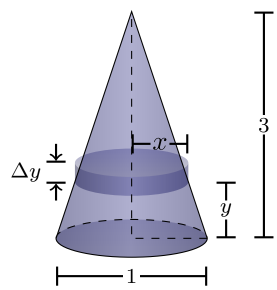
1. A colony of termites is building a termite mound in the shape of an inverted cone. The height of the cone is 3m and the diameter at it's base is 1m. Assume that the tunnels inside the termite mound affect the soil composition such that average density of the soil is given by

$$\delta(y) = 100(y + 12)\,\text{kg/m}^3.$$

Set up, but do not evaluate, an integral that gives the amount of work the termites must do to lift all the soil from ground level to build the termite mound. Clearly show the shape, orientation an dimensions of your slices, and clearly indicate any relevent quantities or the slices.(volume, mass, etc...) or each slice. [*15 points*]



2. Decide if the following statements are true or false (2 points each) and give a short explanation for your answer (1 point each).

   (a) If the series $\sum_{n=1}^{\infty} a_n$ diverges, then $\sum_{n=1}^{\infty} ka_n$ diverges for all constants k.

   (b) If the sequence b_n is monotone, then it cannot have both positive and negative terms.

   (c) If the sequence c_n is unbounded, then the sequence has an infinite number of terms greater than one million.

   (d) If $\lim_{n\to\infty} |d_n| = 0$, then the series $\sum_{n=1}^{\infty} d_n$ converges.

   (e) If $\sum_{n=1}^{\infty} e_n$ converges, then $\lim_{n\to\infty} e_n = 0$.

3. Find the following partial sums and the sum of the geometric series below. [*15 points*]

$$4 - 3 + \frac{9}{16} - \frac{27}{64} + \ldots$$

   (a) S_3 (Exact answer)

   (b) S_{30} (Estimate to 3 decimal places)

   (c) S_n (In terms of n)

   (d) S (Exact answer)

4. Use the integral test to determine whether the following series converges or diverges. Justify your answer by showing that all requirements of the test are met. [*15 points*]

$$\sum_{k=2}^{\infty} \frac{1}{k\,[\ln(k)]^2}$$

5. Determine whether the series is convergent or divergent. Justify your answer by clearly stating which test you use and show that all requirements of the test are met. [*15 points*]

$$\sum_{n=2}^{\infty} \frac{n!}{2016^n}$$

6. Determine whether the series is absolutely convergent, conditionally convergent or divergent. Justify your answer by clearly stating which tests you use and show that all requirements of the tests are met. [*15 points*]

$$\sum_{j=2}^{\infty} \frac{(-1)^j\,(j+1)}{\sqrt{j^3-1}}$$

7. Find the radius of convergence for the power series. [*10 points*]

$$\sum_{n=1}^{\infty} \frac{(x+5)^n}{3^n\,n^2}$$