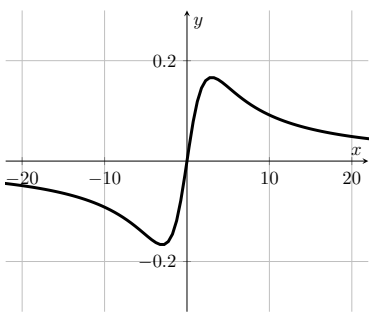
Math 132 - October 27, 2017

8.1 Arc Length	**8.2 Surface Area**
$L = \int ds = \int_a^b \sqrt{1 + (f'(x))^2}\, dx = \int_a^b \sqrt{1 + \left(\frac{dy}{dx}\right)^2}\, dx$	$S = \int_a^b dS = \int_a^b 2\pi r\, ds = \int_a^b 2\pi r \sqrt{1 + \left(\frac{dy}{dx}\right)^2}\, dx$

Warm-up Problems

1. **Clicker**

Below is a graph of $f(x) = \frac{x}{9+x^2}$.



Find $\displaystyle\int_{-\infty}^{\infty} \frac{x}{9+x^2}\, dx$

(a) Converges to 0

(b) Converges to something else

(c) Diverges to $+\infty$

(d) Diverges to $-\infty$

(e) Diverges

Note the following work:

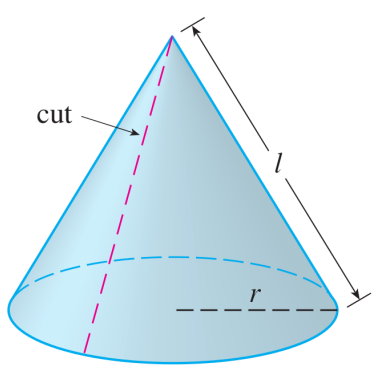
$$\int_0^{\infty} \frac{x}{9+x^2}\, dx = \lim_{t\to\infty} \int_0^t \frac{x}{9+x^2}\, dx = \lim_{t\to\infty} \frac{1}{2}\ln(x^2+9)\Big|_0^t$$

$$\lim_{t\to\infty} \frac{1}{2}\ln(t^2+9) - \frac{1}{2}\ln(9) = \lim_{t\to\infty} \frac{1}{2}\left[\ln\left(\frac{t^2+9}{9}\right)\right] = \infty$$

2. Find the length of the line segment between the points $(x_i, f(x_i))$ and $(x_j, f(x_j))$.

3. **Clicker**

Find the surface area of the cone



(a) $\pi r l$

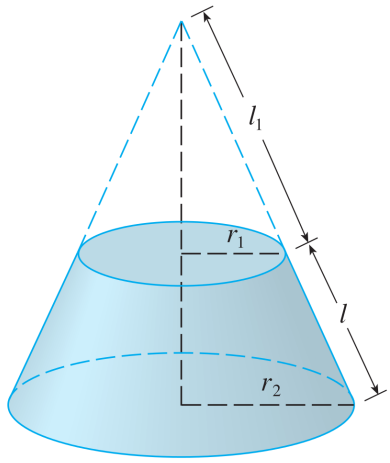
(b) $2\pi r l$

(c) $\pi(r^2 + l^2)$

(d) $\pi\sqrt{r^2 + l^2}$

4. **Clicker**

Find the surface area of the frustum of the cone.
(Just the cone part, not the top/bottom.)



(a) $\pi l r_1$

(b) $\pi l r_2$

(c) $2\pi l \left(\frac{r_1 + r_2}{2}\right)$

(d) $2\pi l \left(\frac{r_1 - r_2}{2}\right)$

Class Problems

5. Set up arc length integrals

   (a) Find length of $y = 2x + 3$ between $x = 0$ and $x = 2$

   (b) Find length of $y = \cos x$ between $x = 0$ and $x = \pi$

   (c) Find length of $y = 2(x-1)^{3/2}$ from $x = 1$ to $x = 5$.

6. Set up surface area integrals

   (a) Find the area of $y = \sqrt{x}$ on the interval $[3/4, 15/4]$ rotated about the x-axis.

   (b) Find the area of $x = \frac{y^3}{3}$ on the interval $y = 0$ to $y = 1$ rotated about the y-axis.

   (c) Find the area of $y = \sin x$ from $x = 0$ to $x = \pi$.