Python For Chemical Engineering

Assignment 1:

Name: Arnav Shendurnikar

Roll No: 200929

Aim: To calculate the terminal velocity of a spherical object falling in a fluid

Given:

Mass of the object=m

Viscosity of the fluid= N

Density of fluid=rhol

Density of spherical object= rhos

Radius of the spherical object= r

Calculations:

The drag force on the spherical object,

$$F_d = 6\pi r\eta v$$

The buoyant force on the object,

$$F_b = \rho_l V g$$

The weight of the object,

$$F_g = mg$$

Net force on the spherical object in the downward direction,

$$F_{net=}F_g - F_b - F_d$$

By Newton's law of motion,

$$m\frac{dv}{dt} = (\rho_s - \rho_l)Vg - 6\pi r\eta v$$

$$\frac{dv}{dt} = \frac{(\rho_s - \rho_l)}{\rho_s}g - \frac{9\eta v}{2\rho_s r^2}$$

Algorithm:

1) Assuming a reasonable value of tolerance and dt
2) Taking the initial guess of v(0)=v_prev=0
3) While error > tolerance(we run the following code till error becomes less than tolerance)
   a) We calculate del_v/del_t using following equation,
   $$\frac{dv}{dt} = \frac{(\rho_s - \rho_l)}{\rho_s} g - \frac{9\eta v}{2\rho_s r^2}$$
   b) We calculate v using v_prev and del_v/del_t using following equation,
   $$v(t) = v(t-1) + \frac{dv}{dt} . \triangle t$$
   c) We calculate error by using the following equation,
   $$error = \frac{v(t) - v(t-1)}{v(t)}$$
   d) Update v_prev=v