



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)

CEM

NMO

KLD

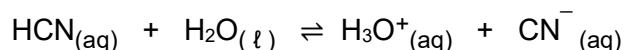
MXC

Mark: _____ / 41

Section 1: Multiple Choice

(Total 10 marks)

1. Consider the following reaction:



Which of the species in the equations shown are acting as bases?

- A. $\text{HCN}_{(\text{aq})}$ and $\text{H}_2\text{O}_{(\ell)}$
B. $\text{H}_2\text{O}_{(\ell)}$ and $\text{CN}^-_{(\text{aq})}$
C. $\text{CN}^-_{(\text{aq})}$ and $\text{HCN}_{(\text{aq})}$
D. $\text{HCN}_{(\text{aq})}$ and $\text{H}_3\text{O}^+_{(\text{aq})}$
2. The conjugate base of the species $\text{H}_2\text{PO}_4^-_{(\text{aq})}$ is:
- A. $\text{PO}_4^{3-}_{(\text{aq})}$
B. $\text{H}_3\text{PO}_4_{(\text{aq})}$
C. $\text{H}_2\text{PO}_4^-_{(\text{aq})}$
D. $\text{HPO}_4^{2-}_{(\text{aq})}$
3. The strength of an acid is determined by:
- A. the number of hydrogen atoms in the formula of the acid
B. the concentration of the acid
C. the degree of ionisation in aqueous solution
D. the purity of the acid
4. Which species is likely to be **most** abundant in 1 mol L⁻¹ NH₄Cl solution?
- a) NH_4^+
b) Cl^-
c) NH_3
d) H_3O^+
5. Which of the following compounds, when dissolved in water, would not form a solution with a pH less than 7?
- I NH_4NO_3
II Na_2CO_3
III $\text{Ba}(\text{OH})_2$
IV NH_3
- a) I only
b) I and II
c) II and IV
d) II, III, and IV

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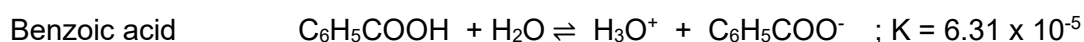
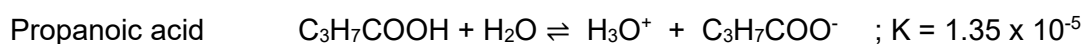
6. The table below lists the pH of $0.00001 \text{ mol L}^{-1}$ solutions of four acids:

Acid solution	pH
I	4.0
II	3.5
III	5.0
IV	3.0

The acid that cannot be monoprotic and weak is

- A. I
 B. II
 C. III
 D. IV
7. Which of the following solutions will have the lowest pH at 25°C ?
- A. $0.10 \text{ mol L}^{-1} \text{ H}_2\text{SO}_4$
 B. $0.05 \text{ mol L}^{-1} \text{ H}_3\text{PO}_4$
 C. $0.20 \text{ mol L}^{-1} \text{ HNO}_3$
 D. $0.20 \text{ mol L}^{-1} \text{ CH}_3\text{COOH}$

8. Propanoic acid and benzoic acid are both monoprotic weak acids whose equilibrium constants are listed below:



Which of the following statements is true?

- A. Benzoic acid is a weaker acid than propanoic acid.
 B. The pH of a 0.100 mol L^{-1} solution of benzoic acid will be higher than that of a 0.100 mol L^{-1} solution of propanoic acid.
 C. The benzoate ion is a stronger base than the propanoate ion.
 D. A 0.100 mol L^{-1} solution of benzoic acid will react faster with a piece of magnesium metal than will a 0.100 mol L^{-1} solution of propanoic acid with an identical piece of magnesium.
9. A substance which can accept and donate a proton is amphiprotic. Which of the following species are amphiprotic?
- I H_2O
 II The hydrogencarbonate ion
 III The hydroxide ion
 IV The ethanoate ion
- A. I, II and III only
 B. I, III and IV only
 C. II and III only
 D. all of them

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10. Which of the options below best describes the solutions of the three salts?

	KCl	Na_2SO_4	NH_4NO_3
A.	neutral	basic	acidic
B.	acidic	acidic	acidic
C.	neutral	acidic	acidic
D.	neutral	basic	basic

END OF SECTION ONE

Section 2: Short Answer

(Total 32 marks)

Question 1

4 marks

Write a balanced ionic equation and observations for the reaction between ammonium sulfate solution and barium hydroxide.

Equation:

Observations:

Question 2

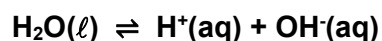
6 marks

The pH of pure water at 90°C is 6.13.

(a) What is the K_w , the equilibrium constant for water, at 90°C ? Show all working.

(3 marks)

(b) Using this information determine whether the self ionization of water:



is an exothermic or endothermic reaction. Explain your answer.

(3 marks)

Question 3

6 marks

(a) Chloroethanoic (CH_2ClCOOH) is a monoprotic weak acid. A 0.100 mol L^{-1} solution of chloroethanoic acid has a pH of 1.93 (at 25°C). Calculate the percentage of chloroethanoic molecules that is ionised.

(2 marks)

(b) Two experiments were conducted that measured the rate of reaction of acids with magnesium carbonate solid. In this experiment, the acid used was the independent variable. Hydrochloric acid was used in **Experiment 1** whilst chloroethanoic acid was used in **Experiment 2**. All other variables were adequately controlled.

(i) The initial rate of **Experiment 2** was:

higher the same lower (circle your answer)

than **Experiment 1**.

(ii) The mass of the hydrogen produced was found to be

higher the same lower (circle your answer)

than in **Experiment 2**.

(2 marks)

(iii) Explain your response to (i).

(2 marks)

Question 4

6 marks

(a) What is the pH of 100 mL of 0.001 molL⁻¹ nitric acid?

(1 mark)

(b) Calculate the number of moles of H₃O⁺ in the nitric acid in (a).

(1 mark)

(c) Calculate the number of moles of OH⁻ in 70 mL of 0.001 molL⁻¹ potassium hydroxide.

(1 mark)

(d) Calculate the pH of the solution produced by mixing the potassium hydroxide and nitric acid together.

(3 marks)

Question 5

10 marks

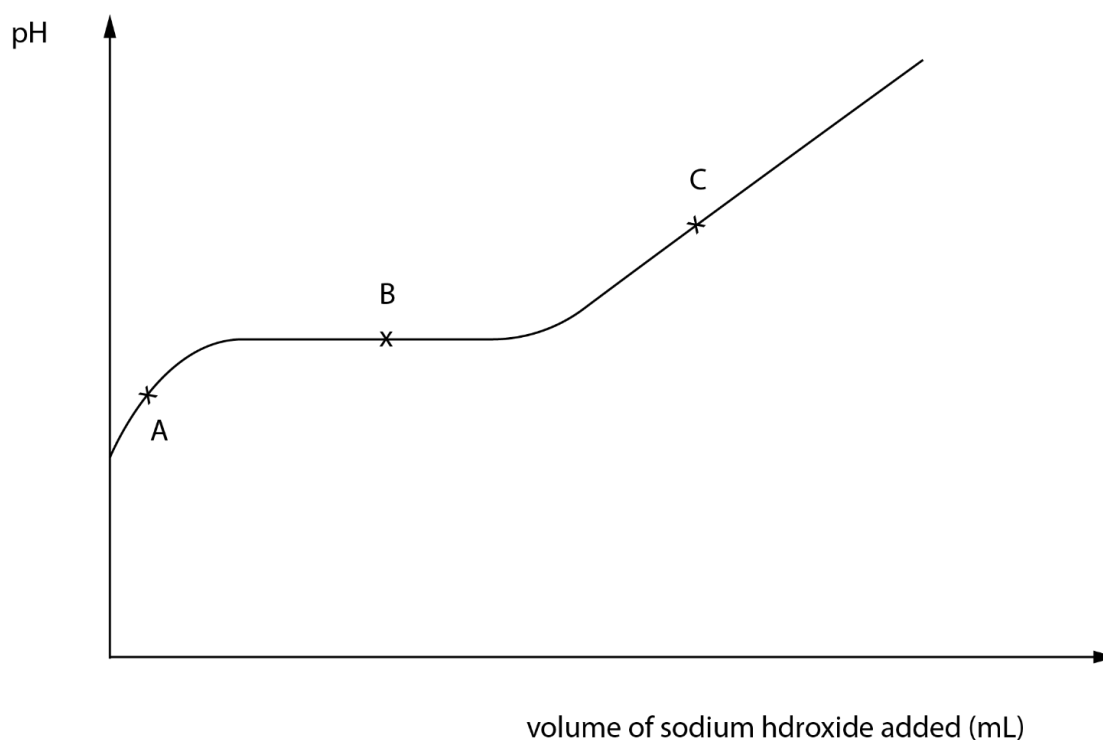
Benzoic acid is a weak acid and its structure is shown below. A buffer can be made by adding sodium hydroxide solution to benzoic acid.

benzoic acid
(C_6H_5COOH)

(a) Write an ionic equation for the neutralization of benzoic acid with sodium hydroxide.

(2 marks)

(b) Adding sodium hydroxide to benzoic acid results in a buffer solution being formed. Using a pH meter, the following graph was produced. Three points A, B and C are marked on the graph.



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Using your knowledge of buffers, complete the table by writing one of the symbols =, > or < in the boxes below.

Point on graph	Concentration of species		
	A	C_6H_5COOH	<input type="text"/>
B	C_6H_5COOH	<input type="text"/>	$C_6H_5COO^-$
C	C_6H_5COOH	<input type="text"/>	$C_6H_5COO^-$

(3 marks)

(c) Using relevant equations and appropriate theory, explain why the pH of the mixture at point B is resistant to further change to pH by addition hydroxide ions.

(5 marks)

END OF TEST