

**“It’s all basic really”**

**Y13 UNIT 4 TEST 6**

**4.3 ACIDS AND BASES**

**BOA SORTE!**

Answer all questions  
Total 50 marks

**Name:.....**

**Mark for section A..... /35**

**Mark for section C..... /15**

**Total: ..... /50**

**Grade.....**

## SECTION A

1. (a) (i) Write an expression for the dissociation constant  $K_a$  of propanoic acid,  $\text{CH}_3\text{CH}_2\text{COOH}$ .

Expression for  $K_a$  .....

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- (ii) Write an expression for  $\text{p}K_a$  in terms of  $K_a$

Expression for  $\text{p}K_a$  .....

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- (iii) Calculate the pH of a 0.10 M solution of propanoic acid, given that  $K_a = 1.35 \times 10^{-5} \text{ mol dm}^{-3}$  for this acid at  $25^\circ\text{C}$ .

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(6)

- (b) Explain why an aqueous solution containing propanoic acid and its sodium salt constitutes a buffer system able to minimise the effect of added hydrogen ions.

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(3)

(Total 9 marks)

2. (a) Write an equation for the reaction which occurs when the weak acid HA is added to water.

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(1)

- (b) Write an expression for the dissociation constant,  $K_a$ , for the weak acid HA.

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(1)

(c) The dissociation of the acid HA is an endothermic process. Deduce the effect, if any, of

(i) an increase in temperature on the value of the dissociation constant,  $K_a$

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(ii) an increase in temperature on the pH of an aqueous solution of the acid

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(iii) an increase in the concentration of the acid on the value of  $K_a$

.....

(3)

(d) Identify a compound which could be added to aqueous ethanoic acid so that the pH of the resulting solution would not change significantly if a small volume of dilute hydrochloric acid were added. State the name given to solutions which behave in this way.

*Compound*.....

*Name*.....

(2)

(Total 7 marks)

3. (a) At 25°C, the constant  $K_w$  has the value  $1.00 \times 10^{-14} \text{ mol}^2 \text{ dm}^{-6}$ . Define the term  $K_w$ .

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(1)

(b) Define the term *pH*.

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(1)

(c) Calculate the pH at 25 °C of 2.00 M HCl.

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(1)

(d) Calculate the pH at 25 °C of 2.50 M NaOH.

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(2)

- (e) Calculate the pH at 25 °C of the solution that results from mixing 19.0 cm<sup>3</sup> of 2.00 M HCl with 16.0 cm<sup>3</sup> of 2.50 M NaOH.

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(6)  
(Total 11 marks)

4. Methylamine is a weak Brønsted-Lowry base and can be used in aqueous solution with one other substance to prepare a basic buffer.

- (i) Explain the term *Brønsted-Lowry base* and write an equation for the reaction of methylamine with water to produce an alkaline solution.

*Brønsted-Lowry base* .....

*Equation* .....

- (ii) Suggest a substance that could be added to aqueous methylamine to produce a basic buffer.

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- (iii) Explain how the buffer solution in part (a)(ii) is able to resist a change in pH when a small amount of sodium hydroxide is added.

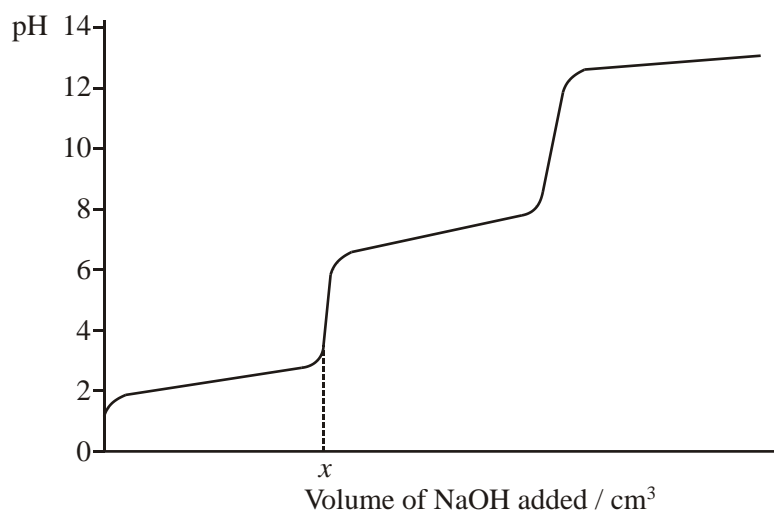
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(5)  
(Total 5 marks)

5. The pH curve for the titration of the weak diprotic acid  $\text{H}_2\text{SO}_3$  with aqueous sodium hydroxide is shown below.



- (i) Identify the sodium salt formed from  $\text{H}_2\text{SO}_3$  when  $x \text{ cm}^3$  of NaOH have been added.
- .....
- (ii) Write an equation for the reaction that occurs between the two end-points (equivalence points).
- .....
- (iii) Name an indicator which could be used to determine the second end-point (equivalence point).
- .....

(3)  
(Total 3 marks)

## SECTION B

6. A  $0.210 \text{ mol dm}^{-3}$  solution of potassium hydroxide was added from a burette to  $25.0 \text{ cm}^3$  of a  $0.160 \text{ mol dm}^{-3}$  solution of ethanoic acid in a conical flask.

Given that the value of the acid dissociation constant,  $K_a$ , for ethanoic acid is  $1.74 \times 10^{-5} \text{ mol dm}^{-3}$ , calculate the pH at  $25^\circ\text{C}$  of the solution in the conical flask at the following three points:

before any potassium hydroxide had been added;

after  $8.0 \text{ cm}^3$  of potassium hydroxide solution had been added;

after  $40.0 \text{ cm}^3$  of potassium hydroxide solution had been added.

**(Total 15 marks)**

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