

Math 217 - December 7, 2010

Review Topics:

1. First order equations
 - (a) Slope fields
 - (b) Separable equations
 - (c) Linear first order
 - (d) Substitution methods (homogeneous equations)
 - (e) Exact equations
2. Mathematical models and numerics
 - (a) Population models
 - (b) Equilibrium solutions and stability
 - (c) Euler's Method
3. Linear equations
 - (a) Homogeneous vs. nonhomogeneous equations
 - (b) Mechanical vibrations (including forced oscillations and resonance)
 - (c) Solving constant coefficient equations
 - (d) Boundary value problems
4. Systems of differential equations
 - (a) Matrices
 - (b) Eigenvalues and eigenvectors
5. Laplace Transform
 - (a) Transform and inverse transform methods
 - (b) Application to differential equations
 - (c) Delta functions
6. Power series
 - (a) Ordinary points, singular points, regular singular points, irregular singular points
 - (b) Series solutions at ordinary points
 - (c) Frobenius solutions at regular singular points

1. Solve the initial value problems

- (a) $x^2y' + xy = 0, y(1) = 2.$
- (b) $x^2y' + xy = 2, y(1) = 2.$
- (c) $x^2y' + xy = 1/x, y(1) = 2.$
- (d) $y' + y/(1-x) = 3, y(2) = 2.$

2. Discuss the equilibrium solutions and stability for the equations

- (a) $x' = (2x - 3)(x - 4)^2(x + 7)^3$
- (b) $x' = (x - 4)(x^2 - 4)$

3. Match the slope fields and the differential equations (which one doesn't match up?).

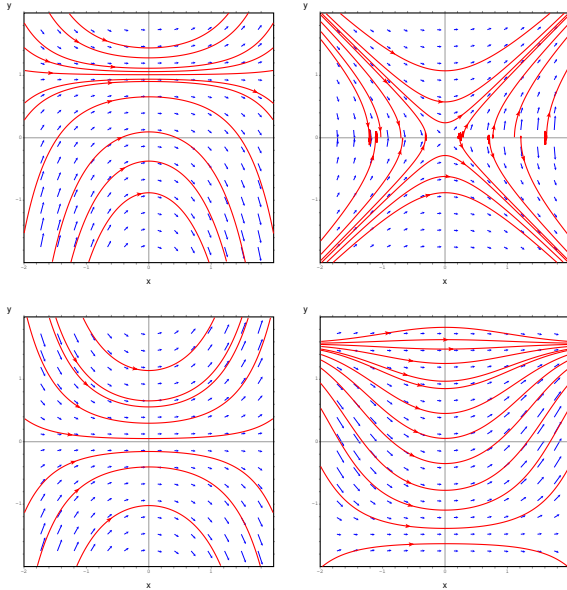
$$y' = xy$$

$$y' = x - y$$

$$y' = x/y$$

$$y' = x \cos y$$

$$y' = x(y - 1)$$



4. Use Euler's method to approximate solutions

(a) $y' = x + y, y(0) = 2$. Using $h = 0.5$ approximate $y(1)$.

(b) $y' = x^2 + y, y(1) = 2$. Using $h = 0.5$ approximate $y(2)$.

(c) $y' = x - y, y(1) = 2$. Using $h = 0.5$ approximate $y(0)$.

5. Find all ordinary and singular points of the given equations. Determine if each singular point is regular or irregular. For the regular singular points, find p_0, q_0 and the exponents. What does our theorem say about Frobenius solutions at the regular singular points?

(a) $y'' + y' + y = 0$.

(b) $x^2 y'' + y' + y = 0$.

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

(d) $x^2 y'' + (1 - \cos x) y' - y = 0$.

(e) $(x^2 - x) y'' + (\sin x) y' - (\cos x) y = 0$.