ON THE FRONT OF YOUR BLUEBOOK write: (1) your name, (2) your student ID number, (3) lecture section (4) your instructor's name, and (5) a grading table. You must work all of the problems on the exam. Show ALL of your work in your bluebook and **BOX IN YOUR FINAL ANSWERS**. A correct answer with no relevant work may receive no credit, while an incorrect answer accompanied by some correct work may receive partial credit. Only the provided formula sheet is permitted (no textbooks, classnotes, crib sheets, or calculators).

1. (36 points) For each of the following series, determine whether the series converges absolutely, converges conditionally, or diverges. Justify your answers.

   a. $\displaystyle\sum_{n=1}^{\infty} \frac{n}{2^n}$

   b. $\displaystyle\sum_{n=1}^{\infty} (-1)^n \frac{n}{n+1}$

   c. $\displaystyle\sum_{n=2}^{\infty} (-1)^n \frac{1}{\ln(n^3)}$

   d. $\displaystyle\sum_{n=1}^{\infty} \frac{\sin(n)}{n^2}$

2. (36 points) For what values of x do the following series converge (i) absolutely, (ii) conditionally? Justify your answers.

   a. $\displaystyle\sum_{n=1}^{\infty} \frac{(x-1)^n}{\sqrt{n}}$

   b. $\displaystyle\sum_{n=0}^{\infty} \frac{(\ln x)^n}{n!}$

   c. $\displaystyle\sum_{n=0}^{\infty} (\ln x)^n$

   d. $\displaystyle\sum_{n=1}^{\infty} \frac{n(\ln x)^{n-1}}{x}$ (*Hint:* How is this series related to the series in (c)?)

HEY, THERE'S MORE—TURN THE PAGE OVER!

3. (28 points)

a. The following series is the value of the Maclaurin series of a function $f(x)$ at some point. What function and what point? What is the sum of the series?

$$(.1) - \frac{(.1)^2}{2} + \frac{(.1)^3}{3} - ... + (-1)^{n-1}\frac{(.1)^n}{n} + ...$$

b. Compute $P_1(x)$, the Taylor polynomial of order 1 generated by $f(x) = x^3 + x + 1$ at $x = 1$. Give $R_1(x)$, the error term when $P_1(x)$ is used to approximate $f(x)$.

c. Estimate the error if $\cos(t^2)$ is approximated by $1 - \frac{t^4}{2} + \frac{t^8}{4!}$ in the integral $\int_0^1 \cos(t^2)dt$.