FINDING ORDERS OF REACTION EXPERIMENTALLY

1. a) You have to be able to mix the hydrogen peroxide solution and the manganese(IV) oxide without any change in volume in the apparatus and without allowing any gas to escape.

    b) Shake the flask so that the weighing bottle falls over, start the timer, and continue shaking to make sure everything is well mixed. Record the time for the collection of some small volume of gas (say 5 cm^3, but it doesn't actually matter as long as you use the same volume for each experiment).

    c) You would need to keep the following the same for each experiment:

    *   the temperature
    *   the volume of the solution
    *   the mass of MnO_2
    *   the state of division of MnO_2 (by using the same source of MnO_2 for each experiment)
    *   the volume of gas collected

    d) $\log(\text{rate}) = \log k \ + \ n \log[H_2O_2]$

    Use 1/t as a measure of rate, and plot log (1/t) against $\log[H_2O_2]$. This will give a straight line. Measure the slope of the line to give you a value of n.

2. a) The reaction is still continuing while the sample is in the pipette, and will go on while you are doing the titration as well if you don't do anything to try to slow it down or stop it altogether. Pouring it into iced water dilutes it, which slows the reaction. It also cools it, and that slows the reaction as well.

    b) There are several problems:

    *   The timing is inaccurate. Even if pouring the reaction mixture into the iced water stopped the reaction completely, it takes time for a pipette to drain. Recording the time when the pipette is half-drained is just a compromise.
    *   The reaction is still going on, although more slowly, while you are doing the titration. The longer it takes to do the titration, the more inaccurate the result.
    *   You only get one attempt at each titration - you can't repeat it for greater accuracy. You are also having to do the titration as fast as possible which lessens the accuracy as well.

    c) The slope of the graph at any point tells you the rate of the reaction for a particular concentration. Draw a number of tangents to the curve at various concentrations, and then measure their slopes. That will give you a table of rates and concentrations. You would then plot a graph of log(rate) against log(concentration), and measure its slope to find a value for the order of reaction.

3. a) You need to choose a filter which absorbs most of the light when the solution is concentrated, and very little when it is very dilute. There is no really simple way of working out which you need, so you just try them all in turn with a solution, in this case of iodine, with a similar concentration to the one you will start with in the real experiment. Choose the one which the meter shows absorbing the most light.

    b) You plot a calibration curve by making up a range of solutions of known concentrations starting with one with a concentration at least as great as the one you will be using in the real experiment, and getting progressively more dilute, in each case recording the meter reading for each concentration.

    Plot a graph of these. You can then use this to convert observed readings from your experiment into actual concentrations of the solution at each time.