Solutions to Attendance Quiz # 1 for Dr. Z.’s Calc4 for Sept. 5, 2013

1. Verify that \( y(t) = e^t + t \) is a solution of the initial value differential equation

\[
y'' - y' = 0 \quad , \quad y(0) = 1 \quad , \quad y'(0) = 2 \quad .
\]

**Sol. to 1:** \( y(t) = e^t + t \). So \( y'(t) = e^t + 1 \), and \( y''(t) = e^t \). So

\[
y''(t) - y'(t) = e^t - (e^t + 1) = -1 \quad .
\]

So this is \textbf{NOT} a solution. Once the proposed solution failed to be a solution it is not necessary to check the initial conditions. (you only check them if it passed the diff.eq. test!).

**Comment:** This was an (unintentional) trick question. A fairer wording would have been “Check whether ...” instead of “Verify”. However it still makes sense. I am glad that more than \%70 of the students got it right.

2. For each of of the following diff.eq. state whether there are linear or non-linear, and find the order.

a. \( y^{(5)}(t) + 6ty''(t) + (\cos t^2)\ y(t) = 7 \quad , \)

**Sol. to 2a:** The highest order that shows up is fifth. So this is a \textbf{fifth order} diff. eq. (most people got this right). It is \textbf{linear} since all the derivatives, and the function itself, are by themselves, and none of them is raised to a power. About half of the people got confused and said that it is non-linear. Note that the \textbf{coefficients}, \( 6t \), and \( \cos t^2 \) are complicated functions of \( t \) but they do not change the fact that the diff.eq. is linear.

b. \( y^{(100)}(t) + y''(t)y'(t) + y(t) = 6 \quad . \)

**Sol. to 2b:** The highest order that shows up is 100, so the order is 100. Since \( y''(t) \) and \( y'(t) \) gets multiplied by each other, it is \textbf{non-linear}.

(About \%85 of the people got it right).