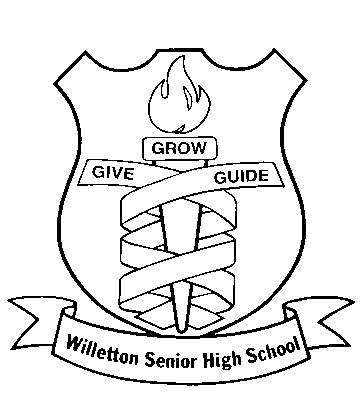
**YEAR 12 CHEMISTRY – ATCHE**

**TEST 2 2021**

**Acids & Bases**

**Recommended time: 55 Minutes**

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Teacher: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

This test is in two parts.

**/ 55**

**Part 1:** Multiple choice style consisting of (15) questions.

Each question is worth 1 mark.

**Part 2:** Short and/or Extended Answer questions worth 40 marks.

Write all answers in the spaces provided.

The marks allocated to each question are shown next to each question.

**Part 1: Multiple Choice Section. 15 MARKS**

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| For each question shade the box to indicate your answer.  Use **only** a blue or black **pen** to shade the boxes.  For example, if b is your answer: a □ b ■ c □ d □  If you make a mistake, place a cross through that square and shade your new answer. **Do not** erase or use correction fluid/tape.  For example, if b is a mistake and d is your answer: a □ b ■ c □ d ■  If you then want to use your first answer b, cross out d and then circle b.  a □ b ■ c □ d ■  Marks will **not** be deducted for incorrect answers.  **No marks** will be given if more than one answer is completed for any question. |

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| 1 | a □ b □ c □ d □ |  | 6 | a □ b □ c □ d □ |  | 11 | a □ b □ c □ d □ |
| 2 | a □ b □ c □ d □ |  | 7 | a □ b □ c □ d □ |  | 12 | a □ b □ c □ d □ |
| 3 | a □ b □ c □ d □ |  | 8 | a □ b □ c □ d □ |  | 13 | a □ b □ c □ d □ |
| 4 | a □ b □ c □ d □ |  | 9 | a □ b □ c □ d □ |  | 14 | a □ b □ c □ d □ |
| 5 | a □ b □ c □ d □ |  | 10 | a □ b □ c □ d □ |  | 15 | a □ b □ c □ d □ |

**Part 2: Short Answer and Calculation Section.**

**40 MARKS**

**Question 16**  **(8 marks)**

Malic acid (H2C4H4O5) is a weak diprotic acid with the structural formula HOOCCH2CH(OH)COOH.

Being diprotic it dissociates in two stages. The equation for the first stage dissociation of malic acid is shown below.

HOOCCH2CH(OH)COOH(aq) + H2O(ℓ) ⇌ HOOCCH2CH(OH)COO–(aq) + H3O+(aq)

1. Write the equation for the second stage ionisation of malic acid. (2 marks)

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1. Malic acid (H2C4H4O5) can react with a solution of potassium hydroxide to form a salt. Will the salt formed be acidic, neutral or basic? Justify your answer using chemical equations.

(4 marks)

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1. Calculate the pH of the potassium hydroxide solution used in part (c) given that 25.0 mL of the KOH solution has a concentration of 0.0755 mol L–1. (Assume temperature of 25 oC)

(2 marks)

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**Question 17 (5 marks)**

The solubility of strontium hydroxide, Sr(OH)2, is 1.77 g in 100 mL water at 40°C.

1. Calculate the hydroxide ion concentration in the solution. (3 marks)

(b) Given that the Kw of water at this temperature is 2.916x10-14, calculate the pH of the solution. (2 marks)

**Question 18 (3 marks)**

Calculate the amount of water that would need to be added to 50 mL of a 0.100 mol L-1 solution of nitric acid to raise its pH to 1.62.

**Question 19 (10 marks)**

Acids and bases exist as conjugate acid–base pairs. The term *conjugate* comes from the Latin stems meaning "joined together" and refers to things that are joined, particularly in pairs, such as Bronsted–Lowry acids and bases.

Below is a table showing the Ka value for a number of acids and the Kb for the corresponding conjugate bases.

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| **Some Conjugate Acid–Base Pairs at 25 °C** | | | |
| **Acid** | **Ka** | **Base** | **Kb** |
| HNO3 | (Strong acid) | NO3– | (Negligible basicity) |
| HF | 6.8 x 10–4 | F– | 1.5 x 10–11 |
| CH3COOH | 1.8 x 10–5 | CH3COO– | 5.6 x 10–10 |
| H2CO3 | 4.3 x 10–7 | HCO3– | 2.3 x 10–8 |
| NH4+ | 5.6 x 10–10 | NH3 | 1.8 x 10–5 |
| HCO3– | 5.6 x 10–11 | CO32– | 1.8 x 10–4 |
| OH– | (Negligible acidity) | O2– | (Strong base) |

1. ‘The stronger the acid the stronger the conjugate base.’ Is this statement true or false? Explain how you came to your conclusion. (2 marks)

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An acidic buffer solution consists of a weak acid and one of its salts. The buffer can be prepared by reacting 40.0 mL of 1.00 mol L–1ethanoic acid with 20.0 mL of 1.00 mol L–1potassium hydroxide solution.

1. Calculate the concentration of potassium ions in this resulting buffer solution. (2 marks)
2. Explain why the two quantities (specifically 40.0 mL of 1.00 mol L–1ethanoic acid and

20.0 mL of 1.00 mol L–1potassium hydroxide solution) were used to make this buffer.

(3 marks)

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1. Using the chemical equation below and the collision theory to explain how this buffer solution resists a change pH when a few drops of concentrated sodium hydroxide solution are added to it. (3 marks)

CH3COOH(aq) + H2O(ℓ) ⇌ H3O+(aq) + CH3COO–(aq)

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**Question 20 (14 marks)**

Oxalic acid crystals (H2C2O4.2H2O) are commonly used as a primary standard in acid-base volumetric analysis.

(a) List **three** characteristics you expect oxalic acid crystals to have to justify this classification as a suitable primary standard. (3 marks)

One:

Two:

Three:

A number of 2.50 g samples of oxalic acid crystals had been carefully weighed, sealed and labelled H2C2O4.nH2O.

**Step 1:** One 2.50 g sample was very carefully dissolved in an empty beaker using distilled water. The resulting solution (H2C2O4 (aq)) was then transferred into a 250.00 mL volumetric flask and then made up to 250.00 mL.

**Step 2:** A burette was filled with this solution and was used to titrate a 25.00 mL sample of 0.100 mol L-1 NaOH using a suitable indicator.

1. (i) Name the substance used to rinse the burette immediately prior to its use. (1 mark)

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(ii) Explain the reason for your answer to (d) (i). (1 mark)

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**Step 3:** Titrations were repeated until a consistent end point was obtained.

The student’s results were as follows:

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| **Final reading (mL)** | 20.65 | 19.60 | 20.75 | 21.85 |
| **Initial reading (mL)** | 4.45 | 3.90 | 4.95 | 5.95 |
| **Titration volume (mL)** |  |  |  |  |

1. Complete the table and determine the average titre value for the oxalic acid solution.

Average Titre: **\_\_\_\_\_\_\_\_\_** (1 mark)

1. Calculate the moles of oxalic acid which reacted with the NaOH. Note oxalic acid is a diprotic acid. (1 mark)
2. Calculate the mass of oxalic acid in the 2.50g sample. (3 marks)
3. Use your result to show that n = 2 in H2C2O4.**n**H2O. (3 marks)

**END OF TEST**