MATH 1311

Section 6.5

Equilibrium or Steady State Equations:

When an object is dropped from an airplane, there are two opposing forces acting upon the object:

Acceleration due to gravity will cause an object to speed up as it dropped.

Slowing down due to resistance from air molecules.

These will eventually balance out to an steady-state, known as terminal velocity.

Why are we still alive?

Our solar system is based on two opposing forces:

Centripetal force is constantly pushing us out into space (think about when you are driving around a sharp turn).

Gravitational attraction from the sun is constantly pulling us towards the sun.

The balance is that we are in a stable orbit…..or are we?

Equations of Equilibrium:

Equilibrium or Steady State Equations must have a rate of change equal to 0.

For the falling object:

$A = g - rV = 32 - 0.1818V$ [You would be given these values.]

Determine the value of V, assuming that this equation is at equilibrium.

Continuing with the idea of a falling object:

We saw that the value of x placing this equation at equilibrium is 176.018.

We know that our limiting value of the velocity is: 176.018 and our rate of change would be: $e^{(-1/.1818)t.}$ We also know that velocity will begin lower than our limiting value and increase to 176.018.

Find the velocity function of a falling object with air resistance:

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Find the velocity function of a falling object with air resistance:

$v(t) = 176.018 - ke^{(-1/.1818)t}$

Determine the value of k is the initial velocity of the object is 0:

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$k = 176.018$

Making the function:

$v(t) = 176.018 – 176.018e^{(-1/.1818)t} = 176.018(1 - e^{(-1/.1818)t})$

How fast the object reaches terminal velocity will be determined by the atmospheric conditions (temperature, pressure, humidity, etc).

https://www.desmos.com/calculator/vu72gji5dn