Name: ______________________

4-digit code: ______________________

- Write your name and the last 4 digits of your SSN in the space provided above.
- The test has six (6) pages, including this one.
- Enter your answer in the box(es) provided.
- You must show sufficient work to justify all answers unless otherwise stated in the problem. Correct answers with inconsistent work may not be given credit.
- Credit for each problem is given in parentheses at the right of the problem number.
- No books, notes or calculators may be used on this test.

Page	**Max. points**	**Your points**
2	20	
3	15	
4	20	
5	25	
6	20	
Total	100	

Problem 1 (10 pts)**.** Find a formula for the general term of the following sequences:

(a) $\frac{1}{2}, \frac{3}{4}, \frac{5}{6}, \frac{7}{8}, \ldots$

$x_n = \boxed{}$

(b) $1 - \frac{1}{2}, \frac{1}{3} - \frac{1}{2}, \frac{1}{3} - \frac{1}{4}, \frac{1}{5} - \frac{1}{4}, \ldots$

$x_n = \boxed{}$

Problem 2 (10pts)**.** Write out the first five terms of the sequence $\left\{ \frac{\ln n}{n} \right\}_{n=1}^{\infty}$

Determine whether the sequence converges, and if so find its limit.

First five terms: $\boxed{}$

$\lim_{n \to \infty} x_n = \boxed{}$

Problem 3 (5 pts)**.** Use $x_{n+1} - x_n$ to show that the sequence $\left\{n - n^2\right\}_{n=1}^{\infty}$ is strictly increasing or strictly decreasing.

Problem 4 (5 pts)**.** Use x_{n+1}/x_n to show that the sequence $\left\{ne^{-n}\right\}_{n=1}^{\infty}$ is strictly increasing or strictly decreasing.

Problem 5 (5 pts)**.** Use **differentiation** to show that the sequence $\left\{3 - \dfrac{1}{n}\right\}_{n=1}^{\infty}$ is strictly increasing or strictly decreasing.

Problem 6 (20 pts)**.** Determine whether the series converge, and if so find their sum:

(a) $\displaystyle\sum_{k=1}^{\infty}\left(-\frac{3}{2}\right)^{k+1}$

$$\sum_{k=1}^{\infty}\left(-\frac{3}{2}\right)^{k+1} = \boxed{}$$

(b) $\displaystyle\sum_{k=1}^{\infty}\left(\frac{1}{2^k}-\frac{1}{2^{k+1}}\right)$

$$\sum_{k=1}^{\infty}\left(\frac{1}{2^k}-\frac{1}{2^{k+1}}\right) = \boxed{}$$

Problem 7 (5 pts)**.** Apply the **divergence test** and state what it tells you about the series.

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

Problem 8 (10 pts)**.** Use the **integral test** to determine whether the series $\displaystyle\sum_{k=1}^{\infty}\frac{1}{1+9k^2}$ converges.

Problem 9 (10 pts)**.** Use the **ratio test** to determine whether the series $\displaystyle\sum_{k=1}^{\infty}\frac{3^k}{k!}$ converges. If the test is inconclusive, then say so.

Problem 10 (10 pts)**.** Use the **root test** to determine whether the series $\sum_{k=1}^{\infty}\left(\frac{k}{100}\right)^k$ converges. If the test is inconclusive, then say so.

Problem 11 (10 pts)**.** Classify the series $\sum_{k=1}^{\infty}\frac{k\cos k\pi}{k^2+1}$ as absolutely convergent, convergent or divergent.