01 mol.L^{-1} sodium bicarbonate and 0.01 mol.L^{-1} sodium acetate solution, which will have the highest pH (closest to 14)? Justify your answer.

                                                    [2 marks]

_____

_____

_____

_____

_____

_____

4. Write ionic equations (with phases) to show the reaction between:

a) Magnesium and hydrochloric acid.

b) Sodium sulfite solid and hydrochloric acid.

c) Ammonium Chloride solution and potassium hydroxide solution.

d) Calcium bicarbonate solution and nitric acid.

e) Ammonia solution and hydrochloric acid.

[5 marks]

5. Calculate the pH of:

    a) A solution of 1.575×10^{-2} g of HNO_3 in 250 mL of water.

    b) A solution of 0.2 g of NaOH in 500 mL of water.

    NB: You must show all working in this question.

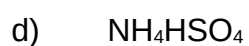   [4 marks]

6. Gastric juice is approximately 0.15 mol.L^{-1} HCl. Calculate the volume of gastric juice that would be neutralised by an antacid tablet containing 750mg of CaCO$_3$.

[3 marks]

7. State whether the following solutions of salts will be acid, basic or neutral. In each case that a solution is not neutral give a one line **hydrolysis** equation to justify its acid or base nature.

a)   Mg(NO$_3$)$_2$

c)   LiCl

c)   KHSO$_3$

d)   NH$_4$HSO$_4$

[4 marks]

8. Give an example of any

   a) Acidic oxide _____

   b) Basic hydroxide _____

   c) Amphiprotic substance (Something that can act as an acid or as a base)

   _____

   [3 marks]

10. Explain in a paragraph what happens to the pH of water when there is an increase in temperature beyond 25°C. Be sure to state the effect of the increase in temperature, and the reason for the change.

   _____

   _____

   _____

   _____

   _____

   _____

   [3 marks]

11. a) Explain in a few sentences why a mixture of Ethanoic Acid and Sodium Ethanoate can act as a buffer, but a mixture of hydrochloric acid and sodium chloride solution cannot.

   _____

   _____

   _____

   _____

   _____

   _____

   b) Write equations to show what happens to a buffer solution containing equimolar amounts of HCO_3^{-1} and CO_3^{-2} when we add small amounts of:

   i) $OH^{-1}_{(aq)}$
   ii) $H_3O^+_{(aq)}$

   [5 marks]