MATH 141
FALL 2017
EXAM 3

NAME:

1. [10 pts. each] Find the limit of each sequence, or show that the limit does not exist.

   (a) $\left(\dfrac{2n^6}{\sqrt{36n^{12} - 4n^{10} + 12}}\right)$

   (b) $\left(\ln \sin(1/n) + \ln n\right)$

2. [10 pts.] Use the Squeeze Theorem to find the limit of the sequence

$$\left(\frac{4\tan^{-1} n}{n^4 + 1}\right).$$

3. [10 pts.] Evaluate the geometric series $\displaystyle\sum_{k=2}^{\infty} \frac{5}{3^k}$.

4. [10 pts.] Either show the telescoping series

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

diverges, or find a formula for the nth partial sum s_n and evaluate $\lim_{n\to\infty} s_n$ to obtain the value of the series.

5. [10 pts.] Apply a remainder theorem to estimate, using the fewest possible terms, the value of the alternating series

$$\sum_{n=1}^{\infty} \frac{(-1)^n}{2n^4}$$

with an absolute error less than 10^{-3}. Do not bother adding the terms.

6. [10 pts. each] Determine whether the series converges or diverges. The tests that may be used are indicated in parentheses. Arguments must be clear and thorough.

   (a) $\displaystyle\sum_{n=0}^{\infty} \frac{5}{10 - e^{-n}}$ (Any test)

   (b) $\displaystyle\sum_{n=1}^{\infty} n^2 e^{-n^3}$ (Divergence or Integral Test)

   (c) $\displaystyle\sum_{n=1}^{\infty} \frac{(n!)^2}{(2n)!}$ (Ratio Test)

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

(e) $\displaystyle\sum_{n=1}^{\infty} \frac{\cos^2 n}{n^2+1}$ (A comparison test)

(f) $\displaystyle\frac{2}{5} + \frac{2\cdot 6}{5\cdot 8} + \frac{2\cdot 6\cdot 10}{5\cdot 8\cdot 11} + \frac{2\cdot 6\cdot 10\cdot 14}{5\cdot 8\cdot 11\cdot 14} + \cdots$ (Ratio or Root Test)

7. 10 pts. each Use the Alternating Series Test to show the series converges, or use some other test to show it diverges. If the series converges, use any test to determine whether it converges absolutely or conditionally.

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

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

Some Formulas

- $(\sin^{-1} x)' = \dfrac{1}{\sqrt{1-x^2}}$
- $(\tan^{-1} x)' = \dfrac{1}{1+x^2}$
- $(\sec^{-1} x)' = \dfrac{1}{|x|\sqrt{x^2-1}}$
- $\displaystyle\int \frac{1}{\sqrt{a^2-x^2}}\,dx = \sin^{-1}\left(\frac{x}{a}\right) + c$
- $\displaystyle\int \frac{1}{a^2+x^2}\,dx = \frac{1}{a}\tan^{-1}\left(\frac{x}{a}\right) + c$
- $\displaystyle\int \frac{1}{x\sqrt{x^2-a^2}}\,dx = \frac{1}{a}\sec^{-1}\left|\frac{x}{a}\right| + c$
- $\displaystyle\int \tan x\,dx = \ln|\sec x| + c$
- $\displaystyle\int \cot x\,dx = \ln|\sin x| + c$
- $\displaystyle\int \sec x\,dx = \ln|\sec x + \tan x| + c$
- $\displaystyle\int \csc x\,dx = -\ln|\csc x + \cot x| + c$