# DiffEq - Ch 1-2 - Required Practice

## 1.1

#1. $2^{nd}$ order, linear

#2. $4^{th}$ order, linear

#3. $2^{nd}$ order, nonlinear

#4. $3^{rd}$ order, linear

#5. (i) nonlinear     (ii) linear

#6. (a verification – show steps)

#7. (a verification – show steps)
   I: $(2, \infty)$

#8. (a verification – show steps)
$$x(t) = \frac{e^t - 1}{e^t - 2}$$
   I: $(-\infty, \ln 2)$  $or$  $(\ln 2, \infty)$

#9. $m = 0, \ m = -1$
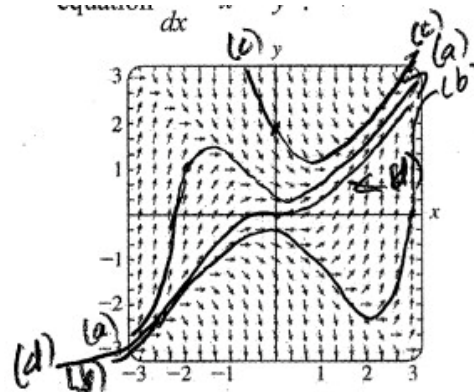
#10. (a verification – show steps)

## 1.2

#1. $y = \dfrac{1}{1 - 4e^{-x}}$

#2. $y = \dfrac{1}{x^2 - 1}$
   I: $(-\infty, -1)$  $or$  $(1, \infty)$

#3. $x = -\cos t + 8 \sin t$

#4. $y = \dfrac{3}{2} e^x - \dfrac{1}{2} e^{-x}$

#5. There will be a unique solution for all (x,y) except where y=0.
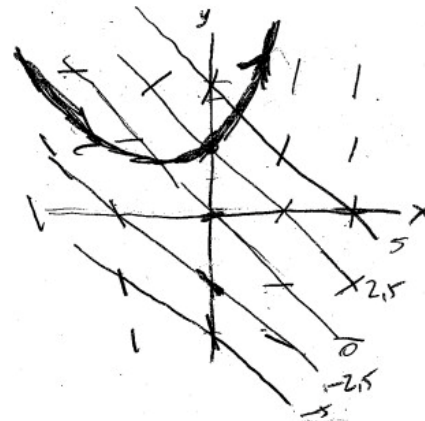
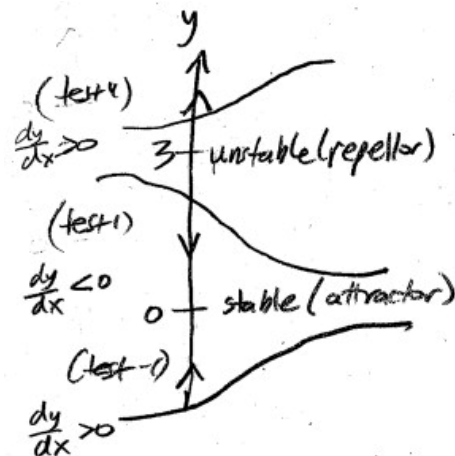#6. There <u>will</u> be a unique solution through (1,4).

## 2.1

#1.



#2.



#3.

## 2.2

**#1.** $y = -\dfrac{1}{5}\cos(5x) + C$

**#2.** $y = \dfrac{1}{3}e^{-3x} + C$

**#3.** $y = Cx^4$

**#4.** $-\dfrac{1}{2}e^{-2y} = \dfrac{1}{3}e^{3x} + C$

**#5.** $\dfrac{1}{3}x^3 \ln x - \dfrac{1}{9}x^3 = \dfrac{1}{2}y^2 + 2y + \ln|y| + C$

**#6.** $y = \arccos\left(\dfrac{1}{2}x + \dfrac{1}{4}\sin(2x) + C\right)$

**#7.** $x = \tan\left(4t + \dfrac{3\pi}{4}\right)$

## 2.3

**#1.** $y = Ce^{5x}$
I: $(-\infty, \infty)$
No transient terms

**#2.** $y = \dfrac{1}{x}\ln x + \dfrac{1}{x}C$
I: $(0, \infty)$
The entire solution is transient

**#3.** $r = \dfrac{\theta - \cos\theta + C}{\sec\theta + \tan\theta}$
I: $\left(-\dfrac{\pi}{2}, \dfrac{\pi}{2}\right)$
No transient terms

**#4.** $y = \dfrac{e^x + 2 - e}{x}$

**#5.** $i(t) = \dfrac{E}{R} + \left(i_0 - \dfrac{E}{R}\right)e^{-\left(\frac{R}{L}\right)t}$

## 2.4

**#1.** $x^2 - x + \dfrac{3}{2}y^2 + 7y = C$

**#2.** $x^2 y^2 - 3x + 4y = C$

**#3.** Not exact

**#4.** $\dfrac{1}{2}x^2 - xy^3 - y^2 \cos x = C$

**#5.** $xy^2 + x^2 y - y + \dfrac{1}{3}x^3 = \dfrac{4}{3}$

**#6.** $x^2 y^2 + x^3 = C$

## 2.5

**#1.** $y = \sqrt[3]{1 + \dfrac{C}{x^3}}$

**#2.** $y^3 = \dfrac{1}{x + \dfrac{1}{3} + Ce^{3x}}$   or   $y = \sqrt[3]{\dfrac{1}{x + \dfrac{1}{3} + Ce^{3x}}}$

**#3.** $y = \tan(x + C) - x - 1$

**#4.** $2x + 2y + \sin(2x + 2y) = 4x + C$
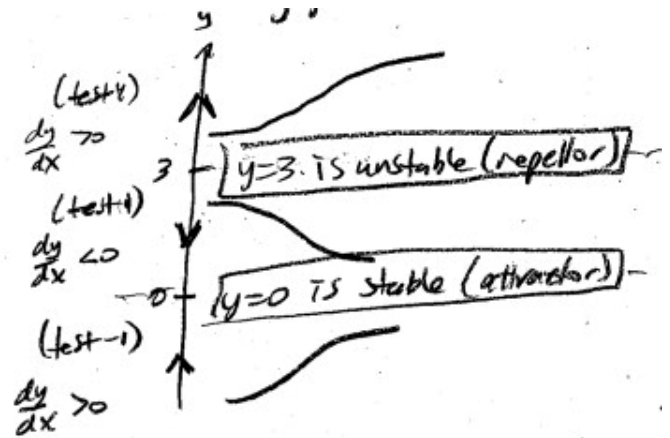
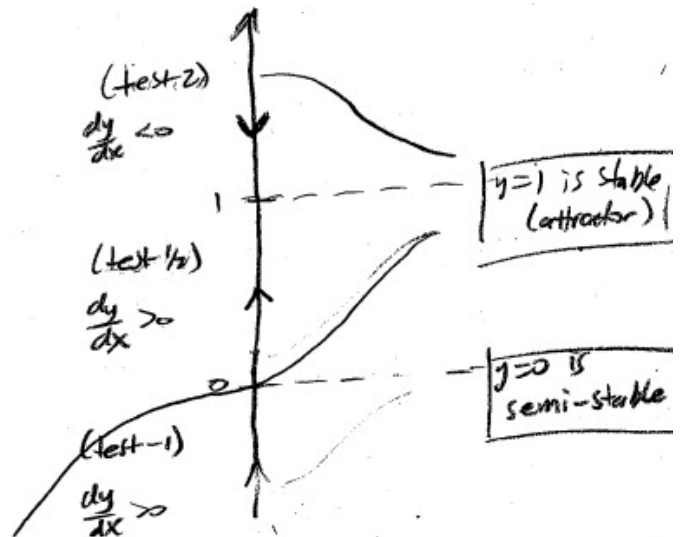## 2.6

**#1.** $y(0.5) \approx 0.4198$

**#2.** $y(1.5) \approx 1.2194$

#1.

(a) linear in y

(b) linear in x, composite with $u = y - x$

(c) separable, exact, linear in x, linear in y

(d) Bernoulli form in x with $n = 2$

(e) separable, Bernoulli form in x and y with $n = 2$

(f) separable, linear in x, Bernoulli in y with $n = 2$

(g) linear in x

(h) Bernoulli form in y with $n = -1$

(i) separable, linear in x, linear in y, exact

(j) linear in y, exact

(k) separable

#2.



#3.



#4. $y = \dfrac{1}{-x+C} + 1$

#5. $y = \cos^{-1}\left(\dfrac{1}{2}x + \dfrac{1}{4}\sin(2x) + C\right)$

#6. $y = \dfrac{1}{3} + Ce^{-4x}$

#7. $y = -x\cos x + Cx$

#8. $x^3 y + xe^y - y^2 = C$

#9. $\dfrac{1}{2}(x+y)^2 = x + C$

#10. $\dfrac{t^2}{y^4} + \dfrac{6}{y^2} = -5$

#11. $y = \sqrt[3]{\dfrac{1}{x + \dfrac{1}{3} + Ce^{3x}}}$

#12. $y = \dfrac{t}{\ln t + C}$