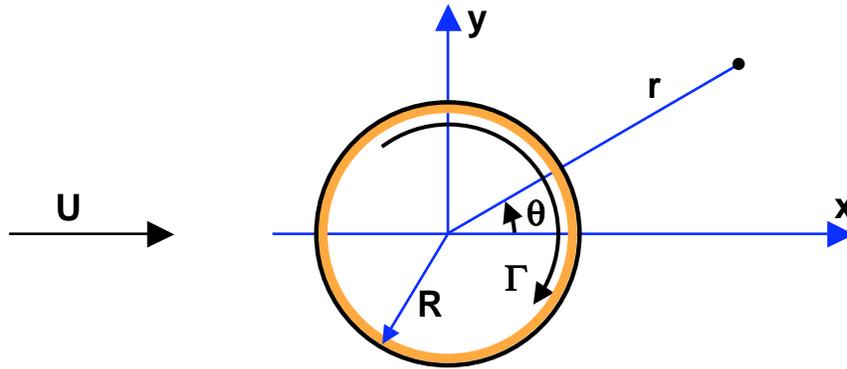


Problem 290A

A planar incompressible potential flow past a spinning cylinder (radius = R) is constructed by superposition of the velocity potentials for (a) a uniform stream, $\phi = Ux$ (b) a doublet, $\phi = UR^2 \cos \theta/r$ at the center of the cylinder and (c) a potential vortex with circulation, Γ , such that $\phi = -\Gamma\theta/2\pi$:



Here the circulation, Γ , is defined as positive in the clockwise direction. That is to say we have used the normal airfoil sign convention. This simulates the flow due to clockwise rotation of the cylinder.

Find the velocity and pressure on the surface of the cylinder as a function of angular position, θ . Find the LIFT on the cylinder by appropriate integration of the pressure over the surface.

[The lift effect produced is called the MAGNUS effect and is readily observed in the flight of golfballs, baseballs, etc.]