Inorder to solve this system of coupled differential equations we need to first reduce it into a system of first order differential equations

$\Rightarrow$ we then proceed as follows:

$\Rightarrow$ we first rewrite the coupled system as follows:

$$\Rightarrow \frac{d^3 f}{dn^3} = -\frac{f}{2}\frac{d^2 f}{dn^2}$$

$$\Rightarrow \frac{\partial^2 g}{\partial \eta^2} = \frac{\sigma}{2}(-f\frac{\partial g}{\partial \eta} + g\frac{\partial f}{\partial \eta} + 2x\frac{\partial f}{\partial \eta}\frac{\partial g}{\partial x})$$

$$\Rightarrow \frac{\partial^2 \Phi}{\partial \eta^2} = \frac{S_c}{2}(-f\frac{\partial \Phi}{\partial \eta} + 2x\frac{\partial f}{\partial \eta}\frac{\partial \Phi}{\partial x})$$

$\Rightarrow$ Let, $x_1 = f, x_2 = f', x_3 = f'', x_4 = f'''$

$\Rightarrow$ differentiating the above wrt η we obtain;

$$\Rightarrow x_1' = x_2, x_2' = x_3, x_3' = x_4$$

$\Rightarrow$ This implies that,

$$x_1' = x_2 - - - (1)$$

$$x_2' = x_3 - - - (2)$$

$$x_3' = -\frac{x_1 x_3}{2} - - - (3)$$

Similarly we let,$x_5 = g, x_6 = \Phi, \Longleftrightarrow x_7 = g', x_8 = \Phi', x_9 = g'', x_{10} = \Phi''$

Differentiating the above wrt η we obtain the following;

$$x_5' = g' = x_7 - - - (4)$$

$$x_6' = \Phi' = x_8 - - - (5)$$

From the boundary conditions we can obtain the values for g and Φ with their derivetives wrt η

Thus ,the last 2 equations simplifies into;

$$x_7' = \frac{\sigma}{2}(-x_1x_7 + x_5x_2 + 2x_1x_2[\frac{-x_6\alpha\eta e^{\frac{x_5\sqrt{x_1}}{1+\epsilon x_5\sqrt{x_1}}}}{2\sqrt{x_1}(1+\epsilon x_5\sqrt{x_1})^2}]) - - - (6)$$

$$x_8' = \frac{S_c}{2}(-x_1x_8 + 2x_1x_2[\frac{x_6 e^{\frac{x_5\sqrt{x_1}}{1+\epsilon x_5\sqrt{x_1}}}}{2\sqrt{x_1}(1+\epsilon x_5\sqrt{x_1})^2}]) - - - (7)$$

$\Rightarrow$ The system of first order Differential Equations (1)--(7) is what we will now solve

$\Rightarrow$ using the solve_ivp inbuilt solver in python to obtain the values for g and Φ

$*\,*\,*$ Now onto python: $*\,**\Rightarrow\Rightarrow\Rightarrow\ \ldots$