Mixing of Diffusing Particles ELI BEN-NAIM, Los Alamos National Laboratory — We study how the order of $N$ independent random walks in one dimension evolves with time. Our focus is statistical properties of the inversion number $m$, defined as the number of pairs that are out of sort with respect to the initial configuration. In the steady-state, the distribution of the inversion number is Gaussian with the average $\langle m \rangle \simeq N^2/4$ and the standard deviation $\sigma \simeq N^{3/2}/6$. The survival probability, $S_m(t)$, which measures the likelihood that the inversion number remains below $m$ until time $t$, decays algebraically in the long-time limit, $S_m \sim t^{-\beta_m}$. Interestingly, there is a spectrum of $N(N-1)/2$ distinct exponents $\beta_m(N)$. We also find that the kinetics of first passage in a circular cone provides a good approximation for these exponents. When $N$ is large, the first-passage exponents are a universal function of a single scaling variable, $\beta_m(N) \to \beta(z)$ with $z = (m - \langle m \rangle)/\sigma$. In the cone approximation, the scaling function is a root of a transcendental equation involving the parabolic cylinder equation, $D_{2\beta}(-z) = 0$, and surprisingly, numerical simulations show this prediction to be exact.