Chemistry Department
Christ Church Grammar School

Year 12
2022

Acids & Bases Topic Test

Time allowed: 45 minutes

Instructions
Please ensure you enter your name and circle your teacher's initials below. Scientific calculators only. Chemistry Data Sheet will be provided

Name

_____

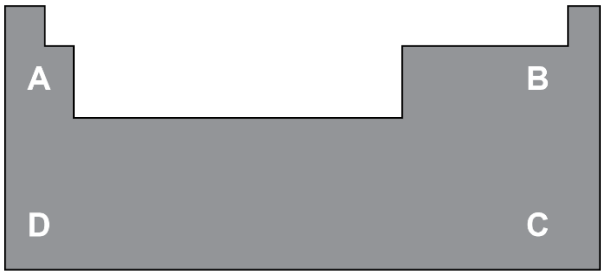
Teacher: (circle)

MXC NMO BLR

Mark:_____ **/ 42**

Section 1: Multiple Choice **(Total 10 marks)**

1. The diagram below shows four regions on the Periodic Table. Which of these regions would produce the most acidic oxides?



(a) Region A
(b) Region B
(c) Region C
(d) Region D

2. If Solution **X** has a pH of 3 and Solution **Y** has a pH of 6, we can conclude that

(a) $[H^+]$ in Solution **X** is 1000 times that of $[H^+]$ in Solution **Y**.
(b) $[H^+]$ in Solution **X** is half that of $[H^+]$ in Solution **Y**.
(c) $[OH^-]$ in Solution **Y** is twice that of $[OH^-]$ in Solution **X**.
(d) Solution **Y** must contain a stronger acid than Solution **X**.

3. What is the pH of a solution of barium hydroxide with a concentration of 0.1 mol L^{-1}?

(a) 13.3
(b) 9.0
(c) 12.7
(d) 13.0

4. Which of the following statements about aqueous solution of weak acids is true?

(a) A weak acid is a concentrated acid that has been diluted.

(b) A 1.00 mol L^{-1} solution of a weak acid contains more molecules of acid than ions.

(c) Less than 1.0 mol of sodium hydroxide is required to react completely with 1.0 mol of a monoprotic weak acid.

(d) The salt produced through the neutralisation of a weak acid by a strong base is slightly acidic.

5. Which of the substances in bold is acting as a Bronsted-Lowry acid?

(a) $\mathbf{CH_3CH_2NH_2}(aq) + H_2O(l) \rightleftharpoons CH_3CH_2NH_3^+(aq) + OH^-(aq)$

(b) $2\mathbf{H_2O}(l) \rightleftharpoons H_3O^+(aq) + OH^-(aq)$

(c) $H_2S(aq) + NH_3(aq) \rightleftharpoons \mathbf{HS^-}(aq) + NH_4^+(aq)$

(d) $H_2CO_3(l) + H_2O(l) \leftrightharpoons H_3O^+(l) + \mathbf{HCO_3^-}(aq)$

6. Which of the following solutions contains hydroxide ions?

(i) 2 mol L^{-1} HNO_3

(ii) pure water at 50°C

(iii) 0.1 mol L^{-1} NaCl

(iv) 3.0 mol L^{-1} NH_4NO_3

(a) (iv) only

(b) (ii) and (iv)

(c) (ii) and (iii)

(d) all of them

7. Which of the following correctly lists the expected pH of solutions of a series of salts at 25°C?

	Potassium carbonate	Lithium chloride	Ammonium nitrate	Sodium phosphate
(a)	Less than 7	neutral	less than 7	greater than 7
(b)	greater than 7	neutral	less than 7	greater than 7
(c)	greater than 7	greater than 7	more than 7	less than 7
(d)	less than 7	less than 7	less than 7	less than 7

8. Which of the following can be used to prepare a buffer solution with the highest buffer capacity?

(a) 100mL of 0.1 mol L^{-1} NH_3 and 50mL of 0.1 mol L^{-1} HCl

(b) 50mL of 0.1 mol L^{-1} NH_3 and 100mL of 0.1 mol L^{-1} HCl

(c) 100mL of 0.1 mol L^{-1} NH_3 and 100mL of 0.1 mol L^{-1} CH_3COOH

(d) 50mL of 0.1 mol L^{-1} NH_3 and 50mL of 0.1 mol L^{-1} HCl

9. Which one of the following statements about 1.00×10^{-8} mol L^{-1} HCl is correct?

   (a) The pH is 6
   (b) The pH is a little less than 7
   (c) The pH is 8
   (d) Such a solution cannot exist

10. The pH of pure water, measured at 50°C, is about 6.6. Which of the following is true?

   (a) The concentration of hydroxide ions is lower at 50°C than at 25°C.
   (b) This proves that the self-ionisation of water is an exothermic reaction.
   (c) The water is acidic.
   (d) Kw at 50°C is higher than it is at 25°C.

Section 2: Short Answers **(Total 32 marks)**

Question 1 **4 marks**

Hydroiodic acid, HI, has a K_a of 3.2×10^9 at 25°C and is highly soluble in water.

(a) Write an equation showing hydroiodic acid behaving as a Bronsted-Lowry acid.
(1 mark)

(b) Write the expression for K_a.
(1 mark)

(c) State if hydroiodic acid is a strong or weak acid and briefly explain how you know this.
(2 marks)

Question 2 **7 marks**

(a) Consider the following acids and their K_a values.

Iodic acid, HIO_3 $K_a = 1.6 \times 10^{-1}$
Nitrous acid, HNO_2 $K_a = 7.2 \times 10^{-4}$

(i) Rank the salt solutions of equal concentration given below from highest to lowest pH. (3 marks)

KNO_2 KIO_3 NH_4NO_2 $Ca(NO_2)_2$

Highest _____ Lowest

(ii) Explain the placement of the solution with the highest pH. Use suitable chemical equations to support your answer. (4 marks)

Highest:

Question 3 **8 marks**

Naturally occurring calcite is crystalline calcium carbonate. 25.00 mL of dilute hydrochloric acid was added to 0.6342 g of calcite which was in excess. The reaction, shown below, ceased after 2 minutes. The unreacted solid was filtered and washed. It was then dried at 120°C to a constant mass of 0.392 g.

$$\mathbf{CaCO_3\,(s) + 2H^+(aq) \longrightarrow Ca^{2+}(aq) + CO_2(g) + H_2O(l)}$$

(a) Using this information determine the pH of the dilute hydrochloric acid solution that was used. (5 marks)

(b) If the hydrochloric acid was replaced by ethanoic acid of the same concentration, would you expect the reaction to be complete in 2 minutes as described above? Explain your answer. (3 marks)

Question 4 **6 marks**

A student investigating buffers prepared a buffer by dissolving ammonium chloride in ammonia solution, establishing the following equilibrium:

$$NH_3(aq) + H_2O(\ell) \rightleftharpoons NH_4^+(aq) + OH^-(aq)$$

She tested her buffer by adding KOH solution, 5 drops at a time, and measured the pH of the mixture with a pH meter. After the addition of 25 drops of KOH the pH of the buffer solution had only increased by 0.1.

(a) Describe how this buffer is able to withstand a significant change in pH when the potassium hydroxide solution is added.

(4 marks)

(b) State the two factors to give a buffer the highest possible buffer capacity.

(2 marks)

Question 5 **7 marks**

A strong acid with a pH of 6 has double the volume of a strong base with a pH of 8 added to it. Determine the pH of the resultant solution.

END OF TEST