

Show **all work clearly and in order**.

1. (16 points) Find the limits of the following functions.

1) (8 points)

$$\lim_{x \rightarrow \infty} \frac{e^x + x^2}{e^x + 2x}$$

2) (8 points)

$$\lim_{x \rightarrow 0^+} x \ln(x^2)$$

2. (12 points) Evaluate the following integrals

$$\int_0^{\infty} \frac{2x}{(x^2 + 2)^3} dx$$

3. (20 points) Determine the convergence or divergence of the sequences. If the sequence is convergent, find the limit. **Show all steps of your calculation.**

1)(8 points) $a_n = \left(\frac{n+1}{2n}\right)\left(1 + \frac{1}{n^2}\right)$

2)(8 points) $a_n = \frac{\cos(2n+1)}{2^n}$

3)(4 points) $a_n = \frac{10^{n+1}}{n!}$

4. (12 points) Determine if the geometric series converges or diverges. Give reasons for your answer. **If the series converges, find the value.**

$$(1)(8 \text{ points}) \sum_{n=1}^{\infty} \frac{3^n}{4^{n+1}}$$

$$(2)(8 \text{ points}) \sum_{n=1}^{\infty} \frac{(-3)^n}{2^n}$$

5. (24 points) Determine the convergence or divergence of the series. Give reasons for your answer.

1)(8 points) $\sum_{n=1}^{\infty} \cos\left(\frac{2}{n^2}\right)$

2)(8 points) $\sum_{n=1}^{\infty} \frac{n+1}{2^n n!}$

2)(8 points) $\sum_{n=1}^{\infty} \frac{n^2 - 1}{n^5 + n^3}$

6. (16 points) Find all the values of x such that the following power series converge

$$\sum_{n=1}^{\infty} \frac{x^n}{n3^n}$$

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