MIDTERM #1 REVIEW – EXTRA PROBLEMS

1. (Kreyszig 1.1 #2) $y' = xe^{-x^2/2}$
2. (Kreyszig 1.1 #12) $yy' = 4x$, $y(1) = 4$
3. (Kreyszig 1.1 #14) $y' \tan(x) = 2y - 8$, $y(\pi/2) = 0$
4. (Tennenbaum & Pollard Ex. 8 #8) $(x+2y)dx + (3x+6h+3)dy = 0$
5. (Tennenbaum & Pollard Ex. 8 #8) $(x+y)dx + (3x+3y-4)dy = 0$, $y(1) = 0$
6. (Kreyszig 1.3 #8) $y' = (y+4x)^2$
7. (Kreyszig 1.3 #3) $y' = \sec^2(y)$
8. (Kreyszig 1.3 #14) $y' = (x+y-2)^2$, $y(0) = 2$
9. (Kreyszig 1.3 #17) $xy' = y + 3x^4 \cos^2(y/x)$, $y(1) = 0$
10. (Rice & Strange 2-3 #14) $y' = (x-y)/(x+y)$
11. (Rice & Strange 2-5 #18) $(y\cot(x) - x)dx + dy = 0$
12. (Rice & Strange 2-5 #31) Solve $xe^{-y}y' + e^{-y} = x$. *Hint:* use the substitution $z = e^{-y}$
13. (Kreyszig 1.5 #6) $y' + 2y = 4\cos(2x)$, $y(\pi/4) = 3$
14. (Kreyszig 1.5 #8) $y' + y\tan(x) = e^{-0.01x}\cos(x)$, $y(0) = 0$
15. (Kreyszig 1.5 #13) $y' = 6(y-2.5)\tanh(1.5x)$
16. (Kreyszig 1.5 #24) $y' + y = -x/y$
17. (Kreyszig 1.5 #25) $y' = 3.2y - 10y^2$
18. (Kreyszig 1.5 #28) $2xyy' + (x-1)y^2 = x^2e^x$
19. (Tennenbaum & Pollard Ex. 7 #12) $(x^2 + y^2)dx = 2xydy$, $y(-1) = 0$
20. (Tennenbaum & Pollard Ex. 7 #14) $y' - y/x + \csc(y/x) = 0$, $y(1) = 0$
21. (Tennenbaum & Pollard Ex. 11 #3) $xy' + y = y^2\log(x)$
22. (Rice & Strange 1-4 #5)
    (a) Solve the ODE $y' = y^2/\sqrt{x-1}$ with the initial condition $y(1) = 2$
    (b) Show that $y(x) = 0$ is also a solution of this ODE
    (c) Explain this contradiction in terms of the existence and uniqueness theorems.
23. (Rice & Strange 1-4 #4) Give the regions for existence and uniqueness for the ODE $(x-2)y' - y = 0$, $y(0) = 2$. If possible, state the interval of validity.

24. (Rice & Strange 1-4 #6) Give the regions for existence and uniqueness for the ODE $y' = y^2/\sqrt{x^2+1}$, $y(0) = 0$. If possible, state the interval of validity.

25. (Kreyszig 21.1 #1) Solve the ODE $y' + 0.2y = 0$, $y(0) = 5$ using backward Euler with $h = 0.2$.

26. (Kreyszig 1.2 #19) Solve the ODE $y' = (y-x)^2$, $y(0) = 0$ for 3 steps using forward Euler with $h = 0.1$.

27. Supposed you solve an ODE using backward Euler and find a local error of $\epsilon_{local} = 0.5$ using $h = 0.1$. What step size should be used to reduce global error to be $\epsilon_{global} = 1$?