

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) Evaluate the following integrals.

a. $\int x e^{-x} dx$

b. $\int \frac{dx}{(x+1)(x^2+1)}$

c. $\int_0^1 (-\ln x) dx$

2. (24 points) Determine whether the following sequences converge or diverge. If the sequence converges, find the limit. Be sure to show your work.

a. $a_n = \left(\frac{n}{n-1}\right)^n$

b. $b_n = \frac{(\ln n)^2}{n}$

c. $c_n = (-1)^n \left(1 - \frac{1}{n}\right)$

3. (40 points) Determine whether the following series converge or diverge. Whenever possible, find the sum of a convergent series. **For each part, clearly state the test you are using and show all of your work.**

a.
$$\sum_{n=3}^{\infty} (-1)^{n+1} \frac{3}{2^n}$$

b.
$$\sum_{n=1}^{\infty} n \sin \frac{1}{n}$$

c.
$$\sum_{n=1}^{\infty} \ln \left(\frac{n}{n+1} \right)$$

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

e.
$$\sum_{n=1}^{\infty} \frac{2 + (-1)^n}{\sqrt{n}}$$