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4a)

$$\sin(x) + 5 = y'''' + 1.1 y''' - 0.1 y'' - 0.3 y$$

$$y'''' = \sin(x) + 5 - y'''' - 1.1 y''' + 0.1 y'' + 0.3 y$$

$$z_1 = y(x)$$

$$z_2 = y'(x)$$

$$z_3 = y''(x)$$

$$z_4 = y'''(x)$$

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

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

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

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

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

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

$$z_1 = y(x)$$

$$z_2 = y'(x)$$

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

$$z_2' = y''(x) = -\frac{y'}{x} - y + \frac{n^2 y}{x^2} \\ = -\frac{z_2}{x} - z_1 + \frac{n^2 z_1}{x^2}$$

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