Physics 161
Lecture 12, Summ
Hydrodynamics

October 12, 2017

Lecture 12: learning objectives

This lecture

You will be able to state the properties of an ideal fluid.

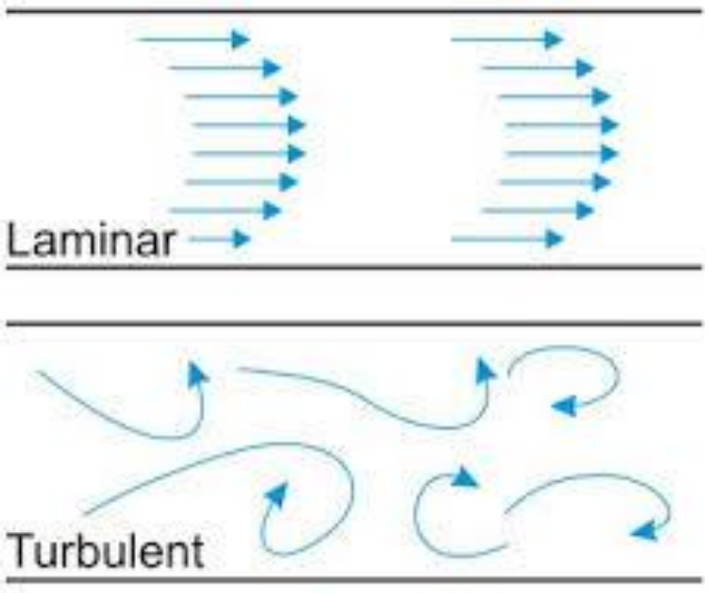
You will be able to apply both Bernoulli's and the continuity equations to ideal fluid systems and explain some common fluid phenomena.

Fluid flows

Flow pattern:
- streamline or laminar (smooth, constant in time)
- turbulent (eddy, time dependent) onset is determined by Reynold's number, $(\rho v L)/\eta$

Viscosity:
- inviscid (no internal friction)
- viscous (internal friction)

Density change:
- incompressible (constant density)
- compressible (variable density)



"Ideal fluid" flow:
Stream line, inviscid, incompressible, steady flow.

Flow equations

Continuity equation:
Rate of flow of fluid into a system equals the rate of flow out of the system.

$$v_1 A_1 = v_2 A_2$$

Bernoulli equation:
The sum of the pressure, the kinetic energy per unit volume, and the potential energy per unit volume, has the same value along a streamline.

$$P + \frac{1}{2}\rho v^2 + \rho g y = \text{constant}$$

Bernoulli and continuity equations

Consequence of continuity equation:
Ideal fluids flow faster in narrow tubes for a given pressure.

Consequence of Bernoulli equation:
Ideal fluids have decreased pressure at faster flow speeds.