Midterm I: Some problems for review

You should review all homework problems from Section 1.1 to 3.4. The exam is a closed-book exam. You will not be asked to graph complicated functions. The following problems are for further practice.

- Section 1.1: Problems 10, 20.

- Section 1.3: Problems 13, 14.

- Section 2.1: Problems 2, 7, 20, 26.

- Section 2.2: Problems 4, 7.

- Section 2.3: Problems 3a, 9.

- Section 2.4: Problems 5, 11, 12.

- Section 2.5: Problems 22, 25.

- Section 2.6: Problems 2, 6.

- Section 3.1: Problems 11, 12.

- Section 3.2: Problems 20, 21.

Circle all correct answers. In the exam, you will not be asked to give explanations. But you should know the reason for your answers in this practice.

(1) The ODE $y' = 2y + 1$ is

   a. Linear

   b. Nonlinear

(2) The ODE $y' = 2y + t$ is

   a. Autonomous

   b. Non-autonomous

(3) The ODE $\frac{y'y''}{y'''} = \sin(ty)$ is

   a. First order

   b. Second order

   c. Third order

(4) Every solution to the ODE $y' = \sin(y)$ is bounded. (That is, there is some number $M > 0$ such that $-M \le y(t) \le M$ for all t.)

   a. True

   b. False

(5) Every solution to the ODE $y' = 2y^3 - 3y$ is bounded.

   a. True

   b. False

(6) The function $y = \sin(t)$ satisfies the first order ODE $y' + ay = 0$ for some constant a.

    a. True

    b. False

(7) Every solution to the second order ODE $y'' + y = 0$ is periodic. (That is, there is some number $T > 0$ such that $y(t + T) = y(t)$ for all t.)

    a. True

    b. False

(8) The functions $y_1 = e^t$ and $y_2 = t^2$ can solve the same second order ODE of the form $y'' + p(t)y' + q(t)y = 0$ on the interval $(-1, 1)$.

    a. True

    b. False

(9) The functions $y_1 = e^t$ and $y_2 = te^{-2t}$ can solve the same second order ODE of the form $y'' + p(t)y' + q(t)y = 0$ on the interval $(-1, 1)$.

    a. True

    b. False

(10) The function $c_1 e^{-2t} + c_2 te^{-2t}$ is a general solution of the ODE

    a. $y'' + 2y' + y = 0$

    b. $y'' + 4y' + 4y = 0$

    c. $y'' + 3y' + 2y = 0$

    d. $y'' + 4y' + 4y = t$