**Measuring diffusion coefficient**

from Dr. Socolofsky’s EFM problem dictionary

A chemist is trying to calculate the diffusion coefficient for a new chemical. In the experiment, this chemist measured the concentration as a function of time at a point 5 cm away from a point source diffusing in three dimensions. We want to find out how concentration would change over time, i.e., find an equation to describe their relationship. Typically, we would like to see a linear relationship (*y* = *ax* + *b*) so that we can do linear regression. This can be done by doing coordinate transformation (i.e., *x* and *y* should be transformed from your measurement variables).

Table 1: Measured concentration and time for a point source diffusing in three dimensions.

|  |  |
| --- | --- |
| Time (days) | Concentration (µg/cm3 ± 0.03) |
| 0.5 | 0.02 |
| 1.0 | 0.50 |
| 1.5 | 2.08 |
| 2.0 | 3.66 |
| 2.5 | 4.81 |
| 3.0 | 5.50 |
| 3.5 | 5.80 |
| 4.0 | 5.91 |
| 4.5 | 5.81 |
| 5.0 | 5.70 |
| 5.5 | 5.54 |
| 6.0 | 5.28 |
| 6.5 | 5.05 |
| 7.0 | 4.87 |
| 7.5 | 4.65 |
| 8.0 | 4.40 |
| 8.5 | 4.24 |
| 9.0 | 4.00 |
| 9.5 | 3.84 |
| 10.0 | 3.66 |

Determine a set of coordinates using coordinate transformation such that, when plotting the data in Table 1, *D* is the slop of a best-fit line through the data. Determine the value of *D* from this data.

Based on this coordinate transformation, what is more important to measure precisely, concentration or time? What recommendation would you give to this chemist to improve accuracy of the estimate for the diffusion coefficient?