**3AN**

# Comparing Radio-active Decay with other Random processes

1. **Preparation:**
   a) Learn the definition of the half-life of a radio-active substance.
   b) Revise the properties of exponential relationships.
   c) See below.

2. Experiments show that radio-active decay is a random process. There appears to be no way of predicting when a particular nucleus will give out its radiation. However, useful predictions can be made if we have large numbers of unstable nuclei. This is, in practice, always the case. Consider for example the radio-active substance radium D. This substance (which is an isotope of lead) has mass number 210. This means that 1 mol of it has a mass of about 210 g. Even if we only had 1milli-gram of radium D, we would have about

$$N_A \times (1 \times 10^{-3}/210) \text{ or } 2{\cdot}87 \times 10^{18} \text{ nuclei !}$$

3. In this experiment, rather than observing the behaviour of a radio-active substance you will observe another process which exhibits random behaviour.
   You will be provided with 100 small cubes (assumed to be identical) each having one side marked with an X. Throw the cubes onto a horizontal surface and see how many have landed with the “X” side up. Each cube represents a nucleus of a radio-active substance. Consider those which land with the “X” side up to be nuclei *which have decayed and become stable*. (How many would you expect to have the X upwards ?) Separate these “decayed nuclei” from the others. Collect the “undecayed nuclei” and throw again... and again... etc.
   Stop when you have about 10 left. Then repeat the whole process as many times as you can making sure that you have the same number of throws in each set of results.

4. **Results**
   Record the number of cubes removed after each throw and then calculate the number N, of cubes **remaining** after each throw.

Plot a graph of N against “number of throw”. Plot the graph with “number of throw” on the horizontal axis as this is equivalent to time in the case of a radio-active decay process.

5. Analysis

To find out if your graph is exponential, measure the “half-life” of the thrown cubes. Take at least three values of the half-life from your graph.

Write a brief conclusion explaining why we can expect radio-active decay to be, in some ways, similar to the throwing of the cubes.