Stokes solution (1851) Consider a sphere of radius a, which at time t is located at the origin, $\boldsymbol{X}(t) = \boldsymbol{0}$, and moves at velocity $\boldsymbol{U}(t)$. The corresponding solution of the Stokes equation with standard boundary conditions (5.13) reads[7]

$$u_i(t,\boldsymbol{x}) = U_j \left[\frac{3}{4}\frac{a}{|\boldsymbol{x}|}\left(\delta_{ji} + \frac{x_j x_i}{|\boldsymbol{x}|^2}\right) + \frac{1}{4}\frac{a^3}{|\boldsymbol{x}|^3}\left(\delta_{ji} - 3\frac{x_j x_i}{|\boldsymbol{x}|^2}\right)\right], \tag{5.18a}$$

$$p(t,\boldsymbol{x}) = \frac{3}{2}\mu a \frac{U_j x_j}{|\boldsymbol{x}|^3} + p_\infty. \tag{5.18b}$$

If the particle is located at $\boldsymbol{X}(t)$, one has to replace x_i by $x_i - X_i(t)$ on the rhs. of Eqs. (5.18). Parameterizing the surface of the sphere by

$$\boldsymbol{a} = a\sin\theta\,\cos\phi\,\boldsymbol{e}_x + a\sin\theta\,\sin\phi\,\boldsymbol{e}_y + a\cos\theta\,\boldsymbol{e}_z = a_i\boldsymbol{e}_i$$