# Question 1:

Consider the equation of motion of a very light spherical solid particle in the creaping flow regime when the Reynolds number Re >> 1

1. Neglecting Bosinesq–Basset drag force find a solution to the equation of particle motion:

 (1.1)



for two limiting cases:

1. assuming that the density ratio particle to fluid is negligibly small, *r* *p*

*f* 1, and

1. assuming that the particle density is much greater than the fluid density,

(assume that it is a platinum particle with the density 21.45 g/cm3).

*r* *p*

*f* 1

In both case the particle commences its motion from the rest being at the point *z* = 0. For other parameters put *g* = 10 m/s2 (acceleration due to gravity), **= 1 cm2/s (kinematic water viscosity), *a* = 1 mm (particle radius).

**Hint 1:** Convert all dimensional quantities to SI system.

1. Plot your solution for the traversed path *z* (*t*) in mm against time in millisecond (up to 10 msec) and velocity **(*t*) in cm/s in the same time interval.
2. Find the terminal velocity (the asymptotic velocity *t* when *t* ) and the relaxation time *Tr* (the characteristic time required to reach approximately the terminal velocity) for both cases of light and heavy particle.

**Hint 2:** Introduce the particle velocity **= *dz*/*dt* and solve the equation in terms of velocity, then find *z* (t).