The point value of each problem is indicated in the left margin. You must show all of your work for full credit. Points will be deducted for faulty reasoning and for sloppy notation. You may not use a calculator, your class notes, or any reference material. Be neat and clear. **You do not need to simplify your answers unless you are asked to do so.**

1. Differentiate:

   (7) (a) \( \frac{d}{dx} (\tan x)^{\cot x} \)

   (7) (b) \( \frac{d}{dx} \ln(\sinh x) \)

2. Integrate:

   (8) (a) \( \int x^2 \sin x \, dx \)

   (8) (b) \( \int \cot x \csc^3 x \, dx \)
(8) (c) \[ \int_0^1 \frac{x}{9 + x^2} \, dx \]

(8) (d) \[ \int \cot 4t \, dt \]

(8) (e) \[ \int \frac{x^3}{\sqrt{x^2 - 4}} \, dx \]

(8) (f) \[ \int \frac{-2x^2 - 10}{(x^2 + 2)(x - 2)} \, dx \]
(10) 3. Find the limit: \( \lim_{x \to 0} (1 + \sin x)^{1/x} \)

4. Write the first four nonzero terms of the Maclaurin series for:

(12) a) \( \sqrt{1 - \frac{x}{2}} \)

Write the first three nonzero terms of the Maclaurin series for:

(12) b) \((\cos x) \cdot (\cosh x)\)
(14) 5. a) Graph $r = \cos 4\theta$. Give a table of points on the graph, sufficient to sketch the graph.

<table>
<thead>
<tr>
<th>$\theta$</th>
<th>$r$</th>
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(10) b) Find the area inside the graph.

(10) c) Write a definite integral that gives the length of this graph.
6. Find an equation of the parabola with vertex $(2, -2)$ and focus $(2, -1)$.

7. Find the domain of convergence of the power series:

$$
\sum_{n=0}^{\infty} \frac{(-1)^n \cdot (x + 1)^n}{\sqrt{n}}.
$$

Be sure to check the behavior at the endpoints (if there are any).
8. a) Find the center, vertices, foci, and directrices and asymptotes of the hyperbola \(9x^2 - 4y^2 - 18x - 27 = 0\).

\begin{align*}
\text{center} & \quad \text{vertices} \\
\text{foci} & \quad \text{directrices} \\
\text{asymptotes} &
\end{align*}

(10) b) Graph the hyperbola in part a).

\begin{tikzpicture}
\end{tikzpicture}
9. Decide for each of the following series whether it converges conditionally, converges absolutely or diverges. You must give valid reasons (convergence tests) for your answers.

(8) a) \[ \sum \frac{(-1)^n n \log n}{n^2} \]

(8) b) \[ \sum \frac{n^2}{n!} \]

(10) 10. Use Simpson’s Rule, with \( n = 6 \), to approximate \( \int_0^3 \sqrt{1 + x^3} \, dx \). Just write out the terms of the approximation. Don’t evaluate it.