



Christ Church  
Grammar School

# Year 12 Chemistry

## Acids and Bases Test 2016

**NO READING TIME ALLOWED**

Time allowed:

45 minutes

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

Teacher: \_\_\_\_\_ (for CAP) \_\_\_\_\_ /46

**Note that in this test you may assume that the temperature in all questions is 25°C, unless indicated otherwise**

## **SECTION 1. Multiple Choice (10 marks)**

1. Which of the following are Bronsted-Lowry acid/base reactions?

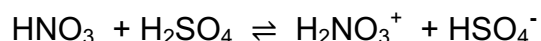
- I.  $2\text{H}_2\text{O}_2 \rightarrow 2\text{H}_2\text{O} + \text{O}_2$
- II.  $2\text{H}_2\text{O} \rightarrow \text{H}_3\text{O}^+ + \text{OH}^-$
- III.  $\text{O}^{2-} + \text{H}_2\text{O} \rightarrow 2\text{OH}^-$
- IV.  $2\text{O}^{2-} + 2\text{H}^+ \rightarrow \text{H}_2\text{O} + \text{O}_2$

- A. II, and III only
- B. I, II and III only
- C. I, II and IV only
- D. II, III and IV only

2. Which of the following is a possible pH of a 0.001 mol L<sup>-1</sup> monoprotic weak acid

- A. 3 exactly
- B. 2.9
- C. 3.1
- D. 6.9

3. Consider the reaction



Which of the following statements is true from the information given

- A. the nitric acid is acting as a base
- B. the hydrogensulfate ion is acting as an acid
- C. the acids must both be strong and concentrated
- D. the  $\text{H}_2\text{NO}_3^+$  ion is acting as a base

4. Both ammonia and phosphine ( $\text{PH}_3$ ) are weak bases. The pH of equimolar solutions were measured and it was found that the pH of the ammonia solution was higher. From this we can conclude that

- A. Phosphine is a stronger base than ammonia
- B. The ammonium ion is a weaker acid than the  $\text{PH}_4^+$  ion
- C. Ammonia must be able to accept more than one proton
- D. The degree of ionisation of phosphine is greater than that of ammonia

5. Which of the following could **not** form an effective buffer solution
- a mixture of  $\text{NH}_3$  and  $\text{NH}_4\text{NO}_3$
  - a mixture of  $\text{HCOOH}$  and  $\text{HCOONa}$
  - $\text{H}_2\text{NCH}_2\text{COOH}$
  - a mixture of  $\text{HCl}$  and  $\text{NaCl}$
6. A  $0.01\text{molL}^{-1}$  solution of which of the following would you expect to have the lowest pH?
- sodium nitrate
  - sodium ethanoate
  - potassium chloride
  - ammonium chloride
7. The pH of water at  $25^\circ\text{C}$  is 7.0 and at  $30^\circ\text{C}$  is 6.9. From this we can conclude that
- the ionisation of water is exothermic
  - the water at  $30^\circ\text{C}$  is slightly acidic
  - both solutions are neutral
  - the  $[\text{H}^+]$  at  $30^\circ\text{C}$  is greater than the  $[\text{OH}^-]$
8. Which one of the following species acts as an **acid** when ammonia gas is bubbled through an aqueous solution of potassium chloride?
- $\text{H}_2\text{O}$
  - $\text{Cl}^-$
  - $\text{NH}_3$
  - $\text{K}^+$
9. Which of the following solutions will have the lowest pH?
- $0.1\text{molL}^{-1} \text{H}_2\text{SO}_4$
  - $0.2\text{molL}^{-1} \text{CH}_3\text{COOH}$
  - $0.2\text{molL}^{-1} \text{HNO}_3$
  - $0.1\text{molL}^{-1} \text{HCl}$
10. Which of the following equations best represents the change taking place when ethanoic acid reacts with lithium hydroxide solution?
- $\text{LiOH}(\text{aq}) + \text{CH}_3\text{COOH}(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l}) + \text{CH}_3\text{COOLi}(\text{aq})$
  - $\text{OH}^-(\text{aq}) + \text{CH}_3\text{COOH}(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l}) + \text{CH}_3\text{COO}^-(\text{aq})$
  - $\text{OH}^-(\text{aq}) + \text{H}^+(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l})$
  - $\text{Li}^+(\text{aq}) + \text{CH}_3\text{COO}^-(\text{aq}) \rightarrow \text{CH}_3\text{COOLi}(\text{aq})$

## SECTION 2. Short Answers (36 marks)

### Question 11 (2 marks)

Write ionic Bronsted-Lowry equations to show how

- (i) The hypochlorite ( $\text{ClO}^-$ ) ion can act as a base in water

.....  
(1 marks)

- (ii) The hydrazinium ( $\text{N}_2\text{H}_5^+$ ) ion can act as an acid in water

.....  
(1 marks)

### Question 12 (4 marks)

Write ionic equations to show the reaction between

- (i) Ammonium nitrate and sodium hydroxide

.....  
(2 marks)

- (ii) Ethanoic acid and magnesium oxide

.....  
(2 marks)

**Question 13 (10 marks)**

Like water, liquid ammonia is able to react with itself and self-ionise. The equation for this reaction is shown below, with (am) meaning 'dissolved in ammonia'.



- (i) Use arrows to link the conjugate acid/base pairs in the above reaction, clearly identifying the acids and bases. (2 marks)

The value of the equilibrium constant (at 25°C) for this reaction is about  $1.0 \times 10^{-30}$ .

- (ii) What do you think will be a better conductor of electricity, water or liquid ammonia. Explain your reasoning

..... will be the better conductor of electricity (1 mark)

Explanation

.....  
..... (2 marks)

- (iii) Calculate the concentration of ammonium ions in liquid ammonia at 25°C.

.....  
..... (2 marks)

It is found that, as the temperature of the ammonia is increased, both the electrical conductivity and the value of K also increase.

- (iv) Is the ionisation of ammonia endothermic or exothermic? Explain your reasoning.

The ionisation of ammonia is an ..... reaction (1 mark)

Explanation

.....  
..... (2 marks)

**Question 14 (6 marks)**

Even though they can be formed as a product of neutralisation reactions, solutions of salts need not themselves be neutral. They may be acidic, basic or neutral. For the following salts, identify (by circling the correct answer) the nature of the salt and write an ionic Bronsted-Lowry equation to support your answer.

(i) Ammonium nitrate

*Acidic*      *Neutral*      *Basic*

Equation

.....

(ii) Lithium phosphate

*Acidic*      *Neutral*      *Basic*

Equation

.....

(iii) Potassium hydrogensulfate

*Acidic*      *Neutral*      *Basic*

Equation

.....

(3x2=6 marks)

**Question 15 (8 marks)**

A buffer solution contains  $0.100\text{molL}^{-1}$   $\text{CH}_3\text{COOH}$  and  $0.100\text{molL}^{-1}$   $\text{CH}_3\text{COONa}$  and is found to have a pH of 4.76.

- (i) Explain, with the aid of relevant equation, how this buffer can withstand the addition of acid.

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(3 marks)

- (II) After the addition of the acid, circle the correct answer to describe what will have happened to the following values

The $[\text{CH}_3\text{COOH}]$ will have	<i>increased</i>	<i>decreased</i>	<i>stayed the same</i>
The $[\text{CH}_3\text{COO}^-]$ will have	<i>increased</i>	<i>decreased</i>	<i>stayed the same</i>
The pH will have	<i>increased</i>	<i>decreased</i>	<i>stayed the same</i>
The $[\text{OH}^-]$ will have	<i>increased</i>	<i>decreased</i>	<i>stayed the same</i>
The value of $K_w$ will have	<i>increased</i>	<i>decreased</i>	<i>stayed the same</i>

(5 marks)

TEST CONTINUES ON NEXT PAGE

**Question 16 (6 marks)**

17.2mL of sodium hydroxide is added to 25.0mL of  $0.100\text{molL}^{-1}$  hydrochloric acid and the pH of the resultant solution was found to be 1.65. Calculate the concentration of the sodium hydroxide solution.

(6 marks)

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**END OF TEST**



