Name. _____

Differential Equations 5410
Sample Midterm Exam 1
Tuesday, 28 September 2004

Instructions: This in-class exam is 50 minutes. No calculators, notes, tables or books. No answer check is expected. Details count 75%. The answer counts 25%.

1. **(Quadrature Equation)**

   Solve for $y(x)$ in the equation $y' = xe^x - \tan x + \dfrac{x^2}{1+x^3} + e^{-2x}$.

   [The exam problem is shorter and requires no integral table.]

2. **(Separable Equation)**
   The problem $y' = 2x - x^{3/2} - 2xy^2 + x^{3/2}y^2$ may or may not be separable. If it is, then decompose the problem as $y' = F(x)G(y)$ and write formulae for F, G, followed by solving for all solutions y (left as implicit to save time). Otherwise, explain in detail why it fails to be separable, and don't solve for y.

3. **(Separable Equation)**

   Given the separable equation $y' = \dfrac{x^2}{1+x}(1+y)$, find all equilibrium and non-equilibrium solutions in explicit form.

4. **(Linear Equations)**

   Solve the linear equation $5v'(t) = -50 - \dfrac{20}{t+5}v(t)$, $v(0) = 0$. Show all integrating factor steps.

5. **(Existence-Uniqueness)**
   Consider the chemical reaction equation $dx/dt = (1-x)^{1/3}(3-2x)x$. Discuss existence-uniqueness for initial value problems. Cite Peano and Picard-Lindelöf theorems. Justify claims.