Generalized Circle and Sphere Theorems for Inviscid and Viscous Flows

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The circle and sphere theorems in classical hydrodynamics are generalized to a composite double body. The double body is composed of two overlapping circles/spheres of arbitrary radii intersecting at a vertex angle $\pi/n, n$ an integer. The Kelvin's transformation is used successively to obtain closed form expressions for several flow problems. The problems considered here include two-dimensional and axisymmetric three-dimensional inviscid and show viscous flows. The general results are presented as theorems followed by simple proofs. The two-dimensional results are obtained using complex function theory while the three-dimensional formulas are obtained using Stokes stream function.

The solutions for several flows in the presence of the composite geometry are derived by the use of these theorems. These solutions are in singularity forms and the image singularities are interpreted in each case. In the case of three-dimensional axisymmetric viscous flows, a *Faxen* relation for the force acting on the composite bubble is derived.

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