Read each problem carefully. Please show all your work for each problem! Use only those methods discussed thus far in class. No calculators!

1. (10 points) Compute:

$$(a)\ \lim_{\theta\to 0}\frac{1-\cos\theta}{2\theta^2}, \qquad (b)\ \lim_{x\to\infty} x^2 e^{-2x}, \qquad (c)\ \lim_{x\to 0^+}(1+2x)^{1/x}.$$

2. (10 points) Integrate:

$$(a)\ \int_0^2 \frac{dx}{\sqrt{16-x^2}}, \qquad (b)\ \int x\cos 2x\,dx, \qquad (c)\ \int \sin^3 x\,dx$$

3. (12 points) Integrate (evaluate the improper integrals *correctly*):

$$(a)\ \int \frac{dx}{x^2-3x-4}, \qquad (b)\ \int \frac{2x+1}{x^2+4}\,dx, \qquad (c)\ \int_1^\infty \frac{dx}{x^2}.$$

4. (12 points) Find the area of the region in polar coordinates lying outside the curve $r = 1$ and inside $r = 2\cos\theta$.

5. (10 points) Find the first two non-zero terms in the Maclaurin Series of the function $f(x) = \arctan x$.

6. (10 points) Determine whether the following series converge or diverge. Find the sum of those that converge. Justify your answer!

$$(a)\ \sum_{n=1}^\infty n, \qquad (b)\ \sum_{n=0}^\infty \frac{2^n-3^n}{4^n}, \qquad (c)\ \sum_{n=0}^\infty \frac{1}{x^n}.$$

7. (12 points) Determine whether the following positive term series converge or diverge. State clearly which test you use.

$$(a)\ \sum_{n=0}^\infty \frac{n}{n^4+1}, \qquad (b)\ \sum_{n=1}^\infty \frac{2^n}{n!} \qquad (c)\ \sum_{n=1}^\infty \frac{\ln n}{n}$$

8. (12 points) Determine whether the following series converge absolutely, converge conditionally, or diverge. Justify your answer!

$$(a)\ \sum_{n=1}^\infty \frac{(-1)^n}{n^5}, \qquad (b)\ \sum_{n=1}^\infty \frac{(-1)^{n+1}}{\sqrt{n+2}}, \qquad (c)\ \sum_{n=0}^\infty e^{-n}\sin n.$$

9. (12 points) For the power series below, find (i) the radius of convergence, and (ii) the interval of convergence (including both endpoints).

$$\sum_{n=1}^\infty \frac{(-1)^n 3^n x^n}{n}.$$