MTH 3311 Differential Equations Test #1

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Instructions. Show clearly how you arrive at your answers.

1. Classify the following according to **order** and **linearity.**

   (a) $y^{(4)} - x^2y'' - 5xy' + 6y = e^x$

   (b) $(y')^2 = 2xy$

   (c) $\frac{d^2y}{dx^2} + \sin(x)\frac{dy}{dx} = \frac{9x^2+3x}{x^2+1}$

   (d) $y''' - 5xy' - 10xy^3 = 10$

   (e) $6y^{(10)} - y^{(5)} - 10xy' = \tan(x)$

2. Show that the function $y = c_1e^{-3x} + c_2e^x + 3x^2 + 5$ is a solution of the differential equation $y'' + 2y' - 3y = -9x^2 + 12x - 9$

3. Solve: $\frac{dy}{dx} = x^2 y - x^2$; Subject to the initial condition: $y(0) = 3$.

(Assume that $x \geq 0$ and $y \geq 2$).

4. Solve: $x^4 \frac{dy}{dx} + 3x^3 y = x \tan(x)$; using the "integrating factor method."

(Assume that $0 < x < \frac{\pi}{2}$).

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

$$\left(e^y \sec^2(x) - \sin(x) + 10x\sin(y)\right) dx + \left(5x^2\cos(y) + e^y\tan(x) + \tfrac{1}{y}\right) dy = 0$$

6. Solve: $2xy\frac{dy}{dx} + (x^2 - y^2) = 0$ Solve, using the substitution $v = \frac{y}{x}$