Your name: _____

Rec. Instr.:   _____

Rec. Time: _____

Instructions:

Show all your work in the space provided under each question. Please write neatly and present your answers in an organized way. You may use your one sheet of notes, but no books or calculators.

For each test of convergence that you use, either give the name of the test, or briefly describe what the test says.

This exam is worth 120 points. The chart below indicates how many points each problem is worth.

Problem	1	2	3	4
Points	/9	/9	/8	/9
Problem	5	6	7	8
Points	/8	/8	/17	/9
Problem	9	10	11	12
Points	/9	/10	/8	/16

1. Determine whether the series converges or diverges. Explain.

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

2. Evaluate the indefinite integral.

$$\int \frac{x+6}{x^2-4}\,dx$$

3. Determine whether the series converges or diverges. Explain.

$$\sum_{n=1}^{\infty} \frac{n}{n^4 + 4}$$

4. Find the Taylor series at $c = \frac{\pi}{4}$ for the function. You need to find a formula for the general term.

$$f(x) = \cos(2x)$$

5. A spring hangs vertically. A mass of 10 kilograms is attached, and the spring is stretched by one meter. Find the work required in pulling the spring down one additional meter. You might want to use equations such as $F = ma$ and $F = -kx$. Also recall that $9.8 \ \frac{meters}{sec^2}$ is the acceleration of gravity.

6. Evaluate the indefinite integral.

$$\int \frac{dx}{(x^2 + 1)^{\frac{3}{2}}}$$

7. A curve has the parametrization $x = \cos^3(t), \quad y = \sin^3(t)$.

(a) Compute the derivatives $\frac{dx}{dt}$ and $\frac{dy}{dt}$.

(b) Find an equation of the tangent line to the curve when $t = \frac{\pi}{4}$.

(c) Find the arc length of the curve for $0 \le t \le \frac{\pi}{2}$.

8. Evaluate the indefinite integral.

$$\int x^2 \sin(x)\ dx$$

9. Determine whether the series converges or diverges. Explain.

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

10. Find the y-coordinate $\bar{y}$ of the centroid of the region under the curve $y = \sec^2(x)$ for $-\frac{\pi}{4} \le x \le \frac{\pi}{4}$. Note that $\bar{x} = 0$ by symmetry.

11. Evaluate the limit. Show all work.

$$\lim_{x \to 0} \frac{e^x - x - 1}{x^2}$$

12. Consider the curve given in polar coordinates, $r = 1 + 2\cos(2\theta)$.

(a) Solve for those θ where $r \leq 0$.

(b) Graph the curve. In particular, plot the points where $\theta = 0, \frac{\pi}{2}, \pi$ and $\frac{3\pi}{2}$.

(c) Find the total area (of the two small and two large loops) inside the curve.