

1. [10 pt] Solve $y''(x) = 0$, $y(0) = \pi$ and $y'(0) = 1$.

2. [15 pt] Find the general solution to $\frac{dy}{dx} = e^{x-2y}$.

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3. [15 pt] Solve $\frac{dy}{dx} = 1 + (y - x)^2$, $y(1) = 1/2$.

4. [15 pt] Find the general solution to $y' + 2xy = 3$.

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5. Let $\mathbf{A} = \begin{bmatrix} 2 & -1 & 3 \\ -2 & 0 & 2 \end{bmatrix}$ and $\mathbf{B} = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$.

(a) [5 pt] Is it possible to compute $\mathbf{A} + \mathbf{B}$? If so, compute it. If not, briefly explain why not.

(b) [10 pt] Of the products \mathbf{AA} , \mathbf{AB} , \mathbf{BA} , and \mathbf{BB} which one makes sense? Compute the ones that make sense.

6. [10 pt] Find \mathbf{A}^{-1} when

$$\mathbf{A} = \begin{bmatrix} 1 & -1 & 2 \\ 2 & -3 & 3 \\ 1 & -1 & 1 \end{bmatrix}.$$

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7. [20 pt] Find the solution set for the *homogeneous* linear system of equations:

$$\begin{aligned}3x_1 + 2x_2 + x_3 &= 0 \\6x_1 - x_2 + 2x_3 &= 0 \\12x_1 + 6x_2 + 4x_3 &= 0\end{aligned}$$

Hint: the linear system has the following coefficient matrix:

$$\mathbf{A} = \begin{bmatrix} 3 & 2 & 1 \\ 6 & -1 & 2 \\ 12 & 6 & 4 \end{bmatrix}$$

and the problem is asking you to compute the $\text{Nullspace}(\mathbf{A})$.