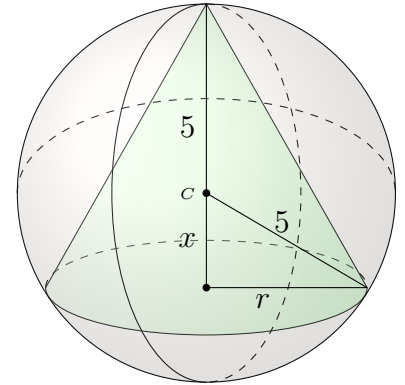
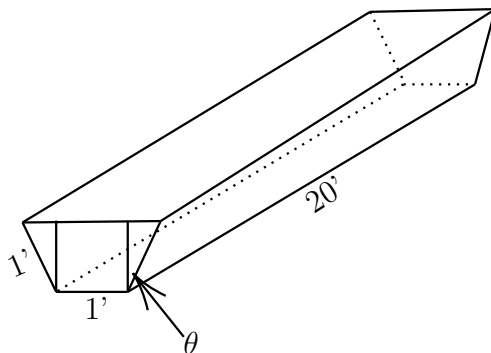


All work on this lab should be the collective effort of all group members. Technology allowed on this lab includes: Desmos (<https://www.desmos.com/calculator>) and an approved TI calculator. This lab has 4 questions for a total of 40 points.

1. (10 points) Find the volume of the largest right circular cone that can be inscribed in a circle of radius 5.



2. (10 points) A 20-foot trough, whose bottom base is 1 foot wide, is made by creating an open trapezoidal prism. If the trapezoidal prism's volume is dependent upon the angle between the vertical height of the trapezoid and the side called  $\theta$ , then what value of  $\theta$  would maximize the volume of the trough?



3. (10 points) One interesting model that determines the concentration of caffeine in the blood based on nicotine consumption is given by the formula below:

$$c(t) = \frac{D}{1 - \frac{\beta}{\alpha}} (e^{-\beta t} - e^{-\alpha t}),$$

where  $D$  is the size of the dose of caffeine,  $\alpha$  is the absorption rate of caffeine, and  $\beta$  is the elimination rate of caffeine. Find the time when the maximum concentration of caffeine is in the blood stream.

4. (10 points) Two different masses – call them  $m_1$  and  $m_2$  – hang from identical springs. The position of the first mass is  $s_1 = 2 \sin t$  as where the position of the second mass is  $s_2 = \sin 2t$ .

(a) At what times in the interval  $0 < t$  do the masses pass each other?

(b) When in the interval  $0 \leq t \leq 2\pi$  is the vertical distance between the masses the greatest?