Unit E – 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. $\frac{dV}{dt} = -\,(\text{constant}) \times V = -c \times V$, then it can be shown that:

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

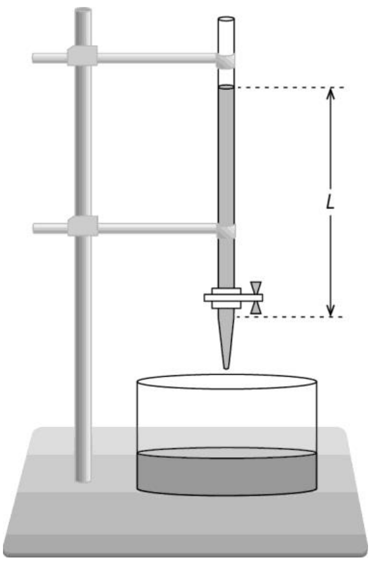
where V_o is the initial volume of water in the burette, t is the time since the water started flowing out of the burette and c is a constant. Assuming a constant diameter of the burette, the above relationship can be written as:

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

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.

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?

