Math 0290   **Midterm Exam 1**

Spring 2014   **Your name:** _____

No calculators, no books. Show all your work (no work = no credit). Write neatly. Simplify your answers.

For each problem (except the bonus) you will get 40% of the maximum points if you do not write a solution. If you write a solution then your score will vary from 0 to maximum.

1. Solve the initial-value problem. Show all the work. Mention a type of the given differential equation.

   (a) (10 points) $\dfrac{y'}{3} = x^2 y, \qquad y(0) = -8, \quad$ where $y' = \dfrac{dy}{dx}$.

(b) (10 points) $ty' = 2y + t^3,$ $y(-1) = 3.$

(c) (10 points) $y'' + 6y' + 9y = 0,$ $y(0) = -3,$ $y'(0) = 11.$

2. (20 points) Suppose you drop a brick from the top of a building with the initial velocity 0 m/sec. The brick has mass of 1 kg. The air resistance force is given by $R(v) = -2v$. How long will it take the brick to reach one-half of its terminal velocity? Leave answer in exact form.

3. (20 points) Andrew opens an account that pays an annual rate of 4% compounded continuously with no initial deposit, but agrees to deposit a fixed amount each year. What annual deposit should be made to save $20,000$ in 5 years? Simplify your answer and leave it in exact form.

4. Find the general solution to the second-order nonhomogeneous differential equation

$$y'' - y' - 2y = 3\,e^{-t}$$

(a) (15 points) by using the method of undetermined coefficients.

(b) (15 points) by using the method of variation of parameters.

bonus problem (10 points extra)   Compare particular solutions found in the previous problem in parts (a) and (b). Are they the same? If not, explain why both solutions are correct.