

## Week 8 FLO (Friday Learning Opportunity)

1. Find a TL to  $y = \sqrt[3]{x}$  with a point of tangency of  $(x = 1000, y = 10)$ .

**Solution:** We have  $\frac{dy}{dx} = \frac{1}{3}x^{-2/3}$ . So  $\left.\frac{dy}{dx}\right|_{x=1000} = \frac{1}{300}$ . So

$$L(x) = 10 + \frac{1}{300}(x - 1000).$$

2. Use the TL from Question 1 to estimate  $\sqrt[3]{1007}$ . Compare this to its true value.

**Solution:**

$$\sqrt[3]{1007} \approx L(1007) = 10 + \frac{1}{300}(1007 - 1000) = \frac{3007}{300} \approx 10.023.$$

The true value is approximately 10.0232790996342627192912842164323354433109773879416081626. So 10.023 is a pretty good estimate.

3. Assume an elliptical pancake. As a cornmeal pancake expands on the skillet, its semi-major axis remains three times its semi-minor axis. At the moment the surface area of the pancake is 12 square inches, the rate of change of its area is  $1/2$  square inches per second. At this moment, find the rate of change of its semi-minor axis.

**Solution:** Let the semi-major axis be  $a$  and the semi-minor axis be  $b$ . We are given that  $a = 3b$ . The area  $A$  is  $A = \pi ab = 3\pi b^2$ . So

$$\frac{dA}{dt} = 6\pi b \frac{db}{dt}. \quad (1)$$

Pasting in the data gives

$$12 = 3\pi b^2 \quad \frac{1}{2} = 6\pi b \frac{db}{dt}. \quad (2)$$

Solving for  $b$  and  $\frac{db}{dt}$  gives  $\frac{db}{dt} = \frac{1}{24\sqrt{\pi}}$ .

4. A monarch butterfly is flying directly south and a goldfinch is flying directly east. At some moment, the monarch is 3 miles south of the UNK belltower and the goldfinch is five miles east. Also at this moment, the speed of the monarch is 8 mph and the speed of the goldfinch is 47 mph. At this moment, what is the rate of change of the distance between the monarch and the goldfinch?