Quiz #5

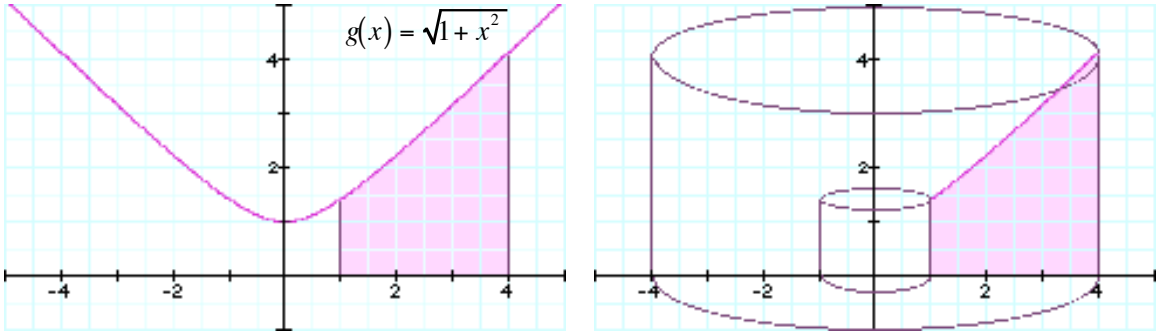
For each question, be careful to indicate your final answer **and show how you obtained it**. Answers with no supporting work will get no credit.

You should not use your calculator to find antiderivatives on any of the problems on this quiz. You may use your calculator for arithmetic and to evaluate functions.

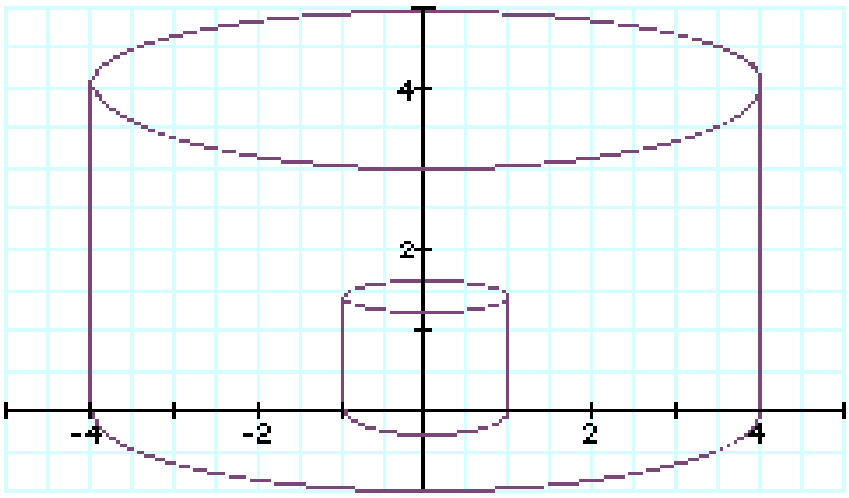
1. In this problem your ultimate objective is to calculate the volume created when the graph of the function:

$$g(x) = \sqrt{1 + x^2}$$

is revolved around the y-axis. You will be concerned with the portion of the graph that lies between $x = 1$ and $x = 4$ (see diagram below).



(a) **(1 point)** The first step when calculating a volume of revolution is to slice the volume up into regular pieces. Using the diagram provided below, carefully sketch one of these regular pieces. Include as many dimensions (such as thickness, radius, height etc.) as you can on your sketch.



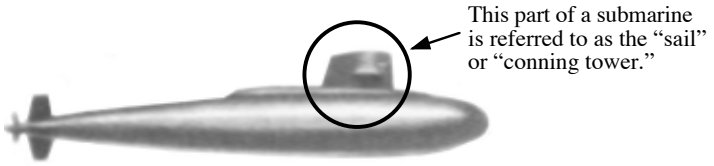
Continued on the next page.

(b) **(1 point)** Write down an equation for the volume of the regular shape that you drew in Part (a).

(c) **(1 point)** Set up an integral that will give the total volume of the volume of revolution depicted in the diagram on the previous page.

(d) **(1 point)** Evaluate the integral from Part (c) to find the numerical value of the volume of revolution.

2. One of the worst naval disasters of the US submarine fleet was the loss of USS *Scorpion* (SSN-589) in 1968. After months of searching, the wreck of the USS *Scorpion* was located at the bottom of the Atlantic Ocean at a depth of 3000 meters.



The conning tower (or "sail") of the USS *Scorpion* was a square sheet of metal measuring 10 meters on each side. Throughout this problem you may assume that the density of sea water is 1027 kg/m^3.

NOTE: You should not use your calculator to evaluate integrals in this problem, apart from working out arithmetic and evaluating functions.

(a) **(1 point)** Calculate the water pressure at a depth of 3000 meters. You may assume the density of sea water is 1027 kg/m^3. Include units with your answer.

(b) **(2 points)** Suppose that the sail of the USS *Scorpion* is lying horizontally at a depth of 3000 meters. Find the total force on the sail. Include units with your answer.

Continued on the next page

(c) **(3 points)** Suppose, instead, that the sail of the USS *Scorpion* is vertical in the water and that its bottom is at a depth of 3000 meters. Find the total force on the sail. Include units with your answer.