Math 0290 **Midterm Exam 1**

Fall 2014 **Your name:** _____

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

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.

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

   (a) (15 points) $x\,y' = (1 + 2x^2)y, \qquad y(-1) = e, \quad$ where $y' = \dfrac{dy}{dx}$.

   (b) (15 points) $(t^2 + 2)x' + 4tx = 3, \qquad x(0) = -1.$

2. (15 points) Suppose you drop a ball from the top of a building with the initial velocity 0 m/sec. The ball has mass of 0.2 kg. The air resistance force is given by $R(v) = -\frac{v}{5}$.

   How long will it take the ball to reach one-half of its terminal velocity? Leave answer in exact form.

3. (15 points) Suppose the electrical circuit has a resistor of $R = 0.4\,\Omega$ and an inductor of $L = 0.2\,H$. Assume the voltage source is a constant $E = 0.6\,V$. If the initial current is $0\,A$ find the resulting current as a function of time. Simplify your answer and leave it in exact form.

4. (20 points) Using the method of undetermined coefficients find the general solution of the equation

$$y'' - y' - 2y = 2e^{2t}$$

Show all the work. Mention a type of the equation.

5. (20 points) Using variation of parameters technique find a particular solution to the equation

$$y'' - 4y = e^{3t}$$

Show all the work. Mention a type of the equation.

bonus problem (15 points extra) Find the general solution of the equation $y' = (y+t)^2$.
Hint: Use the substitution $x = y + t$