Unit E – Practical 1

Exponential decay and half-life of dice

Safety

There are no safety issues concerning this experiment.

Apparatus and materials

- 100 dice
- cup or container (large enough for 100 dice)
- lab tray

Introduction

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

When a number of dice are cast, the decrease in the number of dice that remain after the ones that landed with a specific side up are removed is analogous to the decrease in the number of undecayed nuclei of a radioactive substance.

Procedure

1 Place 100 dice into the cup and throw them carefully into the lab tray.
2 Remove the dice that have landed with the '1' side up and count them. Collect the remaining dice and put them back into the cup.
3 Repeat these steps until you have five dice left.
4 Repeat the process four more times.
5 Each throw represents a time measurement and the total number dice that landed with the '1' side up represents the 'decayed' dice. For each 'time' calculate the average total number of decayed dice and then the average number of undecayed dice. Record your measurements and calculations in a suitable table.
6 Plot a graph of undecayed dice against time.
7 Use this graph to calculate the half-life of dice. The unit of this half-life value will be number of throws.
8 Process your data in order to plot a linear graph. Plot this graph and determine its gradient.
9 The gradient should be a negative number. Calculate the decay constant λ as $\lambda = -$ gradient.

Questions

1 What is the theoretical relationship between half-life and decay constant? Do your calculations agree with this relationship?

2 Would the results be better if more initial dice were used or more repetitions were performed?