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Dynamics of rising and falling cylinders and spheres MATTHEW HOROWITZ, CHARLES H.K. WILLIAMSON, Cornell University — We investigate the dynamics of cylinders and spheres allowed to rise or fall freely through a fluid. In our studies, all falling bodies are found to descend rectilinearly. However, for both rising cylinders and spheres, we show the existence of a critical mass ratio, below which the body suddenly begins to vibrate vigorously. We obtain a critical mass ratio of 0.54 for the cylinder, which agrees closely with the value found for the elastically mounted cylinder experiments of Govardhan and Williamson (2000, 2002; JFM). This surprisingly close agreement is not yet fully understood, as the fluid-structure interactions would appear to be somewhat different. For rising spheres, we find a critical mass of 0.61, near the approximate value for an elastically mounted or tethered sphere (Govardhan and Williamson, 2004, JFM). It is significant, and perhaps coincidental, that the values of the critical mass ratio of cylinders and spheres are relatively close, despite the remarkably different vortex dynamics which cause the vibrations to occur. In the case of the cylinder, the vortices causing vibration are normal to the flow, whereas for the sphere they are streamwise to the flow.

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