MTH 3311 Test #1
SPRING 2023

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   Show **CLEARLY** how you arrive at your answers.

1. Classify the following according to **order** and **linearity.** If an equation is **not linear,** explain why.

   (a) $\frac{d^2y}{dx^2} + 3x\frac{dy}{dx} + \sin(x)\,y = \tan(x)$

   (b) $y^{(6)} + 6y''' - 2yy' + 6y = e^x$

   (c) $8x^4y'' + \cos(x)\,y' + 3y = \sec(6x)$

   (d) $3x^4\frac{d^2y}{dx^2} + 3y^4\frac{dy}{dx} + 6y = \frac{1}{x^2+1}$

2. Solve: $\frac{dy}{dx} = \frac{x\sqrt{x^2+5}}{y^2}$; subject to the initial condition $y(2) = 3$

3. Solve: $y' + x^{-2}y = 6x^{-2}$, using the "Integrating Factor" Method. (Assume $y > 0$)

4. Show that the function $\quad y = e^{2x} + 2x^2 + 6x \quad$ is a solution of the differential equation:

$$y'' - y' - 2y = -4x^2 - 16x - 2$$

5. Determine whether or not the equation is exact. If the equation is exact, solve it.

$$\left(3x^2 + \ln(y) + 3x^2y^3\right)dx + \left(\frac{x}{y} + 3x^3y^2 + \cos(y)\right)dy = 0$$

6. Solve: $\frac{dy}{dx} = \frac{xy + y^2 + x^2}{x^2}$ using the substitution $v = \frac{y}{x}$.