Review Questions for the first midterm in Calc4

Note: You don't have to answer these question verbally. Just make sure you know the answers in your mind and make sure you are capable on solving example problems from the book.

(1) What is a direction field for an ODE? How to draw it? What is an integral curve? How to sketch it? What is the relationship among ODE, solutions of ODE, direction field and integral curves? (Section 1.1)

(2) What is an initial value problem? What is the difference between a solution of an IVP to the general solution of ODE? (Section 1.2)

(3) How to find the order of an ODE? How to determine whether an ODE is linear or nonlinear? (Section 1.3)

(4) What is the standard form of a first-order ODE? How to find its integrating factor? How to check if you have the correct integrating factor? How to use the integrating factor to solve the first-order linear ODE? How to check if you have the correct solution? (Section 2.1)

(5) What does it mean for an ODE to be separable? How to solve it? How to use the explicit form to determine the interval where solution exists? (Section 2.2)

(6) How to use differential equation to model a real world problem? (Section 2.3)

(7) When does a first-order ODE have a unique solution? What are the conditions when the ODE is linear? What about nonlinear ODE? How to find the the regions where the solution exists uniquely? (Section 2.4)

(8) What is an autonomous ODE? What is its equilibrium solution? What does it mean for an equilibrium solution to be stable from above, stable from below, unstable from above, unstable from below? And what does it mean for an equilibrium solution to be stable, semistable and unstable? (Section 2.5)

(9) Given the graph of $f(y)$ versus y, how to find the equilibrium for the ODE $y' = f(y)$? How to draw the phase line? How to determine the stability? (Section 2.5)

(10) What is an exact ODE? How to solve an exact ODE? What can you do when you find your ODE not exact? (Section 2.6)

(11) What is the idea of Euler / Improved Euler / Runge-Kutta algorithm? How bad are their local truncation error measured with order of stepsize? How to give the local truncation error for Euler's method in terms of t and $\phi(t)$?

(12) What is a second order linear homogeneous ODE? What is its characteristic equation? How to solve such ODEs? (Section 3.1)