

Test 4: The Acidic Environment II

Total 25 marks (Suggested time 45 minutes)

Directions to students

- Answer the following questions on your own paper.
- Part A contains 5 multiple-choice questions, each worth 1 mark. Select the alternative A, B, C or D that best answers the question.
- Part B contains 6 short answer and longer response questions.
- You may use the standard formula sheet supplied.

PART A

1. The table below shows the pH range in which colour change occurs for various indicators:

<i>Indicator</i>	<i>pH range for colour change</i>
thymol blue	1.2–2.8
bromocresol green	3.8–5.4
bromothymol blue	6.0–7.6
cresol red	7.2–8.8

Water in tropical fish tanks needs to be maintained at approximately a neutral pH to help keep the fish healthy. An appropriate indicator that could be used to check the pH of the water would be

- (A) thymol blue.
 - (B) bromocresol green.
 - (C) bromothymol blue.
 - (D) cresol red.
2. The pH of a 1 mol L⁻¹ hydrochloric acid solution is
- (A) ten times the pH of 0.1 mol L⁻¹ hydrochloric acid.
 - (B) greater than the pH of 0.1 mol L⁻¹ hydrochloric acid.
 - (C) stronger than the pH of 0.1 mol L⁻¹ hydrochloric acid.
 - (D) less than the pH of 0.1 mol L⁻¹ hydrochloric acid.

3. Which of the following is not a naturally occurring acid solution?

- (A) hydrochloric acid
- (B) hydrobromic acid
- (C) ethanoic acid
- (D) citric acid

4. Carbon dioxide is soluble in water as shown by the following equation:



Carbon dioxide is the gas used to add the fizz to soft drinks. If a warm bottle of soft drink is opened for the first time then the soft drink fizzes

- (A) more than it would have if the drink was cold.
- (B) less than it would have if the drink was cold.
- (C) just as much as if the drink was cold.
- (D) little because the carbon dioxide starts to dissolve.

5. From the following list, the species which cannot be amphiprotic is

- (A) HSO_4^- .
- (B) H_2O .
- (C) H_2PO_4^- .
- (D) HF .

PART B

Marks

Question 6 (2 marks)

Both ethanol and ethanoic acid are liquids at room temperature and pressure.

- (a) Draw the expanded structural formula for both of these compounds. 1
- (b) Vinegar is a diluted mixture of ethanoic acid. Would you expect vinegar to have a relatively low or high pH compared to dilute hydrochloric acid? Explain your reasoning. 1

Question 7 (4 marks)

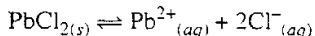
400 mL of a hydrochloric acid solution is fully reacted with pure calcium carbonate to form 7.34 L of gaseous product at room temperature and pressure.

- (a) Write a balanced equation for this reaction. 1
- (b) Determine the number of moles of gaseous product formed. 1
- (c) Calculate the concentration of the hydrochloric acid solution. 2

Question 8 (2 marks)

Marks

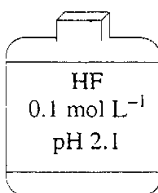
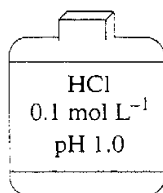
Silver chloride and lead(II) chloride are only slightly soluble in water. Lead chloride establishes an equilibrium as shown in the following equation:



Using Le Chatelier's principle, explain what will happen to the solubility of the lead(II) chloride if the following changes were made to the mixture:

- | | |
|---------------------------------------|---|
| (a) Hydrochloric acid is added. | 1 |
| (b) Silver nitrate solution is added. | 1 |

Question 9 (4 marks)



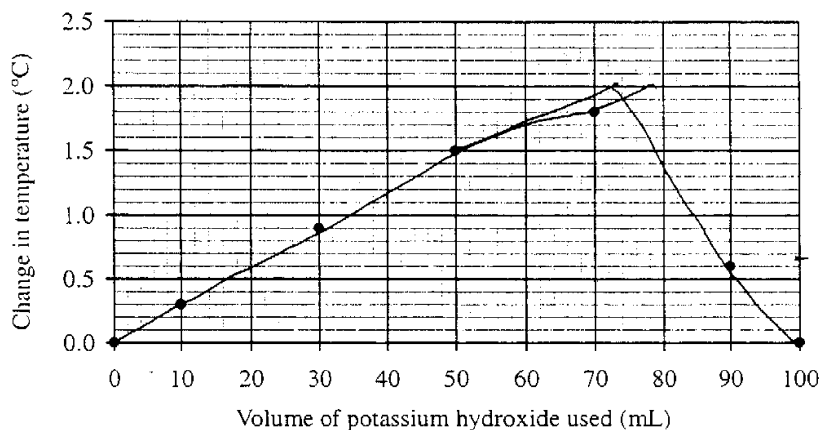
25 mL of each of the solutions of acids shown above in the reagent bottles were poured into their respective beakers.

- | | |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
| (a) Compare the results for the following tests performed on each solution under the same conditions of temperature and pressure. Explain the results. | |
| (i) Electrical conductivity. | 1 |
| (ii) Volume of gas produced at room temperature and pressure when 5 g pure magnesium is fully reacted. | 1 |
| (b) During the reaction of 5 g of pure magnesium, the rate of production of gas is observed to be faster in the HCl beaker than in the HF beaker. Explain this observation. | 2 |

Question 10 (5 marks)

Marks

A group of students performed an experiment in which they mixed 1.0 mol L^{-1} acid Z with 1.0 mol L^{-1} potassium hydroxide solution. The volumes of each solution were varied but the total of the mixture was always 100 mL. The maximum temperature change of the mixtures was recorded and the results were presented in the following graph.



- From the graph, predict the maximum temperature change that can be achieved by mixing the solutions used in this experiment. 1
- Based on the above graph, explain why it can be concluded that the acid Z does not react with potassium hydroxide in a 1:1 molar ratio. 2
- Calculate the heat of reaction per mole of potassium hydroxide used.^{*} 2
Note: The specific heat of water is $4.12 \text{ J K}^{-1} \text{ g}^{-1}$.

Question 11 (3 marks)

The esterification of 1-pentanol and methanoic acid is performed by refluxing.

- Draw a labelled diagram of this equipment. 1
- Name the ester formed. 1
- Name a naturally occurring substance which contains an ester. 1