MATH 579 Exam 4 Part I
Assigned 3/4/10, Due by classtime 3/9/10
Please read the exam instructions.

Please write your answers on separate paper and put your name or initials on every sheet. Cross out work you do not wish graded; incorrect work can lower your grade, even compared with no work at all. Keep this sheet for your records. Show all necessary work in your solutions; if you are unsure, show it. Simplify all numerical answers to be integers, if possible. You are welcome to use your book, notes, calculators, computers, etc. This problem is worth 10-20 points.

You may *NOT* discuss possible solutions to this exam with any human prior to submission. Violations of this policy will cause catastrophic course failure.

Part I: Recall the difference operator Δ, where $\Delta f(x) = f(x+1) - f(x)$. Define the shift operator E, as $Ef(x) = f(x+1)$.

1. Consider functions $u(x), v(x)$. Prove the (difference calculus) product rule:
   $\Delta(uv) = u\Delta v + (Ev)\Delta u$.

2. Use the product rule to prove the summation by parts formula:
   $\sum u\Delta v\delta x = uv - \sum (Ev)\Delta u\delta x$.

3. Use summation by parts to find a closed form for $\sum_{k=0}^{n} k2^k$.

NOTE: It is not necessary to do these parts in order, you may assume 1 to do 2; you may assume 2 to do 3.