

Math 3331 - Spring 2024 - HW1

1. For the following ODEs state the order and whether the equations are linear (homogeneous or nonhomogeneous) or nonlinear. If they are nonlinear, underline or circle the nonlinear terms

$$(i) \quad y' = 1 - y^2$$

$$(ii) \quad x^2 y'' - 2xy' + y = 0,$$

$$(iii) \quad yy''' + y'^2 = x$$

$$(iv) \quad y' e^{y'} = x + 2,$$

$$(v) \quad y''' - 3y'' + 3y' + y = \sin(x),$$

2. Verify that the given function satisfies the given ODE and IC/BC if given

$$(i) \quad y = x^2 + \frac{c}{x}, \quad xy' + y = x^2$$

$$(ii) \quad y = \tan(x^3 + c), \quad y' = 3x^2(1 + y^2)$$

$$(iii) \quad y = c_1 e^x + c_2 x + 1, \quad (x-1)y'' - xy' + y = 1$$

$$(iv) \quad y = \frac{2}{x-2}, \quad y' = -\frac{y(y+1)}{x}, \quad y(1) = -2$$

3. Solve the following ODEs (separable)

$$(i) \quad \frac{dy}{dx} = 1 - y^2$$

$$(ii) \quad y' = 2xy^2, \quad y(0) = 1$$

$$(iii) \quad \frac{dy}{dx} = \frac{xy + 2y - x - 2}{xy - 3y + x - 3}$$

$$(iv) \quad \frac{dy}{dx} + 2y = 1,$$

4. Solve the following ODEs (linear)

$$(i) \quad xy' = 4y + x^4 e^x$$

$$(ii) \quad (x+1)\frac{dy}{dx} + y = \ln x, \quad y(1) = 10$$

$$(iii) \quad x\frac{dy}{dx} + 2y = 6x^3 + 2$$

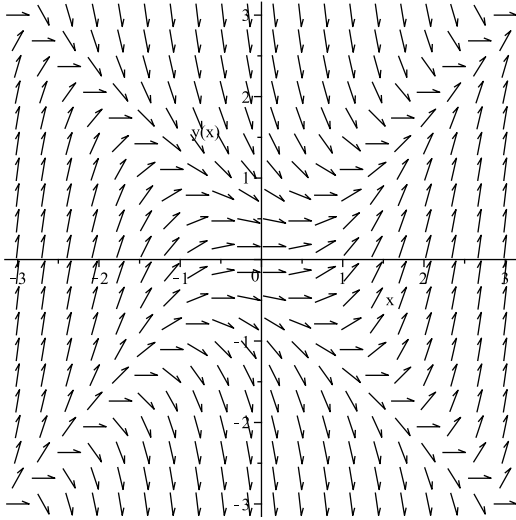
$$(iv) \quad \frac{dy}{dx} + \tan x y = \cos^2 x, \quad y(0) = -1$$

5. For the given ODEs and corresponding direction fields, trace the solution for the given IC.

(i). $\frac{dy}{dx} = x^2 - y^2$

(a) $y(-2) = 1$ (b) $y(3) = 0$

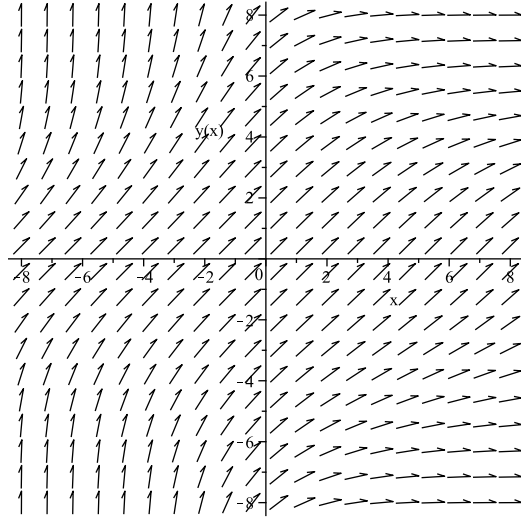
(c) $y(0) = 2$ (d) $y(0) = 0$



(ii). $\frac{dy}{dx} = e^{-0.01xy^2}$

(a) $y(-6) = 0$ (b) $y(0) = 1$

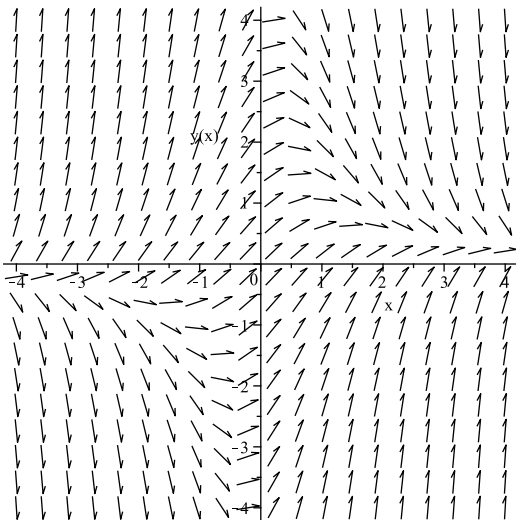
(c) $y(0) = -4$ (d) $y(8) = -4$



(iii). $\frac{dy}{dx} = 1 - xy$

(a) $y(0) = 0$ (b) $y(-1) = 0$

(c) $y(2) = 2$ (d) $y(0) = -4$



(iv). $\frac{dy}{dx} = \sin x \cos y$

(a) $y(0) = 1$ (b) $y(1) = 0$

(c) $y(3) = 3$ (d) $y(0) = -5/2$

