Module 8 Summative Assessment

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| ***Marks*** | | |
| ***Maximum Possible*** | ***Earned*** | ***%*** |
| ***102*** |  |  |

**Lesson 1**

1. Calculate the pOH of a solution that has a pH of 12.25. Identify this solution as acidic, basic or neutral.

**Answer (2 marks)**

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1. Calculate the pH of a solution that has a [OH-(aq)] of 3.2 x 10-2 mol/L. Identify this solution as acidic, basic or neutral.

**Answer (3 marks)**

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1. Explain the expected relative conductivity of 0.10 mol/L samples of hydrobromic acid, benzoic acid, and hydrocyanic acid.

**Answer (3 marks)**

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**Lesson 2**

1. Using the five-step method, predict the predominant Bronsted-Lowry acid base reaction when solutions of ammonium chloride and sodium hydrogen carbonate are combined.

**Answer (2 marks)**

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1. Identify one conjugate acid-base pair from the reaction equation.

**Answer (1 mark)**

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1. Predict whether the equilibrium will favour the formation of the reactants or products. Support and explain your answer.

**Answer (2 marks)**

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1. Using the five-step method, predict the predominant Bronsted-Lowry acid base reaction when solutions of perchloric acid and lithium hypochlorite are combined.

**Answer (2 marks)**

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1. Write two Bronsted-Lowry reaction equations illustrating the fact that the dihydrogen phosphate ion (H2PO4-(aq)) is amphiprotic. In both equations, products should be favoured.

**Answer (2 marks)**

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**Lesson 3**

1. A 1.0 mol/L solution of ethanoic acid has a pH of 2.37, while a 1.0 mol/L solution of methanoic acid has a pH of 1.87. Explain why there is a difference in the pH values of these two solutions.

**Answer (2 marks)**

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1. Calculate the pH of a 0.35 mol/L solution of nitric acid.

**Answer (2 marks)**

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1. Calculate the pH of a 0.35 mol/L solution of butanoic acid.

**Answer (4 marks)**

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1. As shown on the acid-base table, the conjugate acid of the benzoate ion is benzoic acid. The Ka of benzoic acid is 6.3 x 10-5 . Find Kb for the benzoate ion.   
     
   **Answer (2 marks)**

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1. A 100 mL sample of hydrazoic acid, HN3(aq) with a concentration 0.25 mol/L has a pH of 2.78. Calculate the Ka for hydrazoic acid. Remember, when calculating the Ka, do not round off any of the numbers until the very end of the calculation!

**Answer (5 marks)**

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1. Calculate the pH of a 0.025 mol/L solution of magnesium hydroxide.

**Answer (4 marks)**

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1. Calculate the pH of a 0.025 mol/L solution of sodium nitrite.

**Answer (6 marks)**

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1. Hydrazine, N2H4(aq), is used in the preparation of polymers, pharmaceuticals and rocket fuel. Hydrazine has alkaline properties similar to ammonia and will act as a weak base. Given that a 100 mL sample of 0.10 mol/L hydrazine solution has a pH of 10.55 at 25.0 oC, write the formula for the conjugate acid and calculate the Ka of the conjugate acid.

**Answer (8 marks)**

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**Lesson 4**

*Use the following information to answer the next 3 questions.*

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| A student performed two titrations.  Titration A: A strong monoprotic base is titrated with a strong monoprotic acid.  Titration B: A weak monoprotic base is titrated with a strong monoprotic acid. |

15. Compare the expected approximate pH at the equivalence point of Titration A with the expected approximate pH at the equivalence point of Titration B.

**Answer (2 marks)**

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1. Provide an explanation for the predicted pHs in Question 15.

**Answer (2 marks)**

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1. Sketch a titration curve for Titration B. On the titration curve, label any buffer regions and identify the equivalence point.

**Answer (3 marks)**

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| Perform the Virtual Investigation “Titration 2, Exercise 1, Procedure 2” and “Titration 2, Exercise 3, Procedure 1” (See Module 8 Lesson 4.3). Use the results to answer Questions 18-23. |

1. Perform the steps outlined in Titration 2, Exercise 1, Procedure 2. Record your dispensed volumes and measured pH values in the data table shown.

**Answer (4 marks)**

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| **Dispensed Volume (mL)** | **pH** |
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1. Draw a titration curve from the data collected from the hydrochloric acid and sodium hydroxide titration. Graph the pH versus NaOH added.

**Answer (4 marks)**

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1. Perform the steps outlined in Titration 2, Exercise 3, Procedure 1. Record your dispensed volumes and measured pH values.

**Answer (4 marks)**

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| **Dispensed volume (mL)** | **pH** |
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1. Draw a titration curve from the data collected from the acetic (ethanoic) acid and sodium hydroxide titration. Graph the pH versus NaOH added. Identify any buffer regions on your titration curve.

**Answer (4 marks)**

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1. Describe the role of a buffer. Write the net ionic equation for the buffer reaction that occurs in the buffer region shown in Question 21.

**Answer (2 marks)**

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1. Identify two differences between the two titration curves drawn for this investigation. Explain those differences.

**Answer (4 marks)**

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1. Sketch a titration curve for the titration of oxalic acid with sodium hydroxide to the second endpoint. Identify any buffer regions on your titration curve.

**Answer (2 marks)**

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1. Write the net Bronsted-Lowry reaction for the second equivalence point.

**Answer (1 mark)**

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1. Outline a procedure to prepare an ammonia/ammonium buffer solution.

**Answer (2 marks)**

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1. Use the five step method to predict the quantitative reaction of an ammonia/ammonium ion buffer solution when a small quantity of HCl is added. Show your work.

Will the added acid cause a change in pH?

**Answer (3 marks)**

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1. Chlorophenol red is an acid-base indicator. The conjugate acid form of the indicator is yellow and the conjugate base form is red.

**Predict which form of the indicator will be favoured when:**

1. a small quantity of HCl(aq) is added
2. a small quantity NaOH(aq) is added

**Answer (4 marks)**

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| Perform the Virtual Investigation “Investigating a Buffer System” in Lesson 4.4 and use the data collected to answer Questions 27- 30. |

1. Record the pH changes for Experiment 1 in the following table.

**Answer (4 Marks)**

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| **Test tube** | **Initial pH** | **pH after addition of HCl** | | **pH after addition of NaOH** | |
|  |  | 1st drop | 2nd drop | 1st drop | 2nd drop |
| 1 - (water) |  |  |  |  |  |
| 2 - (NaH2PO4) |  |  |  |  |  |
| 3 - (Na2HPO4) |  |  |  |  |  |
| 4 – buffer mixture |  |  |  |  |  |

1. Explain, in terms of equilibrium shifts, how this buffer mixture resists changes in pH when small quantities of both a strong acid and a strong base are added.

**Answer (4 Marks)**

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1. Record the pH changes for Experiment 2 in the following tables

**Answer (2 Marks) – add rows as needed**

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| --- | --- | --- | --- | --- |
| Drops of HCl added | pH |  | Drops of NaOH added | pH |
| 0 |  |  | 0 |  |
| 1 |  |  | 1 |  |
| 2 |  |  | 2 |  |
| 3 |  |  | 3 |  |
| 4 |  |  | 4 |  |
| 5 |  |  | 5 |  |
| 6 |  |  | 6 |  |
| 7 |  |  | 7 |  |
| 8 |  |  | 8 |  |
| 9 |  |  | 9 |  |
| 10 |  |  | 10 |  |
| 11 |  |  | 11 |  |
| 12 |  |  | 12 |  |
| 13 |  |  | 13 |  |
| 14 |  |  | 14 |  |
| 15 |  |  | 15 |  |

1. On the basis of the data collected in experiment 2, what is the buffering capacity of the phosphate buffer in terms of drops of strong acid or drops of strong base?

**Answer (1 mark)**

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