ST MARY'S ANGLICAN GIRLS' SCHOOL

YEAR 12 CHEMISTRY *IN-CLASS ASSIGNMENT 2 (2009)*

PUT A CROSS (X) THROUGH THE CORRECT ANSWER.

1.	*a*	*b*	*c*	*d*
2.	*a*	*b*	*c*	*d*
3.	*a*	*b*	*c*	*d*
4.	*a*	*b*	*c*	*d*
5.	*a*	*b*	*c*	*d*
6.	*a*	*b*	*c*	*d*
7.	*a*	*b*	*c*	*d*
8.	*a*	*b*	*c*	*d*
9.	*a*	*b*	*c*	*d*
10.	*a*	*b*	*c*	*d*
11.	*a*	*b*	*c*	*d*
12.	*a*	*b*	*c*	*d*
13.	*a*	*b*	*c*	*d*
14.	*a*	*b*	*c*	*d*
15.	*a*	*b*	*c*	*d*
16.	*a*	*b*	*c*	*d*

PART A */ 16*	
PART B */ 34*	
TOTAL */ 50*	

PART B - Answer all questions in the spaces provided.

1. Write equations for any reactions that occur in the following procedures. If no reaction occurs write 'no reaction'. In each case describe what you would observe, including any: colours, gases evolved, odours and precipitates. If no change is observed you must state this as the observation.

a) Calcium oxide and ammonium chloride solids are mixed and gently heated.

Equation

Observation

b) Dilute nitric acid solution is added to iron (III) sulfite solid.

Equation

Observation

c) Barium hydroxide solution is added to phosphoric acid solution.

Equation

Observation

(9 marks)

2. a) i) *When ammonia gas is dissolved in water, an alkaline solution is produced. Explain this observation including a chemical equation.*

ii) *When solid ammonium chloride is dissolved in water an acidic solution is formed. Explain this observation including at least one chemical equation.*

b) *Write down one conjugate acid-base pair that occurs in (ii).*

(5 marks)

3. *Chemical species may be classified as basic, acidic, or amphoteric.*

a) *Select from the following oxides:*

SO_2, Na_2O, P_2O_5, Al_2O_3, MgO

i) *Two basic oxides*_____ _____

ii) *Two acidic oxides* _____ _____

b) *Write a balanced equation for a reaction that illustrates the nature of one of the oxides in part (a).*

(4 marks)

4. a) *How much water must be added to 100 mL of 0.20 mol L^{-1} sodium hydroxide to obtain a solution of concentration 0.05 mol L^{-1}?*

b) *20.0 mL of 0.15 mol L^{-1} acetic acid is titrated with the 0.05 mol L^{-1} sodium hydroxide. What volume of sodium hydroxide is required for neutralisation?*

c) *What is the approximate pH of the resulting solution? No calculation is required.*

(5 marks)

5. *A experiment was set up to calculate the amount of citric acid present in lemon juice. Citric acid has a formula of $C_6H_8O_7$ and is a weak triprotic acid. 8.00g of the lemon juice was mixed with 50.0 mL of 0.500 mol L^{-1} $NaOH_{(aq)}$ and stirred thoroughly.*

The resulting solution was filtered and immediately titrated against 1.05 mol L^{-1} $HCl_{(aq)}$. The whole experiment was carried out 3 times and the results shown below:

	Titrations of HCl		
	1	*2*	*3*
Final Reading (mL)	*15.90*	*31.75*	*47.65*
Initial Reading (mL)	*0.00*	*15.90*	*31.75*
Titre (mL)			

a) Calculate the concentration of NaOH in the resulting solution.

b) Calculate the % (by mass) of citric acid in the lemon juice.

(11 marks)

NAME: _____

PART A *- Answer all questions on the answer sheet.*

1. *Which one of the following solutions has the highest pH?*
   a) *0.2 M sodium carbonate.*
   b) *0.1 M sodium hydroxide.*
   c) *0.1 M sodium chloride.*
   d) *0.2 M hydrochloric acid.*

2. *The volume of 0.1 M sodium hydroxide required to react exactly with 20.0 mL of 0.2 M of a diprotic acid is*
   a) *20 mL.*
   b) *40 mL.*
   c) *60 mL.*
   d) *80 mL.*

3. *The conjugate base of the ion, HPO_4^{2-} is*
   a) $H_2PO_4^-$
   b) H_2O
   c) OH
   d) PO_4^{3-}

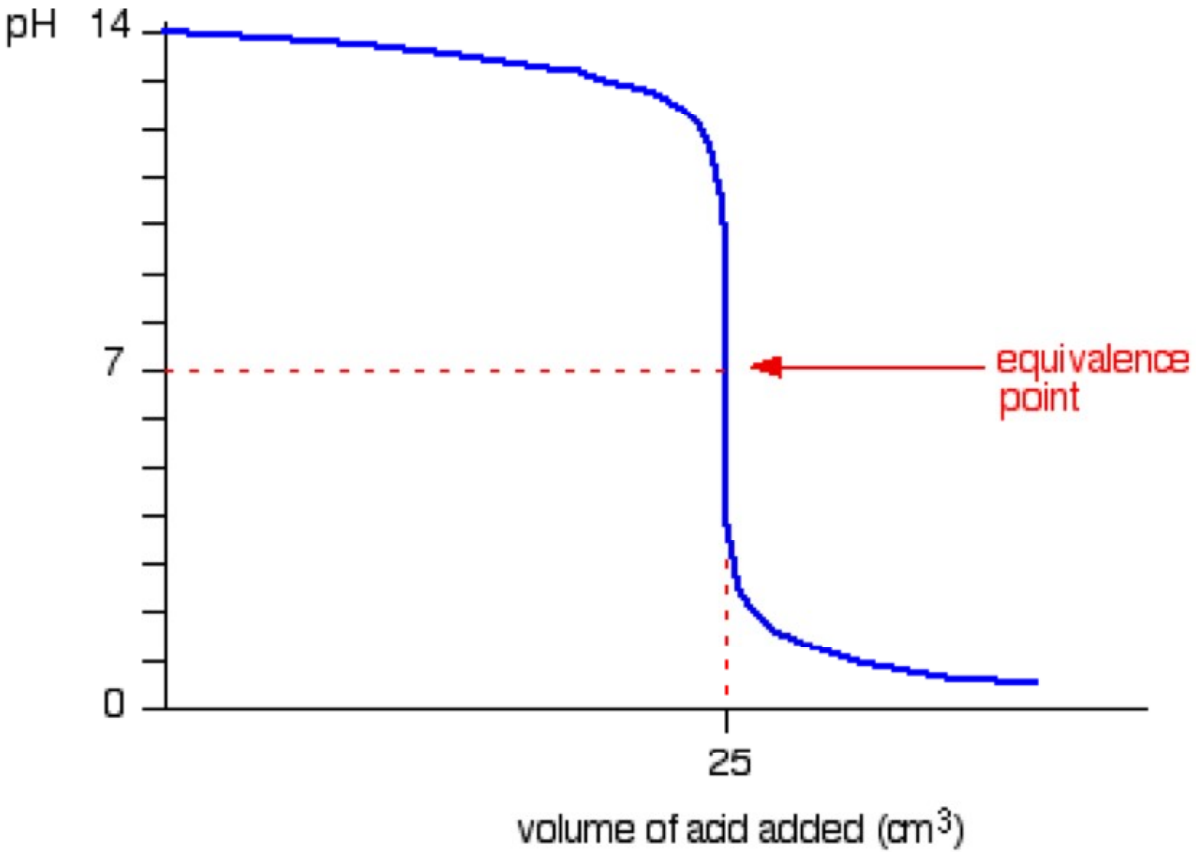
4. *The pH of a 5.0×10^{-5} mol L^{-1} solution of calcium hydroxide is exactly*
   a) *4.0*
   b) *4.3*
   c) *9.7*
   d) *10.0*

5. *Just before using a pipette in a titration, it must be rinsed with*
   a) *a non-alkaline detergent, then distilled water*
   b) *a standard solution, then distilled water*
   c) *a little of the solution to be used in it*
   d) *distilled water only*

6. *Which of the following best describes the pH of 0.1 mol L^{-1} aqueous solutions of copper (II) sulfate, potassium fluoride and lithium carbonate?*

	$CuSO_4$	KF	Li_2CO_3
a)	Acidic	neutral	basic
b)	Basic	neutral	acidic
c)	Neutral	basic	basic
d)	Neutral	basic	acidic

7.



Which one of the following titrations could be described by the graph shown above.

a) 0.2 M HCl is added to 25 mL of 1.0 M NaOH.

b) 1.0 M HCl is added to 25 mL of 1.0 M NaOH.

c) 1.0 M HCl is added to 25 mL of 0.1 M NaOH.

d) 0.2 M HCl is added to 25 mL of 0.2 M NaOH.

8. Which of the following statements concerning the Bronsted theory of acids and bases is NOT TRUE?

a) In aqueous solutions, bases are those cations, anions or molecules that donate protons to other species.

b) The ability to accept protons from other species in aqueous solution is a property of bases.

c) A base is produced when a cation, anion or molecule donate a proton in aqueous solution.

d) When a proton is donated by one species to another in aqueous solution, the reaction is classified as acid-base.

9. *In which of the following titrations has the wrong indicator been listed?*

a)	*0.1 mol L^{-1} HCl*	*0.1 mol L^{-1} NaOH*	*Phenolphthalein indicator*
b)	*0.1 mol L^{-1} HCl*	*0.1 mol L^{-1} NaOH*	*Methyl orange indicator*
c)	*0.1 mol L^{-1} CH_3COOH*	*0.1 mol L^{-1} NaOH*	*Phenolphthalein indicator*
d)	*0.1 mol L^{-1} CH_3COOH*	*0.1 mol L^{-1} NaOH*	*Methyl orange indicator*

10. *The diagram below shows the titration curve of a dilute solution of potassium hydroxide and a dilute solution of a weak acid.*

QuickTime™ and a
decompressor
are needed to see this picture.

Volume (mL) of diluted potassium hydroxide added to 25.0 mL of diluted weak acid

The choices below shows a list of indicators and the pH ranges over which they are useful. Which is the most suitable indicator for this titration?

	Indicator	*pH Range*
a)	*Methyl orange*	*3.1 - 4.4*
b)	*Methyl red*	*4.4 - 6.0*
c)	*Phenol red*	*6.8 - 8.4*
d)	*Bromocresol green*	*3.8 - 5.4*

11. *Which one of the following statements about the aqueous solutions described is FALSE?*
    a) The pH of a 0.1 mol L^{-1} solution of NaCl is equal to 7.
    b) The pH of a 0.1 mol L^{-1} solution of CH_3COOH is less than 7.
    c) The pH of a 0.1 mol L^{-1} sulfuric acid is less than the pH of a 0.1 mol L^{-1} HCl.

d) *The pH of a 0.1 mol L^{-1} NaOH solution is less than the pH of a 0.1 mol L^{-1} NH_3 solution.*

12. *What is the pH of the solution obtained when 90.0 mL of water is added to 10.0 mL of 0.1 mol L^{-1} nitric acid?*

a) 4
b) 3
c) 2
d) 1

13. *The ratio of the hydrogen ion concentration of two solutions of pH 4 and 8 is:*

a) 4 : 1
b) 40 : 1
c) 1000 : 1
d) 10 000 : 1

14. *Which one of the following is commonly used as a primary standard in volumetric analysis?*

a) Sulfuric acid.
b) Hydrochloric acid.
c) Hydrogen peroxide.
d) Sodium carbonate.

15. *Which of the following is **not** used as a raw material in the manufacture of sulfuric acid?*

a) Water
b) Hydrogen Sulfide
c) Sulfur
d) Air

16. *Nitrogen is required for plant growth and can be added to the soil by adding aqueous ammonia ($NH_{3(aq)}$), or fertilisers such as potassium nitrate ($KNO_{3(s)}$). Which of the following is a correct reason to use potassium nitrate instead of ammonia?*

a) Potassium nitrate is insoluble, so pollution caused by excess fertiliser is reduced.

b) Potassium nitrate also contains potassium, which is helpful for plant growth.

c) Potassium nitrate is an acidic salt, which keeps the pH of the soil low.

d) Aqueous ammonia is hard to prepare because ammonia is only slightly soluble in water.

ANSWERS

1.	a	b	c	d
2.	a	b	c	d
3.	a	b	c	d
4.	a	b	c	d
5.	a	b	c	d
6.	a	b	c	d
7.	a	b	c	d
8.	a	b	c	d
9.	a	b	c	d
10.	a	b	c	d
11.	a	b	c	d
12.	a	b	c	d
13.	a	b	c	d
14.	a	b	c	d
15.	a	b	c	d
16.	a	b	c	d

1. a) $CaO\ (s) + 2NH_4Cl\ (s) \rightarrow CaCl_2 + 2\ NH_3\ (g) + 2\ H_2O\ (g)$
Two white solids are heated and produce a pungent, colourless gas.

b) $6\ H^+\ (aq) + Fe_2(SO_3)_3\ (s) \rightarrow 2\ Fe^{3+}\ (aq) + 3\ SO_2\ (g) + 3\ H_2O\ (l)$
A colourless solution is added to a brown solid to form a yellow solution and a choking, colourless gas.

c) $3\ Ba^{2+}(aq) + 6OH^-\ (aq) + 2\ H_3PO_4\ (s) \rightarrow Ba_3(PO_4)_2(s) + 6\ H_2O\ (l)$
Two colourless solutions react to form a white ppt in a colourless solution.

(9 marks)

2. a) i) $NH_3\ (g) + H_2O\ (l) \leftrightarrow NH_4^+\ (aq) + OH^-\ (aq)$
Ammonia gas reacts with water to produce hydroxide ions.

(2)

ii) $NH_4Cl\ (s) \rightarrow NH_4^+\ (aq) + Cl^-\ (aq)$ - optional

$NH_4^+\ (aq) + H_2O\ (l) \leftrightarrow NH_3\ (aq) + H_3O^+\ (aq)$
The hydrolysis of the ammonium ion produces an acid.

Cl^- (aq) + H_2O (l) ↔ n.r. - optional

(2)

b) H_3O^+ (l)/ H_2O (aq) – forward reaction or
NH_4^+ (aq)/ NH_3 (aq) - reverse reaction (1)

(5 marks)

3. a) i) Two basic oxides Na_2O, MgO (1)

ii) Two acidic oxides SO_2, P_2O_5 (1)

b) Na_2O (aq) + H_2O (l) ↔ 2 NaOH (aq)

OR

SO_2 + H_2O (l) ↔ H_2SO_3 (aq) (2)

(4 marks)

4. a) c_1V_1 = c_2V_2
0.2 x 0.1 = 0.05 x V
V = 0.4 L

Added volume = 300 mL (2)

b) CH_3COOH + NaOH → $NaCH_3COO$ + H_2O

n = cV = 0.15 x 0.02 = 0.003 mol of CH_3COOH = NaOH

V = n/c = 0.003/0.05 = 0.0600 L (2)

c) 8-10 (1)

(5 marks)

5.

	Titrations of HCl		
	1	2	3
Final Reading (mL)	15.90	31.75	47.65
Initial Reading (mL)	0.00	15.90	31.75
Titre (mL)	15.90	15.85	15.90

AVERAGE = 15.88 mL (1)

a) $HCl + NaOH \rightarrow NaCl + H_2O$

$n = cV = 1.05 \times 0.01588 = 0.0167$ mol HCl = NaOH in 50 mL

$c = n/V = 0.017/0.05 =$ 0.334 mol L^{-1} (3)

b) $H_3X + 3\,NaOH \rightarrow Na_3X + 3\,H_2O$

Starting NaOH: $n = cV = 0.5 \times 0.05 = 0.025$ mol
Finishing NaOH: $n = cV = 0.5 \times 0.05 = 0.0167$ mol
Reacting with citric acid = 0.025 – 0.0167 = 0.00832 mol

Moles of citric acid in lemon juice = 0.00832/3 = 0.002774 moles.
Mass of citric acid in lemon juice = $n \times M = 0.002774 \times 192.12 = 0.533$ g

% = 0.533/8 x 100 = 6.66% (7)

(11 marks)