# Y12 Extended Certificate Task

**Learning Intention:**

- Find the amount of iron in an iron tablet using redox titration

## Objectives

- To calculate the percentage of iron in an iron tablet
- To perform a redox titration involving $Fe^{2+}(aq)$ and $MnO_4^-(aq)$

## Safety

- Use eye protection.
- 1.5 mol $dm^{-3}$ sulfuric acid is an irritant.

## All the maths you need

- Change the subject of an equation.
- Substitute numerical values into algebraic equations using appropriate units for physical quantities.

## Equipment

- 5 iron tablets
- 100 $cm^3$ of 1.5 mol $dm^{-3}$ sulfuric acid
- 100 $cm^3$ of 0.005 mol $dm^{-3}$ potassium manganate(VII)
- distilled/deionised water
- pestle and mortar
- 100 $cm^3$ beaker
- 25 $cm^3$ measuring cylinder
- two 250 $cm^3$ beakers
- 250 $cm^3$ volumetric flask and stopper
- spatula, glass rod and dropping pipette
- filter funnel and filter paper
- 50 $cm^3$ burette and burette stand
- 25 $cm^3$ pipette and pipette filler
- 250 $cm^3$ conical flask
- white tile
- mass balance (2 d.p.) and weighing boat

## Procedure

1. Crush the iron tablets using the pestle and mortar.
2. Transfer the crushed tablets to a weighing boat and measure their combined mass. Record this mass.
3. Empty the crushed tablets into the small beaker and reweigh the weighing boat. Record this mass.
4. Add 100 $cm^3$ 1.5 mol $dm^{-3}$ of sulfuric acid to the small beaker. Stir to dissolve as much of the tablets as possible.
5. Filter the solution (to remove any undissolved solids) into the volumetric flask. Rinse the beaker with more sulfuric acid and add the washings to the volumetric flask. Make up to the mark with distilled/deionised water. Stopper and shake.
6. Pipette 25.0 $cm^3$ of this solution into the conical flask.
7. Titrate the iron(II) solution with potassium manganate(VII) solution until the mixture has *just* turned pink. On standing, the pink colour will disappear because there is a secondary reaction between the $KMnO_4$ and another ingredient in the tablet. *Do not add any more $KMnO_4$.*
8. Record your results in an appropriate format.
9. Repeat the titration until concordant results are obtained.

## Analysis of results

| | Rough | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| **Initial reading/cm³** | | | | | |
| **Final reading/cm³** | | | | | |
| **Titre/cm³** | | | | | |

Use concordant results to calculate the average titre and then answer the questions below to calculate the mass of iron in the tablet.

## Learning tips

- You need two equations:

  $$\text{number of moles} = \text{concentration} \times \frac{\text{volume}}{1000}$$

  $$\text{number of moles} = \frac{\text{mass}}{M_r}$$

- Show all working carefully in a titration calculation and explain what you are doing in each step. That way you can still gain marks in an exam – even if you get the final answer wrong.

## Summer Task – Part 1

1. Combine the two half-equations given below to write the equation for the reaction:

   $Fe^{2+}(aq) \rightarrow Fe^{3+} + e^-$

   $MnO_4^-(aq) + 8H^+(aq) + 5e^- \rightarrow Mn^{2+}(aq) + 4H_2O(l)$
2. Use your average titre to calculate the number of moles of manganate(VII) ions that were used in the titration.
3. Use the equation to calculate the number of moles of iron(II) ions in the 25 $cm^3$ sample of iron(II) sulfate from the iron tablet.
4. Calculate the number of moles of iron(II) ions in the 250 $cm^3$ graduated flask at the start of the experiment.
5. Calculate the mass of iron in the original five iron tablets, and hence the mass of iron in one iron tablet. $M_r$ Fe = 55.8 g $mol^{-1}$
6. Compare your value for the mass of iron with the information from the supplier about the composition of each iron tablet.
7. Make a list of any procedural errors. Suggest ways in which these errors can be avoided.
8. Calculate the percentage measurement uncertainty for the burette.

## Summer Task – Part 2

- Research the effect of iron in the human diet.
  - Supplement
  - Fortified iron in food: better?
  - Which foods are <u>naturally</u> high in iron?
  - What are the effects of too much iron & low iron levels?
  - What factors affect the absorption of iron in the human body?
    - Such as milk and cereal?