Some stuff

\[ \frac{1}{1-u} = 1 + u + u^2 + u^3 + u^4 + u^5 + \ldots = \sum_{n=0}^{\infty} u^n \quad -1 < u < 1 \]

\[ e^u = 1 + u + \frac{u^2}{2} + \frac{u^3}{3!} + \frac{u^4}{4!} + \frac{u^5}{5!} + \ldots = \sum_{n=0}^{\infty} \frac{u^n}{n!} \quad -\infty < u < \infty \]

\[ \sin u = u - \frac{u^3}{3!} + \frac{u^5}{5!} - \frac{u^7}{7!} + \frac{u^9}{9!} + \ldots = \sum_{n=0}^{\infty} (-1)^n \frac{u^{2n+1}}{(2n+1)!} \quad -\infty < u < \infty \]

\[ \cos u = 1 - \frac{u^2}{2!} + \frac{u^4}{4!} - \frac{u^6}{6!} + \frac{u^8}{8!} + \ldots = \sum_{n=0}^{\infty} (-1)^n \frac{u^{2n}}{(2n)!} \quad -\infty < u < \infty \]

\[ \tan^{-1} u = u - \frac{u^3}{3} + \frac{u^5}{5} - \frac{u^7}{7} + \frac{u^9}{9} - \ldots = \sum_{n=0}^{\infty} (-1)^n \frac{u^{2n+1}}{2n+1} \quad -1 \leq u \leq 1 \]

\[ \ln(1-u) = -u - \frac{u^2}{2} - \frac{u^3}{3} - \frac{u^4}{4} - \ldots = -\sum_{n=1}^{\infty} \frac{u^n}{n} \quad -1 < u < 1 \]

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1. Integrate $\int_{\frac{1}{2}}^{\infty} \frac{dx}{x \sqrt{\ln x}}$. Show all steps.

2. Find the points on the curve

$$
\begin{align*}
x &= e^{-t} \cos t \\
y &= e^{-t} \sin t
\end{align*}
$$

where the tangent line is horizontal.

3. Consider the curve

$$
\begin{align*}
x &= \sqrt{t} \\
y &= \frac{1}{4} (t^2 - 4)
\end{align*}
$$

Find the slope at (2, 3).

4. Set up definite integrals that represent the area between the inner and outer loops of $r = 2 - 4\sin \theta$. You may use your calculator to evaluate the integrals.

5. Write parametric equations for the line through (0, 1, -1) and parallel to the line of intersection of the planes $2x + y - 2z = 5$ and $3x - 6y - 2z = 7$. 
6. Write an equation of the plane that contains the points 
   (2, 3, -2), (3, 4, 2), (1, -1, 0).

7. Set up a definite integral that represents the surface area obtained by 
   revolving 
   \[ x = \frac{1}{3}t^3 \quad y = t + 1 \quad 1 \leq t \leq 2 \]
   about the y-axis. You may use your calculator to evaluate the integral.
Determine whether each of the following series (# 8 – 10) is absolutely convergent, conditionally convergent, or diverges. If the series is a convergent geometric series, find its sum. State the test you are using and show all details of the test. Always verify the conditions needed for the test to be valid.

8. $\sum_{k=1}^{\infty} \frac{\sin(k!)}{k^2}$.

9. $\sum_{k=1}^{\infty} \frac{(-1)^{k+1} k}{(k+2)^2}$.

10. $\frac{2}{3} - \left(\frac{2}{3}\right)^3 + \left(\frac{2}{3}\right)^5 - \left(\frac{2}{3}\right)^7 + \cdots$.

11. Determine the interval of convergence of the power series

$$\sum_{k=1}^{\infty} \frac{2^k (x-3)^k}{k(k+1)}.$$ 

12. Find the Maclaurin series for $\frac{2x}{x^2-1}$.

13. $f(x) = \cos(\pi x^2)$. Use a Maclaurin series to calculate $f(0.6)$ so that the absolute value of the error is less than 0.0005.