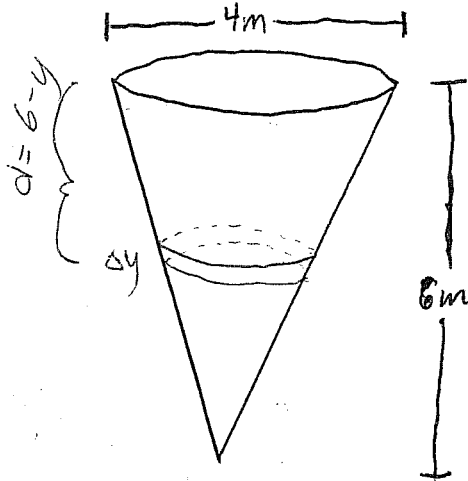


## Quiz 6

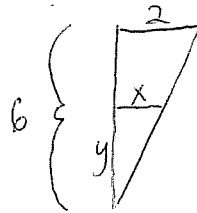
This quiz is graded out of 10 marks. No books, calculators, notes or cell phones are allowed. You must show all your work, the correct answer is worth 1 mark the remaining marks are given for the work. If you need more space for your answer use the back of the page.

## Question 1. §7.5 #25

An open tank has the shape of a right circular cone. The tank is 4 meters across the top and 6 meters high. How much work is done in emptying the tank by pumping the water over the top edge? ( $\rho = 1000 \frac{\text{kg}}{\text{m}^3}$  and  $g = 9.8 \frac{\text{m}^2}{\text{s}}$ )



The volume of the slice is  $\Delta V = \pi x^2 \Delta y$   
We want the volume in terms of  $y$ . We notice



$$\frac{x}{2} = \frac{y}{6}$$

$$x = \frac{y}{3}$$

- ∴  $\Delta V = \frac{\pi}{9} y^2 \Delta y$
- ∴ the mass of the slice is  $\Delta m = \Delta V \rho = \frac{\pi}{9} y^2 \Delta y 1000$
- ∴ the force exerted by the slice is  $\Delta F = \Delta m g = \frac{1000\pi}{9} y^2 \Delta y (9.8)$
- ∴ the distance of the slice to the pump is  $6 - y$

$$\Delta W = \Delta F d = \frac{9800\pi}{9} y^2 (6 - y) \Delta y$$

$$\begin{aligned} W &= \int_0^6 \frac{9800\pi}{9} (6y^2 - y^3) dy = \frac{9800\pi}{9} \int_0^6 (6y^2 - y^3) dy \\ &= \frac{9800\pi}{9} \left[ 2y^3 - \frac{y^4}{4} \right]_0^6 \\ &= \frac{9800\pi}{9} \left[ 2(6)^3 - \frac{6^4}{4} \right] \\ &= 117600 \pi \text{ N}\cdot\text{m} \end{aligned}$$