**WASHINGTON LATIN PUBLIC CHARTER SCHOOL**
**CHEMISTRY 2019-20**

**UNIT 5A PRACTICE TEST – CHEMICAL REACTIONS I: ACIDS AND BASES**

Answer all questions
Recommended time = 50 minutes
BAHATI NJEMA!

## SECTION A – OPEN RESPONSE

| | | | | |
|---|---|---|---|---|
| **1.** | Neutralization reactions are reactions between acids and bases to produce salts. They have a variety of uses, including making different salts. | | | |
| | (a) | Write balanced symbol equations for the following neutralization reactions and name the salt produced: | | |
| | | (i) | Reactants: | magnesium hydroxide and hydrochloric acid |
| | | | Symbol equation: | $Mg(OH)_2 + 2HCl \rightarrow MgCl_2 + 2H_2O$ |
| | | | Name of salt: | magnesium chloride |
| | | (ii) | Reactants: | iron (II) carbonate and sulfuric acid |
| | | | Symbol equation: | $FeCO_3 + H_2SO_4 \rightarrow FeSO_4 + CO_2 + H_2O$ |
| | | | Name of salt: | iron (II) sulfate |
| | | | | 6 |
| | (b) | State a useful application of reaction (a) (i) | | |
| | | $Mg(OH)_2$ can be consumed to neutralize excess stomach acid (HCl) | | 1 |
| | (c) | The salt produced in reaction (a) (ii) is very useful in the treatment of anaemia. Give brief practical details of how you would use reaction (a) (ii) to obtain a pure solid sample of the salt. | | |
| | | Mix the reactants together using excess base<br>Filter off the excess base<br>Heat the solution remaining to evaporate off the water | | 3 |
| | | | TOTAL | 10 |

**2.** The acidity or alkalinity of a solution can be captured in a single number, by using a logarithmic scale called the pH scale.
The acidity of alkalinity of a solution can also be determined by using acid-base indicators. Two common indicators are methyl orange and phenolphthalein. The colors and end-point pH ranges of these indicators is shown in the table below:

| Indicator | Color 1 | End-point pH range | Color 2 |
|---|---|---|---|
| methyl orange | pink | 2.9 – 4.6 | yellow |
| phenolphthalein | colorless | 8.3 – 10.0 | purple |

A sample of rainwater was analysed and found to have a pH of 5.

(a) Calculate the concentration of $H^+$ ions and the concentration of $OH^-$ ions in the sample of rainwater. Show your working.

| | | |
|---|---|---|
| | $[H^+]$ (in mol/L) | $1 \times 10^{-5}$ mol/L |
| | [OH-] (in mol/L) | $1 \times 10^{-14} / (1 \times 10^{-5}) = 1 \times 10^{-9}$ mol/L |

3

(b) A few drops of methyl orange and phenolphthalein were added separately to two samples of the rainwater. State the color shown by:

| | |
|---|---|
| methyl orange | yellow |
| phenolphthalein | colorless |

2

TOTAL 5

| | | | | |
|---|---|---|---|---|
| **3.** | Nitric acid, $HNO_3$, is a strong acid. Nitrous acid, $HNO_2$, is a weak acid.<br>Both acids are neutralized by calcium oxide according to the following equations:<br>Nitric acid: $2HNO_3 + CaO \rightarrow Ca(NO_3)_2 + H_2O$<br>Nitrous acid: $2HNO_2 + CaO \rightarrow Ca(NO_2)_2 + H_2O$ | | | |
| | (a) | Explain the difference between a strong acid and a weak acid. | | |
| | | Strong acid fully dissociates in water to give $H^+$ ions<br>Weak acid slightly dissociates in water to give $H^+$ ions | | 2 |
| | (b) | Write ionic equations to show what happens to nitric acid and nitrous acid in water: | | |
| | | nitric acid | $HNO_3 \rightarrow H^+ + NO_3^-$ | |
| | | nitrous acid | $HNO_2 \rightleftarrows H^+ + NO_2^-$ | 3 |
| | (c) | Rubi poured 50 mL of 1 mol/L nitric acid into a boiling tube.<br>She then added CaO powder gradually to the boiling tube until the acid had been completely neutralized.<br>She then repeated the experiment with 50 mL of 1 mol/L nitrous acid. | | |
| | | (i) | Calculate the maximum mass of CaO which would dissolve in the nitric acid solution. | |
| | | | moles of $HNO_3$ = 50/1000 x 1 = 0.05<br>moles of CaO = 0.05/2 = 0.025<br>mass of CaO = 0.025 x 56.1 = 1.4 g | |
| | | (ii) | State one similarity Rubi would observe when repeating the experiment using the nitrous acid solution. | |
| | | | Both acids would dissolve the same amount of CaO | |
| | | (iii) | State one difference Rubi would observe when repeating the experiment using the nitrous acid solution. | 5 |
| | | | The strong acid ($HNO_3$) would dissolve the CaO much faster | |
| | | | TOTAL | 10 |

## SECTION B – MULTIPLE CHOICE

**Do not answer these questions on this document. Click on the answer sheet provided at the end of the questions.**

| **4.** | When aluminium carbonate reacts with hydrochloric acid, the formula of the salt produced is | |
|---|---|---|
| | A | $H_2CO_3$ |
| | B | $Cl_2CO_3$ |
| | C | $Al_3Cl$ |
| | D | $AlCl_3$ |
| | E | $AlH_3$ |
| | | 1 |

| **5.** | Ammonium nitrate is a dangerous explosive and an important fertilizer.<br>It can be easily prepared in a neutralization reaction by mixing | |
|---|---|---|
| | A | $NH_3$ and $HNO_3$ |
| | B | HCl and CuO |
| | C | $HNO_3$ and $Ca(NO_3)_2$ |
| | D | $NH_3$ and NaOH |
| | E | $H_2SO_4$ and $HNO_3$ |
| | | 1 |

| **6.** | Ammonia is a weak base. In an aqueous solution of ammonia, approximately 1% of ammonia molecules react with water to form $OH^-$ ions.<br>The pH of 0.1 mol/L ammonia solution is approximately | |
|---|---|---|
| | A | 2 |
| | B | 3 |
| | C | 11 |
| | D | 12 |
| | E | 13 |
| | | 2 |

| **7.** | Which of the following solutions has the lowest pH? | |
|---|---|---|
| | A | 0.001 mol/L HCl |
| | B | 0.001 mol/L NaOH |
| | C | pure water |
| | D | a solution containing $1 \times 10^{-12}$ mol/L $H^+$ ions |
| | E | a solution containing $1 \times 10^{-12}$ mol/L $OH^-$ ions |
| | | 2 |

**Questions 8 – 10**

25 mL of standard solution of sodium carbonate (0.5 mol/L) was placed in a conical flask. Two drops of methyl orange indicator were added and a solution of sulfuric acid (of unknown concentration) was gradually added from a burette. When 18.3 mL of the sulfuric acid had been added, the indicator changed color.

| **8.** | The formula of the salt produced in this reaction is: | |
|---|---|---|
| | A | $NaSO_4$ |
| | B | $Na_2SO_4$ |
| | C | $H_2SO_4$ |
| | D | $Na_2CO_3$ |
| | E | $K_2SO_4$ |
| | | 1 |

| **9.** | At the equivalence point of this titration, the indicator will change from | |
|---|---|---|
| | A | orange to yellow |
| | B | pink to yellow |
| | C | yellow to orange |
| | D | yellow to pink |
| | E | orange to pink |
| | | 1 |

| **10.** | The molarity of the sulfuric acid used in this titration is | |
|---|---|---|
| | A | 0.34 mol/L |
| | B | 0.68 mol/L |
| | C | 1.37 mol/L |
| | D | 3.4 mol/L |
| | E | 6.83 mol/L |
| | | 2 |