Hydrodyamic Radius, R_H:

In addition to the analytic size of a linear (C=1) chain, the end to end distance, R_{eted} or R_0, and the structural size, the radius or gyration, R_g, dynamic measurements yield a size called the hydrodynamic radius, R_H.

Consider a rod particle of length L=10R where R is the radius. The end-to-end distance of this rod is L. The radius of gyration is $(L^2/12 + R^2/2)^{1/2} = L/3.36$. Since there is essentially no transport of a rod in the lateral direction the hydrodynamic radius is almost completely related to the radius of the rod, $R_H^3 = (3LR^2)/4$, so $R_H = L/5.11$, http://faculty.washington.edu/varani/chem-453-website/Lecture453_7.pdf.

A description of the hydrydynamic radius can also be found at
http://www.protein-solutions.com/psi_books/light_scattering/dynamic/what_is_the_hydrodynamic_radius_rh_.htm

The hydrodynamic radius is the radius of an equivalent sphere in terms of the dynamic features of a structure. Generally it pertains to the hydrodynamic drag or friction factor, ξ, associated with a particle, $f = \xi u$, where u is the particle velocity and f is the force applied to the particle. For thermal motion such as Brownian motion f is related to kT. For fractal objects with dimension of 2 or greater it is generally assumed that there is no dynamic penetration internal to the object. For a polymer coil in a solvent this is called the "no-draining assumption" which is the basis of the Kirkwood Reisman theory of polymer dynamics. The coil is then hydrodynamically a sphere and we can use the Stokes-Einstein relationship for the friction factor, $\xi = 6\pi R_H \eta_{solvent}$. For an intrinsic viscosity measurement this yields a relationship between R_H and R_g of $R_H = (7/8)\ R_g$. Dynamic light scattering involves measurement of the flickering of scattered laser light from a polymer solution. It is assumed that the flickering is related to thermal motion of the particles in a solution and the Einstein relationship, $D = kT/(4\pi R_H \eta_{solvent})$, together with an exponential decay in correlations of fluctuations in time, $S(q,t) = K \exp(-2Dq^2t)$, where S(q,t) is the scattered intensity as a function of q and time, t. It is found that for these diffusion measurements $R_H = (2/3)\ R_g$.

We will give further consideration to the hydrodynamic radius when we consider dynamics in a later chapter.