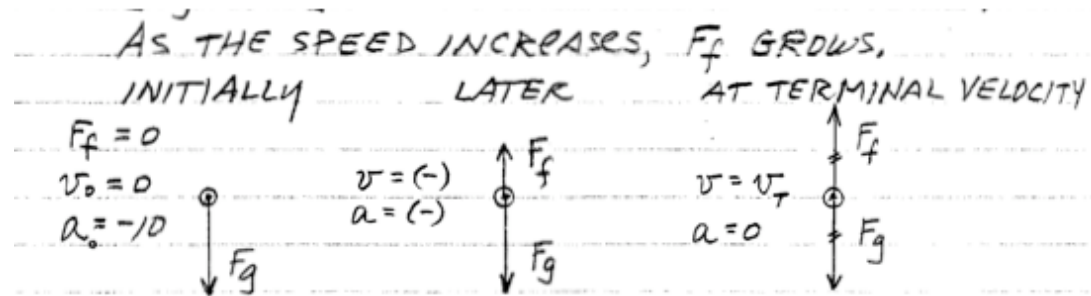


# Velocity Dependent Forces

# Air Friction & Terminal Velocity

- $v_T$  = maximum speed achieved by an object as it falls subject to gravity and upward force of friction.
- After attaining this speed, the object will fall with this speed the rest of the way to the ground.



- **Laminar Flow:** Occurs when the fluid flows smoothly around the object.  $F_f$  grows slowly

$$F_f = \alpha v$$

$F_f$  = friction [N]

$v$  = speed [m/s]

$\alpha$  = coefficient of viscosity [kg/s]



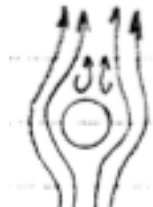
- **Turbulent Flow:** Occurs when whirlpools form in the wake of an object. The friction grows fast.

$$F_f = \beta v^2$$

$F_f$  = friction [N]

$v$  = speed [m/s]

$\beta$  = coefficient of viscosity [kg/m]



- Coefficient of viscosity depends on the stickiness of the fluid, the roughness of the skin of the object, and the surface area of the object.

**Ex1** : Find a formula for the acceleration of an object undergoing laminar flow.

Find a formula for the terminal velocity

**Ex2** : Find a formula for the acceleration of an object undergoing turbulent flow.

Find a formula for the terminal velocity

**Ex3** : A 75 kg Ostrich has air friction whose formula is  $F_f = 4.4 \times 10^{-6} v^7$ . Find its terminal velocity.