Homework 4

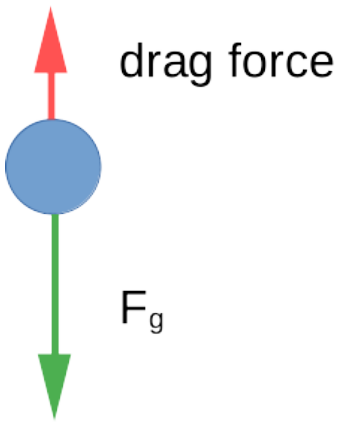
Free fall is a special case of motion with constant acceleration. In most real cases, the acceleration is not constant because the objects do not move through a vacuum.
When an object moves through a fluid, it experiences a force that counteracts its motion and tends to slow it down. The fluid can be a gas (air), a liquid (water) or a solid.

Linear drag force can be written as $F_{drag}=-kv$. Two forces act on a free-falling object. Thus we write:

$$F_g+F_{drag}=ma$$

$$F_g-kv=ma=m\frac{dv}{dt}$$

See lecture notes for velocity, acceleration, and displacement in the case of a linear resisting force.



Task 1
Find the velocity, acceleration and displacement function of an object moving through a fluid and experiencing a *quadratic drag force.*
$F_{drag}=-kv^2$

Draw a graph of (use Matlab):

- velocity *vs* time
- acceleration *vs* time
- displacement *vs* time

for four different masses (m=1, 2, 5, 10).

Task 2
Find at what time falling object reaches 50% of it's terminal velocity.
Find the solution for four different masses (m=1, 2, 5, 10).
Hint-Matlab code:

```
f=@(x) x.^2-10==4;
solve(f, x)

f=@(x) x.^2-10-4==0;
solve(f, x)

f=@(x) x.^2-16==0;
solve(f, x)
```