Year 12 Chemistry **Topic Test #4 (Acids & Bases) - 2013**

Name: _____ Mark = _____ / 38

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

Answer by placing a cross through, or a circle around, the letter of the most correct answer.

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1. Which one of the following correctly arranges 1.0 mol L^{-1} solutions of the substances in the order of **increasing** pH?

A.	$HC\ell$	H_2SO_4	CH_3COONa	CH_3COOH	NH_4CH_3COO
B.	H_2SO_4	$HC\ell$	CH_3COOH	NH_4CH_3COO	CH_3COONa
C.	H_2SO_4	$HC\ell$	CH_3COOH	CH_3COONa	NH_4CH_3COO
D.	$HC\ell$	H_2SO_4	NH_4CH_3COO	CH_3COOH	CH_3COONa

2. Consider the following equation: $HS^-(aq) + CO_3^{2-}(aq) \rightleftarrows S^{2-}(aq) + HCO_3^-(aq)$

Which of the following in **not** true of this equation?

A. HCO_3^- is acting as a Brønsted-Lowry acid.

B. CO_3^{2-} is acting as a Brønsted-Lowry base.

C. HS^- is acting as a Brønsted-Lowry base.

D. S^{2-} is acting as a Brønsted-Lowry base.

3. The hydrogencarbonate ion, HCO_3^-, is amphiprotic, that is, it can donate or accept H^+. Which statement is correct?

A. HCO_3^- is the conjugate base of CO_3^{2-}

B. H_2CO_3 is the conjugate acid of CO_3^{2-}

C. CO_3^{2-} is the conjugate base of H_2CO_3

D. H_2CO_3 is the conjugate acid of HCO_3^-

4. What is the conjugate base of this acid, $[A\ell(H_2O)_6]^{3+}$?

A. $[A\ell(HO)_6]^{2+}$

B. $[A\ell(H_2O)_5(OH)]^{4+}$

C. $[A\ell(H_2O)_5(OH)]^{2+}$

D. $[A\ell(OH)_6]^{3+}$

5. In standardising a sodium hydroxide solution by titrating 20.00 mL aliquots against a standard hydrochloric acid solution, a student experienced difficulty in obtaining consistent values for the volume of acid added.

Which of the following sequential steps could be responsible for this lack of precision?

A. The burette was cleaned and rinsed thoroughly with the standard acid solution before being filled.

B. Several 250 mL conical flasks were washed, and rinsed thoroughly with the sodium hydroxide solution.

C. A clean pipette was rinsed with the sodium hydroxide solution and a 20.0 mL aliquot was carefully pipetted into each conical flask.

D. To each flask in turn, standard hydrochloric acid solution was added with care from the burette until the end point was observed, and the volume added was recorded.

6. Hydrochloric acid, $HC\ell$, is a stronger acid than the ammonium ion, NH_4^+.

Which one of the statements below is true?

A. The equilibrium constant for the hydrolysis of $HC\ell$ is smaller than that for NH_4^+.

B. $C\ell^-(aq)$ is a weaker base than $NH_3(aq)$

C. Solutions of $HC\ell$ will always have more hydrogen ions than solutions of NH_3.

D. The pH of a 0.1 mol L^{-1} solution of $HC\ell$ will be greater than the pH of a 0.1 mol L^{-1} solution of NH_3.

7. In which of the following is the first listed reactant acting as a Brønsted-Lowry base?

A. $CO_2 + 2\ OH^- \rightarrow CO_3^{2-} + H_2O$

B. $CH_3NH_2 + H_2O \rightarrow CH_3NH_3^+ + OH^-$

C. $H^+ + NH_3 \rightarrow NH_4^+$

D. $H_2C_2O_4 + H_2O \rightarrow H_3O^+ + HC_2O_4^-$

8. What is the best indicator to use when titrating a solution of ammonia of concentration 0.100 mol L^{-1} with a solution of hydrochloric acid of the same concentration?

A. phenolphthalein (pH range 8.3 to 10)

B. phenol red (pH range 7 to 8)

C. bromothymol blue (pH range 6 to 7.6)

D. methyl red (pH range 4.4 to 6.3)

9. In the titration of standard NaOH(aq) (in the burette) versus $CH_3COOH(aq)$, a student uses methyl red (end point, pH 4.4 to 6.3) as the indicator.

Based on this information which of the following statements is true?

A. The end point will be achieved before the equivalence point and the calculated $[CH_3COOH]$ will be higher than the actual value.

B. The end point will be achieved after the equivalence point and the calculated $[CH_3COOH]$ will be higher than the actual value.

C. The end point will be achieved before the equivalence point and the calculated $[CH_3COOH]$ will be lower than the actual value.

D. The end point will be achieved after the equivalence point and the calculated $[CH_3COOH]$ will be lower than the actual value.

10. Which of these solutions may be used as a buffer solution?

A. 100 mL of 1.0 mol L^{-1} NaOH(aq) mixed with 100 mL of 1.0 mol L^{-1} $CH_3COOH(aq)$

B. 100 mL of 1.0 mol L^{-1} NaOH(aq) mixed with 50 mL of 1.0 mol L^{-1} $CH_3COOH(aq)$

C. 100 mL of 1.0 mol L^{-1} NaOH(aq) mixed with 200 mL of 1.0 mol L^{-1} $CH_3COOH(aq)$

D. 200 mL of 1.0 mol L^{-1} NaOH(aq) mixed with 100 mL of 1.0 mol L^{-1} $CH_3COOH(aq)$

End of Part One

Part Two: Short Answer Section **28 marks**

Answer questions in the spaces provided. For calculations, show full working and give numerical answers to three significant figures.

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11. Information for two acids is as follows:

0.001 mol L^{-1} of $HC\ell O_4$ has a pH = 3

0.001 mol L^{-1} of $HC\ell O$ has a pH = 4

(a) Using calculations, equations and the above data for the two acids, explain why a solution of $NaC\ell O_4$ is neutral and a solution of $NaC\ell O$ is basic.

(5 marks)

(b) Using the information above, which of the following chemicals could be used as a buffer?

$HC\ell O_4$ $HC\ell O$ $NaC\ell O_4$ $NaC\ell O$

(1 mark)

(c) Explain, with equation(s), what happens when $HC\ell$(aq) is added to this buffer.

(3 marks)

12. The pH of pure water at 50°C is 6.63.

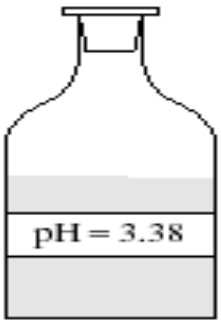
(a) What is the value of K_w, the equilibrium constant for water, at 50°C? Show all working.

(3 marks)

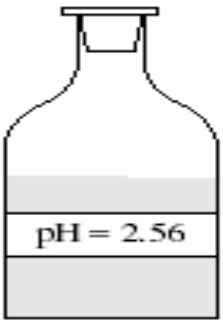
(b) At 50°C, what is the pH of 0.0256 mol L^{-1} NaOH(aq)?

(3 marks)

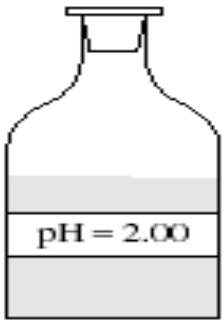
13. The pH values of three acids with the same concentrations at 25°C are shown below. Citric acid is **triprotic**.



0.01 mol L^{-1}
methanoic acid



0.01 mol L^{-1}
citric acid



0.01 mol L^{-1}
hydrobromic acid

(a) 30.0 mL of the three acids were neutralised with 0.02 mol L^{-1} NaOH(aq). If 15.0 mL of NaOH(aq) was needed to neutralise the given HBr(aq), then what volume of NaOH(aq) was needed to neutralise:

(i) methanoic acid _____

(1 mark)

(ii) citric acid _____

(2 marks)

(b) Consider these indicators and their end points:

phenolphthalein	(pH range 8.3 to 10)	phenol red	(pH range 7 to 8)
bromothymol blue	(pH range 6.0 to 7.6)	methyl red	(pH range 4.4 to 6.3)

Which indicator would be best for the titration between methanoic acid and sodium hydroxide? Using equations, explain your choice.

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_____

_____

_____

_____

(3 marks)

(c) List the three acids in increasing order of electrical conductivity

_____

(1 mark)

(d) What is the $[OH^-]$ present in citric acid at 25°C?

_____

_____

(1 mark)

14. When sodium dihydrogenphosphate solution is added to pond water, the pH of the water decreased from 7.83 to 5.56 but when sodium hydrogenphosphate was added the pH increased.

Using equation(s), explain these observations.

(4 marks)

End of Test