

Incompressible Flow Homework 4

1) Consider the temporal instability of a water jet in the absence of gravity. The jet diameter, $2R$, is 1 mm and is flowing at 1 m/s. Based on linear theory:

- a) What is the wavelength of the most unstable mode (in millimeters)?
- b) What is the frequency of this mode (in Hertz)?
- c) Estimate the diameter (and the corresponding volume) of droplets that will be formed through natural modes of instability.
- d) Estimate the time for pinch-off of the jet into droplets if an initial disturbance of 0.001 times the radius is induced.

2) Rayleigh-Bernard convection and Couette flow between rotating cylinders (in the narrow-gap approximation) can be described by similar sets of equations. For the neutral condition ($\sigma = 0$), a single sixth-order ordinary differential equation suffices. Utilizing class notes, write this equation for each flow; include definitions of the two analogous nondimensional parameters which involve the viscosity, and define (briefly) all the dimensional parameters that appear.