Significant Figures and Numerical Methods

These accuracies were worked out by solving the ODEs in MATLAB for a single diffusion time step of 60 s. After 60 s the ODEs get 'new' initial conditions (due to the addition/subtraction of molecules by diffusion) thus the diffusion time scale is the one that must be examined

Forward Euler $(O(\Delta t))$

As a general rule the order of the error (represented as O) is of Δt . This means that in order to reduce the error by an order of magnitude the time step must be reduced by an order of magnitude.

```
\Delta t = 0.03 \text{ s} \quad ABS\_TOL = 1e3

\Delta t = 0.003 \text{ s} \quad ABS\_TOL = 1e4

\Delta t = 0.0003 \text{ s} \quad ABS\_TOL = 1e5

\Delta t = 0.00003 \text{ s} \quad ABS\_TOL = 1e6
```

Runge-Kutta 4th Order

As a general rule the order of the error (represented as O) is of Δt^4 . This means that in order to reduce the error by an order of magnitude the time step must be reduced by $\Delta t^{1/4}$

```
\Delta t = 12 \text{ s} ABS_TOL = 1e3

\Delta t = 6 \text{ s} ABS_TOL = 1e5

\Delta t = 3 \text{ s} ABS_TOL = 1e6
```