Topic 7 – Practical 2

Exponential decay and half-life of water in burette

Safety

Students should wear safety glasses and be careful not to break the glassware.

Apparatus and materials

- burette
- stand and clamp
- beaker (of volume at least equal to the burette capacity)
- water
- stopwatch
- ruler

Introduction

In this practical, you will use a burette to simulate radioactive decay.

If a burette contains water of volume V and water is flowing out of the burette at a rate that depends on the remaining volume of water, i.e. $\frac{dV}{dt}$ = – (constant) × V = $-c \times V$, then it can be shown that:

$$V = V_o\, e^{-ct}$$

where V_o is the initial volume of water in the burette, t is the time since the water started flowing out of the burette and c is a constant. Assuming a constant diameter of the burette, the above relationship can be written as:

$$L = L_o\, e^{-ct}$$

where L_o is the initial length of water in the burette and L the length of water in the burette at time t.

Procedure

1 Set the apparatus as shown in the diagram.

2 Measure the initial length of water in the burette L_o.

3 Turn the stopcock midway and at the same time start the stopwatch.

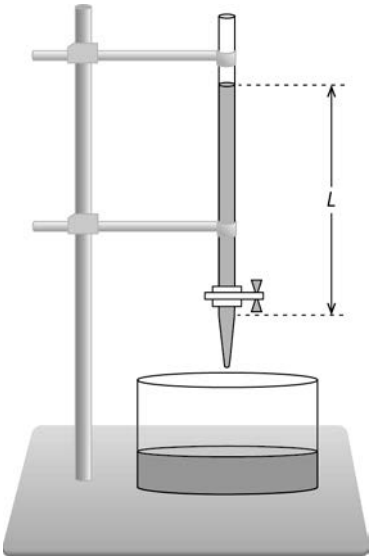
4 Take measurements of the remaining length of water L in the burette at regular intervals, for example every 5 seconds. You need to close the stopcock at these times to allow for a precise measurement of L.

5 Record your measurements in an appropriate table.

6 Repeat the process four more times, taking care to always have the same initial amount of water in the burette.

7 Calculate the average value of L for every value of time and calculate the uncertainty from repeated measurements.

8 Process your data in a way that will allow you to plot a linear graph. You will use this graph to determine the value of the constant c from its gradient.



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9 Determine the gradient uncertainty and use it to calculate the uncertainty of the experimental value of *c*.

10 Use your graph to determine the half-life of water in the burette.

Questions

1 If you plotted the volume of the water in the container below the burette, what would the shape of the graph be?

2 What is the name for this type of curve?

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