

**DO NOT TURN OVER UNTIL  
INSTRUCTED TO DO SO.**

In this exam you may assume, without justification the following identity:

$$\lim_{n \rightarrow \infty} \left(1 + \frac{1}{n}\right)^n = e$$

**CALCULATORS ARE NOT PERMITTED**

**YOU MAY USE YOUR OWN BLANK  
PAPER FOR ROUGH WORK**

**SO AS NOT TO DISTURB OTHER  
STUDENTS, EVERYONE MUST STAY  
UNTIL THE EXAM IS COMPLETE**

**REMEMBER THIS EXAM IS GRADED BY  
A HUMAN BEING. WRITE YOUR  
SOLUTIONS NEATLY AND  
COHERENTLY, OR THEY RISK NOT  
RECEIVING FULL CREDIT**

**This exam consists of 5 questions. Answer the questions in the spaces provided.**

Name and discussion section: \_\_\_\_\_

GSI's name: \_\_\_\_\_

1. Determine if the following sequences converge or diverge. Carefully justify your answer.

(a) (10 points)

$$\left\{ \frac{(-1)^n \arctan(n)}{n} \right\}_{n=1}^{\infty}$$

**Solution:**

(b) (10 points)

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

**Solution:**

2. (20 points) Determine whether the following series is absolutely convergent, conditionally convergent or divergent. If convergent you do not need to determine the sum.

$$\sum_{n=1}^{\infty} (-1)^n \frac{\ln(n)}{n}$$

**Solution:**

3. (20 points) Determine if the following series is convergent or divergent. If convergent you do not need to determine the sum.

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

**Solution:**

4. Determine whether the following series are convergent or divergent. If convergent you do not need to determine the sum.

(a) (10 points)

$$\sum_{n=1}^{\infty} \cos\left(\frac{1}{n^2}\right)$$

**Solution:**

(b) (10 points)

$$\sum_{n=1}^{\infty} \frac{2^n + 3^n}{6^n}$$

**Solution:**

5. (20 points) Determine if the following series is convergent or divergent. If convergent you do not need to determine the sum.

$$\sum_{n=1}^{\infty} \frac{n!}{\sqrt{n^n}}$$

**Solution:**