Calculations (Day 1):

a.) Balance redox reaction in acidic solution

- Break equation into oxidation half reaction and reduction half reaction
- Balance elements (Note: For acidic solutions, balance oxygen using water and hydrogens using "H^+")
- Balance charge using (e^-)

$$MnO_4^- + C_2O_4^{2-} \rightarrow Mn^{2+} + CO_2$$

Oxidation half-reaction:

$$C_2O_4^{2-} \rightarrow 2CO_2 + 2e^-$$

Reduction half-reaction:

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

- Combine half reactions and multiply the oxidation half reaction by the # of e^- in the reduction half reaction and vice versa

Overall Redox Reaction:

$$5\,C_2O_4^{2-} + 2\,MnO_4^- + 16H^+ \rightarrow 10\,CO_2 + 2\,Mn^{2+} + 8H_2O$$

b.) Equivalent weight = $\frac{184\ g/mol}{\#\ of\ e^-\ lost\ in\ oxidation\ half\ reaction\ (eq/mo}$

molar mass of oxalate

c.) Oxalate equivalence in each sample you titrated

$$\text{oxalate equivalence} = \left(\begin{array}{l}\text{sample mass}\\ \text{of oxalate you}\\ \text{measured}\end{array}\right) \times \left(\frac{1}{\text{answer you got in calc. b}}\right)$$

d.) $eq_{red} = eq_{ox}$

So, oxalate equivalence (calc. c) = permanganate equivalence

e.) Normality of $KMnO_4$ solution

$$= \frac{\text{answer in calculation c}}{\text{volume you used of } KMnO_4 \text{ in titration (L)}}$$

f.) Average normality for the 2 trials

$$Avg = \frac{(\text{Normality 1} + 2)}{2}$$

Calculations (Day 2):

a.) Oxidation half-rxn:

$$Fe^{2+} \rightarrow Fe^{3+} + 1e^-$$

Reduction half-rxn:

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

Overall Redox Reaction:

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

b.) Equivalence of $KMnO_4$ titrated

$$= \left[\text{Avg. Normality (determined on Day 1)}\right] \times \left(\text{Volume titrated with Fe unknown}\right)$$

c.) $Eq_{ox} = eq_{red}$

So, equivalence of $KMnO_4$ titrated = equivalence of Fe unknown

d.) Normality of Fe reducing agent:

$$= \frac{\text{Equivalence (calculated in b)}}{0.025\ \text{L}}$$

↳ volume used of unknown Fe

e.) Molarity of Fe solution:

$$= \frac{\text{Normality of Fe (calculation d)}}{\#\text{ of } e^- \text{ lost in oxidation half-rxn}}$$

f.) Mass concentration of Fe solution:

$$= \left(56\ \text{g/mol}\right)\left(\frac{1\ \text{mg}}{1000\ \text{g}}\right)\left(\text{Molarity of Fe solution}\right)$$

molecular Weight of Fe

changing g → mg

calculation "e"

g.) Average Mass concentration of Fe solution:

$$\text{Avg} = \frac{\text{Mass concentration Trial 1} + 2}{2}$$