

Math 2233  
Homework Set 3

1. Determine the order of the following differential equations and whether or not the equations are linear.

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

(b)  $(1 + y^2) \frac{d^2 y}{dx^2} + x \frac{dy}{dx} + y = e^x$

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

(d)  $\frac{dy}{dx} + xy^2 = 0$

(e)  $\frac{d^2 y}{dx^2} + \sin(x + y) = \sin(x)$

2. Solve

$$y' + 3y = x + e^{-2x} \quad .$$

3. Solve

$$y' - y = 2e^x \quad .$$

4. Solve

$$xy' + 2y = \sin(x) \quad ; \quad x > 0 \quad .$$

5. Solve the following initial value problem.

$$y' - y = 2xe^{2x} \quad ; \quad y(1) = 0 \quad .$$

6. Solve the following initial value problem.

$$y' + \frac{2}{x}y = \frac{\cos(x)}{x^2} \quad ; \quad y(\pi) = 0$$

7. Find the solution of the initial value problem below. State the interval in which the solution is valid.

$$xy' + 2y = x^2 - x + 1 \quad ; \quad y(1) = \frac{1}{2} \quad .$$

8. Find the solution of the initial value problem below. State the interval in which the solution is valid.

$$y' + y = \frac{1}{1 + x^2} \quad , \quad y(0) = 0 \quad .$$

9. The equation below has a discontinuity at  $x = 0$ . Solve the differential equation for  $x > 0$  and describe the behavior of the solution as  $x \rightarrow 0$  for various values of the constant of integration. Sketch several solutions. (You can use Maple to plot the direction fields and then sketch the graphs of several solutions on top of that plot by hand.)

$$y' + \frac{2}{x}y = \frac{1}{x^2} \quad .$$