4.a) $\sin(x)+5 = y^{IV} + 1.1y''' - 0.1y'' - 0.3y$

$y^{IV} = \sin(x)+5 - y^{IV} - 1.1y''' + 0.1y'' + 0.3y$

$z_1 = y(x)$ $\quad z_1' = y'(x) = z_2$

$z_2 = y'(x)$ $\quad z_2' = y''(x) = z_3$

$z_3 = y''(x)$ $\quad z_3' = y'''(x) = z_4$

$z_4 = y'''(x)$ $\quad z_4' = y^{IV}(x) = \sin(x)+5 - 1.1y''' + 0.1y'' + 0.3y$

$= \sin(x)+5 - 1.1z_4 + 0.1z_3 + 0.3z_1$

$$f(x,z) = z' = \begin{pmatrix} z_1' \\ z_2' \\ z_3' \\ z_4' \end{pmatrix} = \begin{pmatrix} z_2 \\ z_3 \\ z_4 \\ \sin(x)+5 - 1.1z_4 + 0.1z_3 + 0.3z_1 \end{pmatrix} \quad \& \quad z(0) = \begin{pmatrix} 0 \\ 2 \\ 0 \\ 0 \end{pmatrix}$$

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b) $y'' = -\frac{y'}{x} - y + \frac{n^2 y}{x^2}$

$z_1 = y(x)$ $\quad z_1' = y'(x) = z_2$

$z_2 = y'(x)$ $\quad z_2' = y''(x) = -\frac{y'}{x} - y + \frac{n^2 y}{x^2}$

$= -\frac{z_2}{x} - z_1 + \frac{n^2 z_1}{x^2}$

$$f(x,z) = \begin{pmatrix} z_1' \\ z_2' \end{pmatrix} = \begin{pmatrix} z_2 \\ -\frac{z_2}{x} - z_1 + \frac{n^2 z_1}{x^2} \end{pmatrix} \text{ mit } z(1) = \begin{pmatrix} 2 \\ 2 \end{pmatrix}$$
