This is a Class 1 exam

Lebanon Evangelical School for Boys and Girls

Lebanon Evangelical School

for Boys and Girls — Loueizeh - Baabda

Stage Exam 04

27MAR2023

Do NOT write in this box. Your MARK will be placed here.

Subject :	Chemistry	
Class :	11S	
Teacher :	Mrs. Mirella Chamoun	
Duration :	1 hour	
Your name :		*Time taken to complete exam*
Your Class :		
Exam Room :		
How many sheets, including cover sheet :		

- Do not open this paper until the teacher in charge instructs you to do so.
- The most important thing to remember in taking an exam is NEVER PANIC.
- If you are caught cheating in this exam, you will be awarded zero for ALL exams that are taken on this day.

Exercise I (7 points) **Preparation and Dosage of an anti-moss solution**

Given: Redox couples: MnO_4^-/Mn^{2+} and Fe^{3+}/Fe^{2+}; Molar masses in g/mol: Fe=56; S=32; 0=16; H=1.

Lawns invaded by moss are treated with an anti-moss product containing essentially hydrated iron II sulfate $FeSO_4,7H_2O$.

1. Preparation of the anti-moss solution (S):

To prepare the anti-moss solution, a mass m in grams of hydrated iron II sulfate is dissolved in 100 mL of water.

1.1.List the materials needed for this preparation.
1.2.Write the dissociation equation of hydrated iron II sulfate $FeSO_4$, $7H_2O$ in water.

2. Dosage of solution (S):

In an erlenmeyer flask, pour 50 mL of solution (S) and add 2 mL of concentrated sulfuric acid. Then, the solution (S) is titrated with a potassium permanganate solution ($K^+ + MnO_4^-$) of molar concentration $C_1 = 5\times10^{-2}$ mol/L. The light pink color of the mixture in the erlenmeyer flask persists after pouring 13.8 mL of the titrant solution.

2.1. Draw the annotated diagram of the setup.

2.2. Write the half-equations of the oxidation and reduction reactions involved, then deduce the balanced equation of the titration reaction.

2.3. What does the persistence of the light pink color, in the erlenmeyer flask, indicate?

2.4. Calculate the titrated number of moles of Fe^{2+} ions.

2.5. Deduce the mass m.

Exercise II (8 points) **Dosage of ascorbic acid in a vitamin C tablet**

Given: Redox couples: I_2/I^-; $S_4O_6^{2-}/S_2O_3^{2-}$; Molar mass of $C_6H_8O_6$ = 176 g/mol.

Vitamin C, or ascorbic acid with the formula $C_6H_8O_6$, is sold in pharmacies in the form of chewable tablets.

The aim of this exercise is to find the mass m of vitamin C contained in a tablet.

1. Oxidation of vitamin C by iodine:

Carefully grind a vitamin C tablet and dissolve the resulting powder in 100 mL of distilled water to obtain solution (S).

An excess of iodine I_2, in an acidic medium, is added to 10 mL of solution (S); i.e. a volume of 10 mL of iodine solution of molar concentration 5×10^{-2} mol/L.

The equation of the reaction that took place is as follows:

$$C_6H_8O_6 + I_2 \longrightarrow 2H^+ + 2I^- + C_6H_6O_6$$

1.1.Write the two electron half-equations corresponding to the reaction equation already mentioned.

1.2. List the chemical species present in the solution obtained at the end of the reaction.

2. Dosage of excess iodine:

The solution obtained, at the end of the reaction carried out in part 1, is titrated with a solution of sodium thiosulfate ($2Na^+ + S_2O_3^{2-}$) of molar concentration $C=5\times10^{-2}$ mol/L. The equivalence of the reaction between the excess iodine and the sodium thiosulfate solution is reached when a volume of 8.7 mL of sodium thiosulfate solution is added.

2.1.Write the equation of this titration reaction.

2.2.How can the equivalence be detected?

2.3.Determine the number of moles of iodine titrated by the sodium thiosulfate solution.

2.4.Deduce the number of moles of iodine that reacted in the reaction carried out in part 1.

2.5.Calculate the mass m of vitamin C contained in a tablet.

SE04/20222023/Chemistry

Exercise I

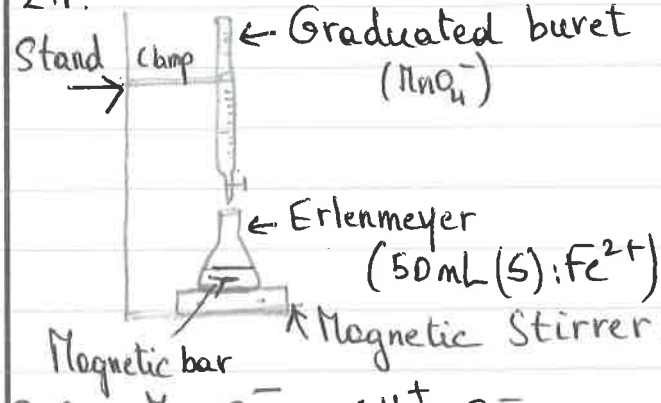
1. Preparation of the anti-mass solution (S):

1.1. Materials needed: Spatula
Balance
Watch Glass
Funnel
Volumetric Flask 100mL.
Distilled water (1½)

1.2 $FeSO_4.7H_2O_{(s)} \longrightarrow Fe^{2+}_{(aq)} + SO_{4(aq)}^{2-} + 7H_2O$. (1)

2. Dosage of solution (S):

2.1.



(1)

2.2. $MnO_4^- + 8H^+ + 5e^- \longrightarrow Mn^{2+} + 4H_2O$. (1/4)

$(Fe^{2+} \longrightarrow Fe^{3+} + 1e^-.) \times 5$ (1/4)

Overall Equation: $MnO_4^- + 5Fe^{2+} + 8H^+ \longrightarrow Mn^{2+} + 4H_2O + 5Fe^{3+}$ (1/4)

2.3. The persistence of the light pink indicates the equivalence point. (1/2)

2.4. At equivalence point, the reactants react according to the stoichiometry: (1/4)

(1/4) $\frac{n_{MnO_4^-} \text{ added at (E)}}{1} = \frac{n_{Fe^{2+}} \text{ (Titrated)}}{5}$

$n_{Fe^{2+}} = 5 \times n_{MnO_4^-}$ added at equiv.

$= 5 \times 5 \times 10^{-2} \times 13.8 \times 10^{-3} = 345 \times 10^{-5}$ mol. (1/2)

2.5. $m_{FeSO_4 \cdot 7H_2O} = n \times M(FeSO_4 \cdot 7H_2O)$

$= 345 \times 10^{-5} \times [56 + 32 + (4 \times 16) + 7(18)]$

$= 345 \times 10^{-5} \times 278$

$= 0.9591$ g. $(1\frac{1}{4})$

Exercise II

1 Oxidation of vitamin C by iodine:

1.1. $C_6H_8O_6 \longrightarrow C_6H_6O_6 + 2H^+ + 2\bar{e}$. (3/4)

$I_2 + 2\bar{e} \longrightarrow 2I^-$ (3/4)

1.2. At the end of the reaction, the species present in the solution are: $C_6H_6O_6$, H^+, I^- and excess of I_2. (1)

2. Dosage of excess Iodine:

2.1. $I_2 + 2\bar{e} \longrightarrow 2I^-$

$2S_2O_3^{2-} \longrightarrow S_4O_6^{2-} + 2\bar{e}$.

$I_2 + 2S_2O_3^{2-} \longrightarrow 2I^- + S_4O_6^{2-}$ (Titration Equation) (1/2)

2.2. Brown $\xrightarrow{\text{Titration}}$ Light yellow + Starch: Blue $\xrightarrow{\text{Titration}}$ Colorless $(1\frac{1}{4})$

2.3. At equivalence, the reactants react according to the stoichio.

$n_{I_2 \text{ to be titrated}} = \frac{n_{S_2O_3^{2-} \text{ added at equiv.}}}{2}$

$= \frac{5 \times 10^{-2} \times 8.7 \times 10^{-3}}{2}$

$n_{I_2 \text{ Titrated}} = 21.75 \times 10^{-5}$ mol. (excess in part 1) $(1\frac{1}{4})$

2.4. $n_{I_2 \text{ reacted in (1)}} = n_{\text{initial}} - n_{I_2 \text{ excess}}$

$= (C_{I_2} \times V_{I_2}) - 21.75 \times 10^{-5}$

$= (5 \times 10^{-2} \times 10 \times 10^{-3}) - 21.75 \times 10^{-5}$

$= 50 \times 10^{-5} - 21.75 \times 10^{-5} = 28.25 \times 10^{-5}$ mol. (1)

2.5. According to the stoichiometry of the reaction in part 1:

$$\frac{n_{C_6H_8O_6\ reacted}}{1} = \frac{n_{I_2\ reacted}}{1} = 28.25 \times 10^{-5}\ mol. \quad (1)$$

$C_6H_8O_6$: Limiting reactant so, Initial $n_{C_6H_8O_6}$ = reacted $n_{C_6H_8O_6}$

28.25×10^{-5} mol Ascorbic Acid $\longrightarrow$ 10 mL

?? $\longleftarrow$ 100 mL.

$n_{C_6H_8O_6}$ in 100 mL $= 28.25 \times 10^{-4}$ mol.

$$m_{C_6H_8O_6} = n \times M = 28.25 \times 10^{-4} \times 176 = 0.4972\ g. \quad (1/2)$$