1. Differentiate the function $y = e^{ax^5}$ where $a > 0$ is a constant.

   a) $y' = 4ax^4 e^{ax^5}$
   b) $y' = e^{ax^5}$
   c) $y' = 5ax^4 e^{ax^5}$
   d) $y' = ax^4 e^{ax^5}$
   e) $y' = 5e^{ax^5}$

2. Solve the equation $e^{9x+2} = k$ for x.

   a) $x = \dfrac{\ln(k) + 2}{9}$
   b) $x = \dfrac{\sqrt[e]{k} - 2}{9}$
   c) $x = \dfrac{\ln(k) - 2}{9}$
   d) $x = \dfrac{\sqrt[e]{k} + 2}{9}$
   e) $x = \ln\left(\dfrac{k-2}{9}\right)$

3. Differentiate the function $f(x) = \cos(\ln(5x))$.

   a) $f'(x) = -\dfrac{\sin(\ln(5x))}{x}$
   b) $f'(x) = -\sin(\ln(5x))$
   c) $f'(x) = \dfrac{1}{\cos(\ln(5x))}$
   d) $f'(x) = \dfrac{\sin(\ln(5x))}{x}$
   e) $f'(x) = -\sin\left(\dfrac{1}{x}\right)$

4. Evaluate the integral $\displaystyle\int \frac{\ln x}{x} dx$.

   a) $\dfrac{1}{2}(\ln x)^2 + C$
   b) $-\dfrac{1}{2}(\ln x)^2 + C$
   c) 0
   d) $(\ln x)^2 + C$
   e) $-(\ln x)^2 + C$

5. Find $\displaystyle\lim_{x\to 0} \frac{e^x - 1}{\sin 3x}$.

   a) ∞
   b) 0
   c) $-\infty$
   d) $\dfrac{1}{3}$
   e) -9

6. Evaluate the integral $\displaystyle\int x^7 \ln(x) dx$.

   a) $\dfrac{1}{7}x^8 \ln(x) - \dfrac{1}{49}x^8 + C$
   b) $\dfrac{1}{8}x^8 \ln(x) - \dfrac{1}{8}x^8 + C$
   c) $\dfrac{1}{8}x^8 \ln(x) - \dfrac{1}{64}x^8 + C$
   d) $\dfrac{1}{8}x^8 \ln(x) + \dfrac{1}{64}x^8 + C$
   e) none of these

7. Evaluate the integral $\dfrac{1}{2\pi}\displaystyle\int_{-\pi}^{\pi} \sin x \cos^3 x \, dx$.

   a) $\dfrac{\pi}{5}$
   b) 0
   c) $\dfrac{\pi}{2}$
   d) π
   e) 1

8. Evaluate the integral $\displaystyle\int_{\sqrt{2}}^{2} \frac{1}{t^2\sqrt{t^2-1}} dt$.

   a) $\dfrac{\pi}{4}$
   b) $\dfrac{1}{4}$
   c) $\dfrac{\sqrt{3}-1}{2}$
   d) $\dfrac{\pi}{12}$
   e) $\dfrac{\sqrt{3-\sqrt{2}}}{2}$

9. Write the form of the partial fraction decomposition of the expression $\frac{5}{(4x^2+1)(x-8)^2}$.

   a) $\frac{A}{4x^2}+\frac{B}{1}+\frac{C}{x^2}-\frac{D}{8}$

   b) $\frac{A}{4x^2+1}+\frac{B}{(x-8)^2}$

   c) $\frac{Ax+B}{4x^2+1}+\frac{Cx+D}{(x-8)^2}$

   d) $\frac{A}{4x^2}+\frac{B}{1}+\frac{C}{x^2}+\frac{D}{8}$

   e) $\frac{Ax+B}{4x^2+1}+\frac{C}{x-8}+\frac{D}{(x-8)^2}$

10. Which of the following integrals is improper?

    a) $\int_1^2 3x^2e^{-x^2}dx$

    b) $\int_{-6}^0 \frac{1}{x^2+6}dx$

    c) $\int_0^4 \frac{x}{x^2-7x+10}dx$

    d) $\int_{13}^{15} \frac{x-4}{x-7}dx$

    e) $\int_0^\pi \sin x\,dx$

11. Find the slope of the tangent line to the curve $x = 2te^t, y = 2t + e^t$ at the point $t = 0$.

    a) 3

    b) $\frac{3}{2}$

    c) $\frac{1}{2}$

    d) 0

    e) 1

12. Find a polar equation for the curve represented by the Cartesian equation $x^2 = 6y$.

    a) $r = 6\tan\theta$

    b) $r = 6\tan\theta\sec\theta$

    c) $r = 6\tan\theta\sin\theta$

    d) $r = 6\cos\theta\sin\theta$

    e) $r = 6\sin\theta$

13. Find the area of the region enclosed by one loop of the curve $r = 2\cos 4\theta$.

    a) $\frac{\pi}{11}$

    b) π

    c) 4π

    d) $\frac{\pi}{4}$

    e) 2π

14. Determine whether the sequence $\left\{\frac{8^n}{5^{n+1}}\right\}$ converges or diverges. If it converges, find the limit.

    a) converges to $\frac{5}{8}$

    b) converges to 0

    c) converges to 1

    d) converges to $\frac{5}{64}$

    e) diverges

15. Determine whether the sequence $\{n^8e^{-n}\}$ converges or diverges. If it converges, find the limit.

    a) converges to $\frac{8}{e}$

    b) converges to 0

    c) converges to $8e$

    d) converges to 1

    e) diverges

16. Determine whether the series $\sum_{n=1}^{\infty}\frac{2}{n(n+2)}$ is convergent or divergent. If it is convergent, find its sum.

    a) $\frac{3}{2}$

    b) $\frac{2}{3}$

    c) 1

    d) $\frac{1}{2}$

    e) divergent

17. What is the minimum number of terms of the series $\sum_{n=1}^{\infty} \frac{(-2)^n}{n!}$ that must be summed in order to approximate the series so that $|error| < 0.5$?

a) 6

b) 4

c) 3

d) 1

e) 2

18. Find the radius of convergence and interval of convergence of the series $\sum_{n=1}^{\infty} \frac{x^n}{4^n n^2}$.

a) $R = \frac{1}{4}, I = \left(-\frac{1}{4}, \frac{1}{4}\right]$

b) $R = \frac{1}{4}, I = \left(-\frac{1}{4}, \frac{1}{4}\right)$

c) $R = 4, I = [-4, 4]$

d) $R = 4, I = [-4, 4)$

e) $R = \frac{1}{4}, I = \left[-\frac{1}{4}, \frac{1}{4}\right)$

19. Find a power series representation for the function $f(z) = \frac{1}{6 - z^3}$.

a) $\sum_{n=0}^{\infty} -\frac{z^{3n}}{6^n}$

b) $\sum_{n=0}^{\infty} \frac{z^n}{6^{n+2}}$

c) $\sum_{n=0}^{\infty} \frac{z^{3n}}{6^{n+1}}$

d) $\sum_{n=0}^{\infty} -\frac{z^{3n}}{6^{n+1}}$

e) $\sum_{n=0}^{\infty} (z^3 - 5)^n$

20. Find the Taylor series for $f(x) = \ln x$ centered at $a = 1$.

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

b) $\sum_{n=2}^{\infty} \frac{(-1)^{n-1} (x-1)^n}{n!}$

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

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

e) $\sum_{n=1}^{\infty} \frac{(x-1)^n}{n!}$

For each series below, determine whether it is absolutely convergent, conditionally convergent, or divergent. **Code on your scantron sheet A** if the series is *Absolutely convergent*, **C** if it is *Conditionally convergent*, or **D** if it is *Divergent*.

21. (3 pts.) $\sum_{n=1}^{\infty} \frac{(-4)^{n+1}}{5^n}$

22. (3 pts.) $\sum_{n=1}^{\infty} (-1)^n \frac{n}{n+5}$

23. (3 pts.) $\sum_{n=1}^{\infty} \frac{(-1)^n}{\sqrt{n+1}}$

24. (3 pts.) $\sum_{n=1}^{\infty} \frac{(-3)^n}{n 4^{n+1}}$

25. (3 pts.) $\sum_{n=1}^{\infty} (-1)^n \left(\frac{2n+1}{3n+2}\right)^n$

For questions 26-29, you are given 5 equations, labeled a) through e), and 4 graphs, labeled I through IV. There is only one equation that corresponds to each graph. **Code your answers on the scantron sheet.**

a) $r = 2\cos\theta$

b) $r = \cos 2\theta$

c) $r = 1 - 2\cos\theta$

d) $x = \cos\theta, y = \sin 2\theta$

e) $x = \cos\theta, y = 1 - \cos^2\theta$

26. (2 pts.) Which equation corresponds to graph I?

27. (2 pts.) Which equation corresponds to graph II?

28. (2 pts.) Which equation corresponds to graph III?

29. (2 pts.) Which equation corresponds to graph IV?

30. (12 pts.) Find $\int \frac{1-x}{x(x^2+1)}dx$.

31. (15 pts.)Let $f(x) = e^{-3x}$.

a) (a) Find $f(0)$, $f'(0)$, $f''(0)$, $f'''(0)$, $f^{(4)}(0)$ and $f^{(5)}(0)$.

b) (b) Use your answers in part (a) to determine the Maclaurin series for $f(x)$ and write the series in summation notation.

c) (c) Find the radius of convergence for the Maclaurin series found in part (b) .