Module 8 Summative Assessment

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)

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

Answer (3 marks)

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

Answer (3 marks)

Lesson 2

4.

a. 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)

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

Answer (1 mark)

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

Answer (2 marks)

5. 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)

6. Write two Bronsted-Lowry reaction equations illustrating the fact that the dihydrogen phosphate ion ($H_2PO_4^-(aq)$) is amphiprotic. In both equations, products should be favoured.

Answer (2 marks)

Lesson 3

7. 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)

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

Answer (2 marks)

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

Answer (4 marks)

10. As shown on the acid-base table, the conjugate acid of the benzoate ion is benzoic acid. The Ka of benzoic acid is 6.3×10^{-5}. Find K_b for the benzoate ion.

Answer (2 marks)

11. A 100 mL sample of hydrazoic acid, $HN_3(aq)$ with a concentration 0.25 mol/L has a pH of 2.78. Calculate the K_a 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)

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

Answer (4 marks)

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

Answer (6 marks)

14. Hydrazine, $N_2H_4(aq)$, 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)

Lesson 4

Use the following information to answer the next 3 questions.

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)

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

Answer (2 marks)

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

Answer (3 marks)

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.

18. 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)

Dispensed Volume (mL)	pH

19. 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)

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

Answer (4 marks)

Dispensed volume (mL)	pH

21. 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)

22. 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)

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

Answer (4 marks)

24.

a) 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)

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

Answer (1 mark)

25.

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

Answer (2 marks)

b) 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)

26. 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:

a) a small quantity of HCl(aq) is added
b) a small quantity NaOH(aq) is added

Answer (4 marks)

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

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

Answer (4 Marks)

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 - (NaH_2PO_4)					
3 - (Na_2HPO_4)					
4 – buffer mixture					

28. 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)

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

Answer (2 Marks) – add rows as needed

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	

30. 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)