

1. Find the limit of the sequence

$$a_n = \left\{ n \tan\left(\frac{1}{n}\right) \right\}$$

2. Determine whether the following series converges or diverges. If it converges, find its sum.

$$\sum_{n=1}^{\infty} \frac{2^n}{3^{n-2}}$$

3. Determine whether the following series converges or diverges.

I. 
$$\sum_{n=1}^{\infty} \frac{n+2}{n^3 - n + 1}$$

II. 
$$\sum_{n=1}^{\infty} \left( \frac{1+2n}{1+n} \right)^n$$

4. Find the interval of convergence for

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

5. Write out the fourth order Taylor polynomial

for  $f(x) = \ln(x - 2)$  centered at  $x = \frac{5}{2}$ .

Calculate:  $|c_4|$

where  $c_4$  is the fourth order term's coeff.

6. Solve the initial value problem

$$-\pi \frac{dy}{dx} = \frac{y^2}{1+x^2} \quad \text{with } y(1) = 4$$

Find  $y(\sqrt{3})$ .

7. Evaluate

$$\int_1^2 \frac{17 - x^2}{x^3 - 8x^2 + 17x} dx.$$

8. Evaluate

$$\int_0^3 \frac{80}{\left(\sqrt{16 + x^2}\right)^3} dx.$$

9. Evaluate

$$\int_0^{\frac{1}{2}} 4xe^{2x} dx$$

10. Evaluate

$$\int_0^{\frac{\pi}{2}} 6 \cos^3(x) dx$$

11. Find the value of  $k$  so that the function below is a probability density function

$$f(x) = \begin{cases} kxe^{2x} & 0 \leq x \leq \frac{1}{2} \\ 0 & \text{otherwise} \end{cases}$$

12. Evaluate

$$\int_0^{\infty} \frac{12(e^x + 7)}{(e^x + 7x)^3} dx.$$

13. Let  $y = \frac{1}{2}x\sqrt{4x^2 - 1} - \frac{1}{4}\ln(\sqrt{4x^2 - 1} + 2x)$

It turns out that  $y' = \sqrt{4x^2 - 1}$ .

Using this fact, find the arclength for  $\frac{1}{2} \leq x \leq \frac{3}{2}$ .

14. Find the volume of the solid generated by revolving the region in the first quadrant bounded by  $y = 1 - x^2$ ,  $x = 0$ ,  $y = 0$  about the line  $x = 3$ .