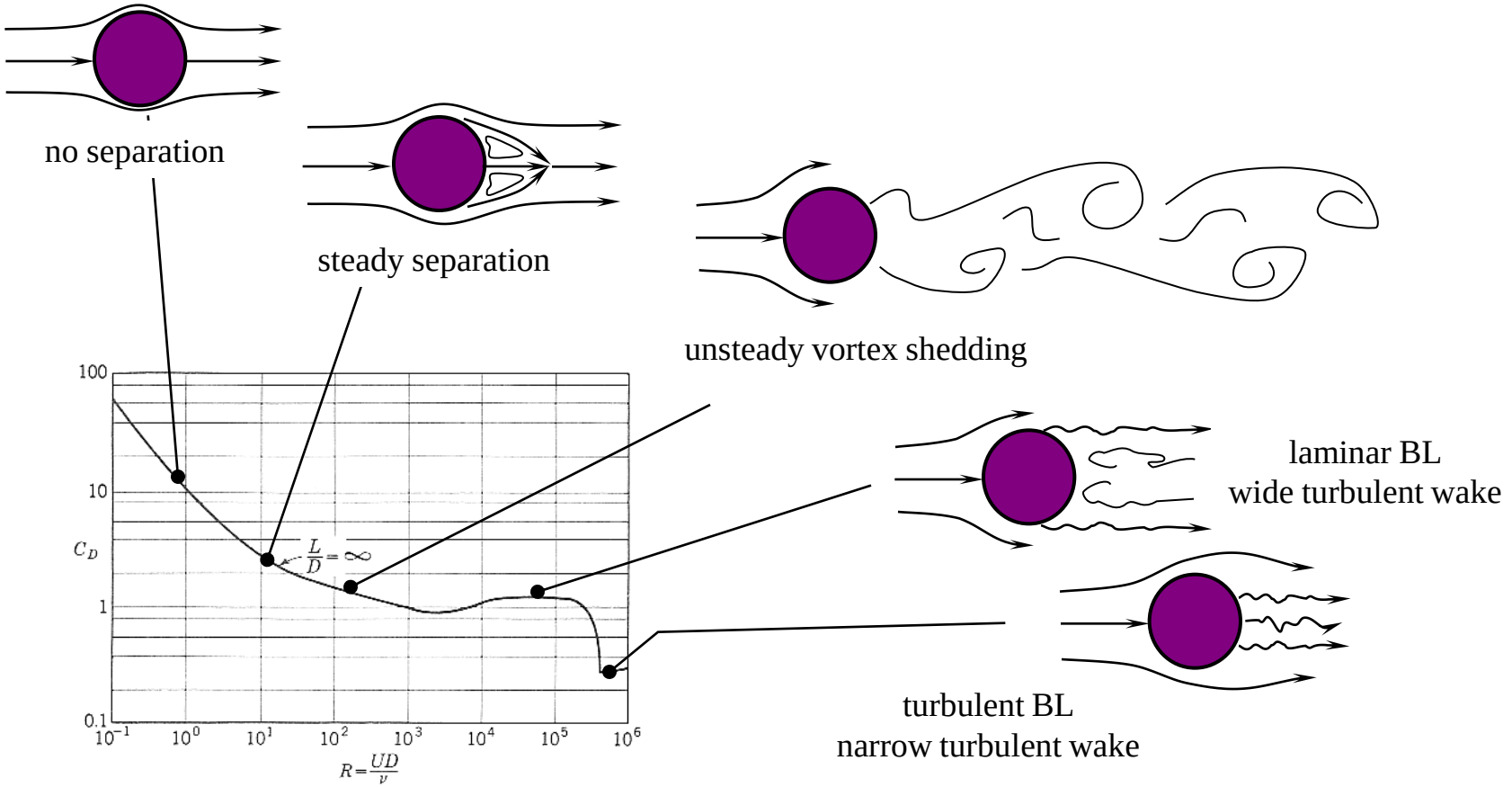
FLUID MECHANICS FOR MECHANICAL ENGINEERING (ME 208F)

Section D:
Boundary Layer Flow - IV

Drag on a smooth circular cylinder

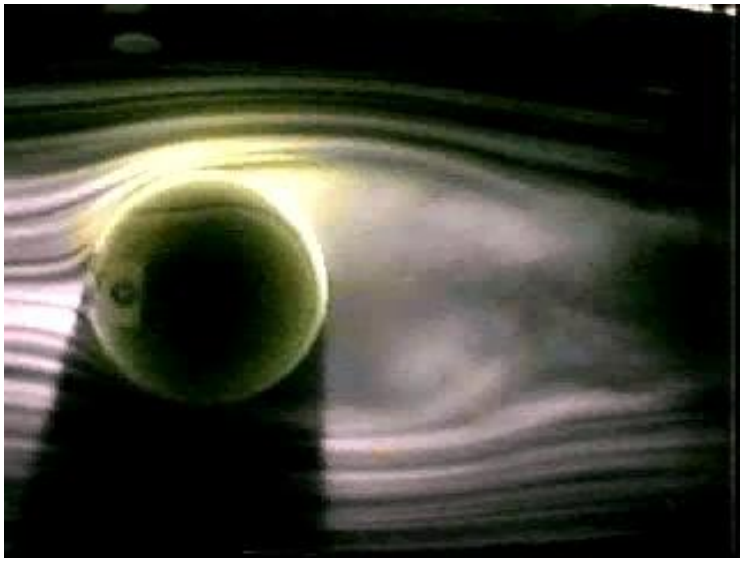
$$F_{drag} = C_D \frac{1}{2} \rho v^2 A_{\perp}$$

- The drag coefficient is defined as follows:



Separation - adverse pressure gradients

- Separation of the boundary layers occurs whenever the flow tries to decelerate quickly, that is whenever the outer pressure gradient is negative, or the pressure gradient is positive, sometimes referred to as an adverse pressure gradient.
- In the case of the tennis ball, the flow initially decelerates on the upstream side of the ball, while the local pressure increases in accord with Bernoulli's equation.
- Near the top of the ball the local external pressure decreases and the flow should accelerate as the potential energy of the pressure field is converted to kinetic energy.



- However, because of viscous losses, not all kinetic energy is recovered and the flow reverses around the separation point.