Year 12 Chemistry **Topic Test #4 (Acids & Bases) - 2012**

Name: _____ Mark = _____ / 50

Part 1: Multiple Choice Section **10 marks**

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1. In which one of the following reactions is water behaving as an acid?

   A. $H_2O(g) + C(s) \rightarrow H_2(g) + CO(g)$

   B. $H_2O(l) + NH_3(g) \rightarrow NH_4^+(aq) + OH^-(aq)$

   C. $HCO_3^-(aq) + H_2O(l) \rightarrow CO_3^{2-}(aq) + H_3O^+(aq)$

   D. $NH_4^+(aq) + H_2O(l) \rightarrow H_3O^+(aq) + NH_3(aq)$

2. The conjugate acid for OH^- is:

   A. H^+

   B. H_2O

   C. H_3O^+

   D. O^{2-}

3. Adding a few drops of concentrated sodium hydroxide to a solution of ethanoic acid:

   A. increases $[CH_3COO^-]$

   B. increases $[H_3O^+]$

   C. increases $[CH_3COOH]$

   D. decreases the pH

4. What mass of NaOH is required to prepare 500 mL of a solution with a pH of 12 at 25°C?

   A. 2.00 g

   B. 0.200 g

   C. 0.0400 g

   D. 4.00 g

5. Which of the following statements is true about equal volumes of nitric acid and ethanoic acid of the same concentration?

A. Each contains the same number of H_3O^+ ions in solution.

B. Each has the same pH.

C. Each will require the same amount of sodium hydroxide in order to reach the equivalence point.

D. When each is titrated to equivalence with sodium hydroxide, the pH of the resulting solution is the same.

6. Which one of the following statements about the aqueous solutions described is *false*?

A. The pH of a 0.1 mol L^{-1} solution of $NaC\ell$ is equal to 7.

B. The pH of a 0.1 mol L^{-1} solution of $NaCH_3COO$ is greater than 7.

C. The pH of a 0.1 mol L^{-1} solution of Na_2CO_3 is less than 7.

D. The pH of a 0.1 mol L^{-1} solution of H_2SO_4 is less than the pH of a 0.1 mol L^{-1} solution of $HC\ell$.

7. Three of the following solutions have a pH of very close to 7. One has a pH of close to 4. Which is the pH 4 solution?

A. ammonium acetate, NH_4CH_3COO

B. ammonium chloride, $NH_4C\ell$

C. ammonium phosphate, $(NH_4)_3PO_4$

D. sodium bromide, NaBr

8. A chemist carries out a titration and records the following figures in his report book.

Final reading (mL)	23.00	22.53	22.59	22.01	22.37
Initial reading (mL)	0.02	1.07	1.15	1.56	0.89

What titration figure should he use in his subsequent calculation?

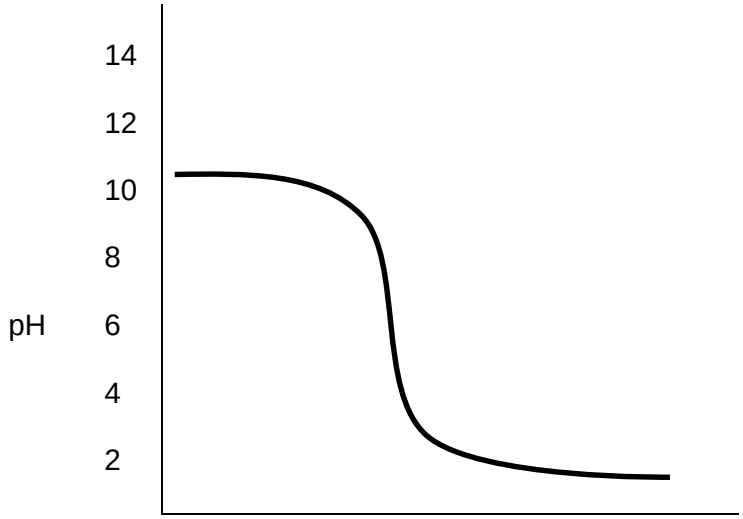
A. 21.208 mL

B. 21.21 mL

C. 21.46 mL

D. 21.562 mL

9. A dilute solution of ammonia (in the conical flask) is titrated with dilute hydrochloric acid (from the burette), and the following graph is obtained showing how the pH of the solution changes as HCℓ is added.



Phenolphthalein is used as an indicator and changes colour at a pH of 8.2. Which of the following statements is true?

A. The end point occurs before the equivalence point.

B. The end point occurs at the equivalence point.

C The end point occurs after the equivalence point.

D. There is no equivalence point because it is the wrong indicator.

10. A student prepared a buffer solution by combining an ethanoic acid solution of pH = 3 with an equal number of moles of solid sodium ethanoate. The resultant pH of the buffer will be

A. equal to 3

B. greater than 3

C less than 3

D. equal to 7

End of Part 1

Part 2: Short Answer Section **30 marks**

Question 11 **(6 marks)**

Write balanced ionic equations for the following reactions and describe what you would observe.

(a) Propanoic acid is reacted with sodium carbonate

Equation _____

Observation _____

_____

(3 marks)

(b) Solid manganese (IV) oxide is added to sulphuric acid.

Equation _____

Observation _____

_____

(3 marks)

Question 12 **(4 marks)**

Anions such as hydrogencarbonate (HCO_3^-) and hydrogenphosphate (HPO_4^{2-}) act as bases in aqueous solutions. However, in water, hydrogensulfate ion (HSO_4^-) does not act as a base.

Use equations to explain these observations.

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Question 13 **(6 marks)**

Phosphoric acid (H_3PO_4) is a polyprotic weak acid.

(a) List all the anions present (in order of decreasing concentration) in a solution of phosphoric acid (excluding hydroxide). Write equations to show how you determined this.

(3 marks)

(b) Phosphoric acid is a weak acid. However, the pH of the acid is observed to decreases when heated. Suggest an explanation for this observation.

(3 marks)

Question 14 **(8 marks)**

A swimming pool holds 250 cubic metres of water. The owner tests the water and finds its hydroxide ion concentration, $[OH^-]$, is 5.55×10^{-5} mol L^{-1} at 25°C. (1 cubic metre = 1000 L)

(a) What is the pH of the pool water? (2 marks)

(b) Thinking the pH is too low, the owner adds to the water 3.00 kg of caustic soda (NaOH). The water pump ensures that the caustic soda dissolves and becomes evenly mixed in the pool. What is the new pH of the water? (6 marks)

Question 15 **(6 marks)**

(a) You are provided with 100 mL of a 1.0 mol L^{-1} ammonia solution and some solid ammonium chloride Describe how you would use these two substances to prepare a buffer solution with the maximum possible buffer capacity. (2 marks)

(b) A 1.0 mol L^{-1} sodium hydroxide solution is added dropwise to your buffer solution. Use equation(s) to describe how the buffer resists a change in pH. (4 marks)

Part 3: Extended Response Section **10 marks**

Question 16

A large quantity of sulphuric acid used as the electrolyte in car batteries was mistakenly contaminated with hydrochloric acid. In order to determine whether the electrolyte was still functional, an analytical chemist is assigned the task of measuring the concentration of both acids in the electrolyte.

The mixture was analysed as follows:

I He used a pipette to remove 20.00 mL of the acid from one of the batteries and dilute this to 250 mL in a volumetric flask. He then placed the diluted battery acid in a burette and titrated it with 20.00 mL samples of 0.2905 mol L^{-1} NaOH. On average he used 17.35 mL of diluted electrolyte solution for end point.

II A second 20.00 mL aliquot taken from the volumetric flask was treated with excess barium nitrate solution and resulted in the precipitation of 0.712 g of barium sulphate.

Determine the concentration of both acids in the battery?

End of Test