Error Propagation in Chemical Calculations

1. Magnetite is a mineral having the formula Fe_3O_4. A 1.1324-g sample of a magnetite ore was dissolved in concentrated HCl to give a solution that contained Fe^{2+} and Fe^{3+} The Fe^{2+} was converted to Fe^{3+} with hot nitric acid. The iron was precipitated as the hydrous Fe_2O_3 with NH_3. The precipitate was converted to 0.5394 g of pure Fe_2O_3 (159.69 g/mol) by ignition. Calculate the percentage Fe in the original sample and estimate the standard deviation of the result. Assume that all masses are ±1 in the last measured digit and that molar masses are ±3 in the least significant digit.

2 Titration of 50.00 mL of 0.5251 M $Na_2C_2O_4$ required 38.71 mL of a potassium permanganate solution. Calculate the molarity of the $KMnO_4$ solution, include the calculated precision.

$$2\ MnO_4^- + 5\ H_2C_2O_4 + 6\ H^+ \rightarrow 2\ Mn^{2+} + 10\ CO_2 + 8\ H_2O$$

According to the NIST standards, the tolerance on the volumetric pipette is ±0.05 mL; the burette, ±0.03 mL. Keep in mind that the burette measurement is the result of two individual measurements each with their own precision. Assume the standard deviation of the concentration of sodium oxalate is ±4 in the last digit (obtained from the propagated standard deviations of the masses, molar masses, and volumes used to prepare the standard).