Test: Acid – Base

SCH3U_ 2010-2011

Name: _____
(Test Score: / 40)

Multiple Choice (6)

1. A Brønsted-Lowry base is defined as a substance which:

A. accepts H^{+1} ions. B. produces OH^{-1} ions.
C. conducts electricity. D. donates protons.

2. The pH value of a 1.00×10^{-3} mol dm^{-3} solution of sodium hydroxide is:

A. 3. B. 8. C. 11. D. 14.

3. How does the $[H^{+1}]$ in an aqueous solution with pH = 4 compare with the in $[H^{+1}]$ in a solution with pH = 2? The is $[H^{+1}]$ is:

A. twice as great. B. half as much. C. 1/10 of the value D. 1/100of the value

4. Which will be the same for separate 1 mol dm^{-3} solutions of a strong acid and a weak acid?

I. Electrical conductivity
II. Concentration of H^{+1} ions

A. I only B. II only C. Both I and II D. Neither I nor II

5. Which statement best describes the difference between solutions of strong and weak acids of equal concentration?

A. Weak acid solutions have lower pH values than strong acids.
B. Weak acid solutions react more slowly with sodium carbonate than strong acids.
C. Weak acid solutions require fewer moles of base for neutralisation than strong acids.
D. Weak acid solutions do not react with magnesium while strong acids do.

6. What is the pH of a solution in which the hydroxide ion, OH^{-1}, concentration is 10^{-10} mol L^{-1} ?

A. 4 B. 7 C. 10 D. 14

Multiple Choice Answers

1	2	3	4	5	6

Problems (34)

1. A lake in England known as Loch Ness, where the friendly monster commonly known as "Nessie", resides has a pH of 4.25.

a. State the relationship between pH and the hydrogen ion concentration. 1

b. State the relationship between pH and pOH. 1

c. Calculate:

i. the hydrogen ion concentration, $[H^{+1}]$ of Loch Ness 1

ii. the hydroxide ion concentration, $[OH^{-1}]$ of Loch Ness 1

iii. the pOH of Loch Ness 1

2. The concentration of hydrochloric acid in the human stomach is approximately 0.10 mol L^{-1}. Excess of this acid causes discomfort referred to as 'heartburn' or 'acid indigestion'. Remedies designed to neutralize some of this excess acid often contain compounds such as magnesium hydroxide, $Mg(OH)_2$, and sodium hydrogencarbonate, $NaHCO_3$.

a. The hydrogen carbonate ion is capable of behaving as either an acid or a base.

i. Define a Brønsted-Lowry acid and a base. 2

Brønsted-Lowry acid:

Brønsted-Lowry base:

ii. What name is given to a species that is capable of behaving either as an acid or a base. 1

b. Label the following reaction in terms of Brønsted-Lowry acid – base concept: 2

$$HCO_3^{-1}{}_{(aq)} + H_2O_{(l)} \rightleftharpoons H_2CO_{3\,(aq)} + OH^{-1}{}_{(aq)}$$

c.(i) Write a balanced chemical equation for the reaction of solid $Mg(OH)_2$ with hydrochloric acid, including the states. 2

(ii) Calculate the number of moles in 1.00 g of magnesium hydroxide. 1

(iii) Calculate the number of moles of hydrochloric acid which can be neutralized by 1.00 g of magnesium hydroxide. 1

(iv) Calculate the volume of 0.100 mol L^{-1} HCl which can be neutralized by 1.00 g of magnesium hydroxide, giving your answer to 3 significant figures. 1

e. What is the resulting pH of the solution after neutralization? Explain. 1

3. Ellen and Filip, students at CB wished to determine the concentration of sodium hydroxide, $NaOH_{(aq)}$. Filip dissolved 1.23 g of the acidic primary standard, potassium hydrogen phthalate, $KHC_8H_4O_4$, (KHP), in 40.0 mL of water, they then proceeded to titrate this solution, to their dismay they concluded that they required 21.50 mL of sodium hydroxide, $NaOH_{(aq)}$ in order to reach the neutralization point.

a. Write a balanced equation for the reaction of $KHC_8H_4O_4$, (you may use the abbreviated form: KHP) with $NaOH_{(aq)}$. 1

b. Calculate the number of moles in 1.23 g of $KHC_8H_4O_4$, (KHP), (molar mass of KHP = 204.23 g mol^{-1}) used by the students. 1

c. Determine the number of moles of the sodium hydroxide used. 1

d. Determine the concentration of the sodium hydroxide used by Ellen and Filip. 1

e. What is the colour of phenolphthalein in a basic medium? 1

f. Explain the effect on the concentration of the sodium hydroxide if some of the KHP did not dissolve in the water? (you may use calculations to explain) 1 ½

g. Explain the effect on the concentration of the sodium hydroxide if the solution at the end point is overshot, i.e. the colour is too deep. (you may use calculations to explain) 1 ½

4. Aluminium metal reacts with hydrochloric acid according to the following equation.

$$Al_{(s)} + HCl_{(aq)} \longrightarrow AlCl_{3\,(aq)} + H_{2\,(g)}$$

a. **Balance** the above equation and **re-write** it. 1

b. Write a total dissociated equation and a net ionic equation for the above reaction.

Total dissociated equation: 1

Net ionic equation: 1

c. If acetic acid, $CH_3COOH_{(aq)}$, was used instead of hydrochloric acid in this reaction, explain the effect of this change on the rate of this reaction. 2

d. 75.0 mL of 1.50 M $HCl_{(aq)}$ is reacted with 5.40 g of aluminium metal.

i. Determine the **limiting reactant**. **(Show all your work)** 3

ii. Calculate the mass of hydrogen gas that can be produced in this reaction. 2

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