ST MARY'S ANGLICAN GIRLS' SCHOOL

YEAR 12 CHEMISTRY *IN-CLASS ASSIGNMENT 4 (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*

PART A */ 10*	
PART B */ 33*	
TOTAL */ 43*	

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) Aluminium metal is added to a solution of cobalt nitrate.

Equation

Observation

b) Zinc metal is added to concentrated nitric acid solution.

Equation

Observation

c) Black manganese (II) oxide powder is added to hydrogen peroxide solution.

Equation

Observation

(9 marks)

*2. A student, while preparing for her TEE Chemistry Examination, studies the table of Standard Reduction Potentials provided in your data sheet. In her notes, she lists the **halogens** in order of oxidising strength. This is her list:*

fluorine
bromine
chlorine
iodine

decreasing oxidising strength ↓

a) *What is the correct order for the halogens?*

b) *Show by equation, chlorine acting as an oxidising agent with a metal.*

c) ***Halide*** *ions can act as reducing agents. List the halide ions in order of* ***decreasing*** *strength as reducing agents.*

d) *Show by equation, a halide ion acting as a reducing agent with a metal ion.*

e) *If excess fluorine gas was bubbled through a solution containing a mixture of chloride, bromide and iodide ions, what effect would this have? Equations and observations are not necessary.*

(8 marks)

3. *One method of analysing the manganese content of steel is to dissolve the steel in nitric acid; producing a solution of manganese (II) ions, $Mn^{2+}(aq)$. The $Mn^{2+}(aq)$ ions are then treated with an excess of acidified solution of periodate ions, $IO_4^-(aq)$. The products of this reaction are iodate ions, $IO_3^-(aq)$, and the deeply purple-coloured permanganate ions, $MnO_4^-(aq)$. The concentration of $MnO_4^-(aq)$ is then determined by titration.*

a) Calculate the oxidation number of iodine in the $IO_4^-(aq)$ ion. _____

b) Write the half equation for the conversion of $IO_4^-(aq)$ ion into $IO_3^-(aq)$ in acid solution.

c) Write the half equation for the conversion of $Mn^{2+}(aq)$ ion into MnO_4^-.

d) Combine these half equations to produce the overall equation.

(6 marks)

4. *An experiment was carried out to determine the percentage of manganese in a particular sample of steel by the above method. A 13.936 g sample of steel was dissolved in acid and the manganese was converted to $MnO_4^-(aq)$ ions. The solution containing the $MnO_4^-(aq)$ ions was filtered and made up to a volume of 1.00 L.*

19.55 g of iron (II) ammonium sulfate $\{(NH_4)_2Fe(SO_4)_2.6H_2O\}$ were dissolved in distilled water to make 500.0 mL of solution. Three 20.0 mL samples of this solution, were acidified with sulfuric acid, titrated and required 24.02, 23.96 and 24.01 mL the permanganate solution for complete reaction.

a) Use the unbalanced half equations below to write the equation used in the titration.

$$Fe^{2+} \rightarrow Fe^{3+}$$

$$MnO_4^- \rightarrow Mn^{2+}$$

(2 marks)

b) From the mass and volume, determine the concentration of the iron (II) ammonium sulfate solution.

(2 marks)

c) Use the titration to determine the concentration of the permanganate solution.

(3 marks)

d) *Calculate the mass of **manganese** in the steel sample. The moles of permanganate will be equal to the moles of manganese in the steel.*

(2 marks)

e) *Calculate the percentage, by mass, of **manganese** in the steel sample.*

(1 mark)

NAME: _____

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

1. *The oxidation number of chlorine in $KClO_4$ is:*

   a) –3

   b) +7

   c) -7

   d) +3

2. *For the reaction below, the oxidation number of the nitrogen changes from:*

$$NO_2 + H_2O \rightarrow e^- + NO_3^- + 2H^+$$

   a) 0 to +1

   b) 0 to –1

   c) +2 to –3

   d) +4 to +5

3. *Which one of the following is NOT a redox reaction?*

   a) $2NO + O_2 \rightarrow 2NO_2$

   b) $K_2O + H_2O \rightarrow 2KOH$

   c) $2CO + O_2 \rightarrow 2CO_2$

   d) $C_2H_4 + H_2 \rightarrow C_2H_6$

4. *Which one of the following pairs of reactants could NOT be used to produce hydrogen gas in the laboratory?*

   a) Tin and dilute hydrochloric acid.

   b) Copper and dilute sulfuric acid.

   c) Zinc and dilute hydrochloric acid.

   d) Iron and dilute sulfuric acid.

5. *A redox reaction involves*

   a) a transfer of electrons from the oxidizing agent to the reducing agent.

   b) a transfer of electrons from the reducing agent to the oxidizing agent.

   c) either a reduction or an oxidation.

   d) a transfer of a proton between two chemical agents.

Use the following information for question 6 to 8.

Four metallic elements A, B, C and D form soluble nitrates having formulae: ANO_3, $B(NO_3)_2$, CNO_3 and $D(NO_3)_3$.

When pieces of each of the four metals were placed in 0.10 mol L^{-1} aqueous solutions of the other metal nitrates the following reactions occur:

I Metal B reacted with all solutions.
II Metal A only reacted with CNO_3.

6. Metal D could react with:
   a) ANO_3 and CNO_3 only.
   b) $B(NO_3)_2$ and CNO_3 only.
   c) ANO_3 and $B(NO_3)_2$ only.
   d) ANO_3, $B(NO_3)_2$ and CNO_3.

7. In order of increasing strength of the metals as reducing agents is:
   a) C, A, D, B.
   b) B, C, D, A.
   c) A, D, C, B.
   d) B, D, A, C.

8. Which of the following ions is the weakest oxidizing agent?
   a) A^+
   b) B^{2+}
   c) C^+
   d) D^{3+}

9. The tarnish on silverware, Ag_2S, can be removed by placing the articles in an aluminium pan and covering them with a warm solution of sodium carbonate. The following half-reactions show why this method is effective.

$$Ag_2S(s) + 2e^- \rightarrow 2Ag(s) + S^{2-}(aq)$$
$$Al(s) + 3OH(aq) \rightarrow Al(OH)_3(s) + 3e^-$$

Which of the following equation represents a balanced IONIC equation for the reaction that occurs?

   a) $3Ag_2S(s) + 2Al(s) + 6OH(aq) \rightarrow 6Ag(s) + 3S^{2-}(aq) + 2Al(OH)_3(s)$
   b) $Ag_2S(s) + Al(s) + 3OH(aq) \rightarrow 2Ag+(aq) + S^{2-}(aq) + Al(OH)_3(s) + e^-$
   c) $Ag_2S(s) + Al(OH)_3(s) \rightarrow 2Ag+(aq) + S^{2-}(aq) + Al(s) + 3OH(aq)$
   d) $Al(s) + 3OH(aq) + 2Ag(s) + S^{2-}(aq) \rightarrow Ag_2S(s) + Al(OH)_3(s) + 3e^-$

10. Which of the following reactions represent disproportionation (self oxidation – reduction)?

I $2CrO_4^{2-}(aq) + H^+(aq) \rightarrow Cr_2O_7^{2-}(aq) + OH(aq)$

II $3I_2(s) + 6OH(aq) \rightarrow 5I^-(aq) + IO_3^-(aq) + 3H_2O(l)$

III $Zn(s) + 2H^+(aq) \rightarrow Zn^{2+}(aq) + H_2(g)$

IV $2Cu^+(aq) \rightarrow Cu(s) + Cu^{2+}(aq)$

   a) I only
   b) II and IV only

c) *III only*

d) *IV only*

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

PART B

1. a) $2\,Al + 3\,Co^{2+} \rightarrow 2\,Al^{3+} + 3\,Co$

A silver solid is added to a pink solution to form a silver solid and a colourless solution.

b) $Zn + 4\,H^{+} + 2\,NO_3^{-} \rightarrow Zn^{2+} + 2\,NO_2 + 2\,H_2O$

A silver solid is added to a colourless solution to form a brown, pungent gas and a colourless solution.

c) $2\,H_2O_2 \xrightarrow{MnO_2} 2\,H_2O + O_2$

A black solid is added to a colourless solution to form a colourless, odourless gas and a colourless solution.

(9 marks)

2. a) **fluorine**
chlorine decreasing
bromine oxidising
iodine strength ↓ [1]

b) $2\,Na + Cl_2 \rightarrow 2\,NaCl$ [2]

c) **iodide**
bromide decreasing
chloride reducing
fluoride strength ↓ [1]

d) $Ag^+ + e^- \rightarrow Ag$
$2\ I^- \rightarrow I_2 + 2\ e^-$
$2Ag^+ + 2\ I^- \rightarrow I_2 + 2Ag$ [2]

e) Fluorine would oxidise all the other ions. [1]
Fluorine would be reduced to F^- ions. [1]

(8 marks)

3. a) +7 [1]

b) $IO_4^- + 2\ H^+ + 2e^- \rightarrow IO_3^- + H_2O$ [2]

c) $Mn^{2+} + 4\ H_2O \rightarrow MnO_4^- + 8\ H^+ + 5\ e^-$ [1]

d) $5\ IO_4^- + 2\ Mn^{2+} + 3\ H_2O \rightarrow 2\ MnO_4^- + 6\ H^+ + 5\ IO_3^-$ [2]

(6 marks)

4. a) $5\ Fe^{2+} \rightarrow 5\ Fe^{3+} + 5\ e^-$

$MnO_4^- + 8\ H^+ + 5\ e^- \rightarrow Mn^{2+} + 4\ H_2O$

$MnO_4^- + 8\ H^+ + 5\ Fe^{2+} \rightarrow Mn^{2+} + 4\ H_2O + 5\ Fe^{3+}$

(2 marks)

b) $n = m/M = 19.55/392.15 = 0.04985$
$c = n/V = 0.04985/0.5 =$ $0.0997\ mol L^{-1}$

(2 marks)

c) Av titre = 23.99 mL
$n(Fe^{2+}) = c \times V = 0.0997 \times 0.02 = 0.001994$
$n(MnO_4^-) = 1/5 \times 0.001994 = 0.000399\ mol$
$c = n/V = 0.000399/0.02399 =$ $0.0166\ mol L^{-1}$

(3 marks)

d) $n(MnO_4^-) = c \times V = 0.0166 \times 1 = 0.0166 = n(Mn)$
$m = n \times M = 0.0166 \times 54.94 =$ $0.913\ g$

(2 marks)

e) $\%\ Mn = 0.913/13.936 \times 100 =$ $6.55\ \%$

(1 mark)