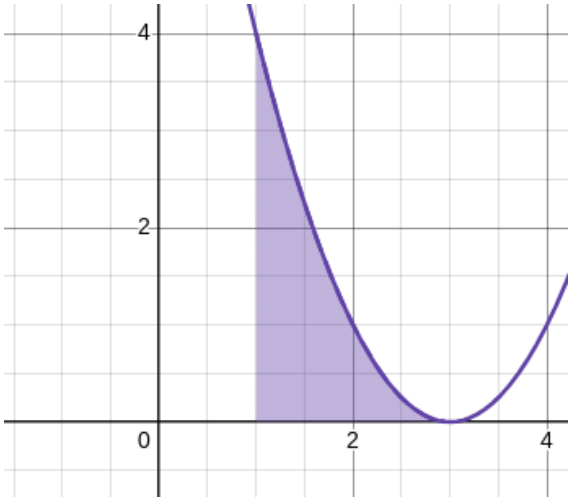
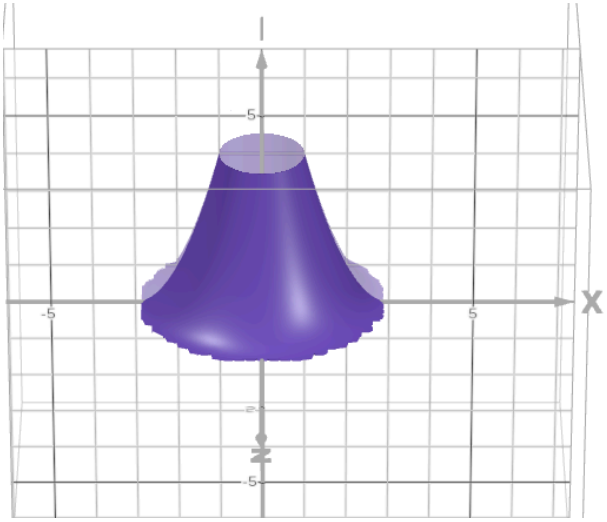
Calculus 8.2 Key Points

Shell Method:

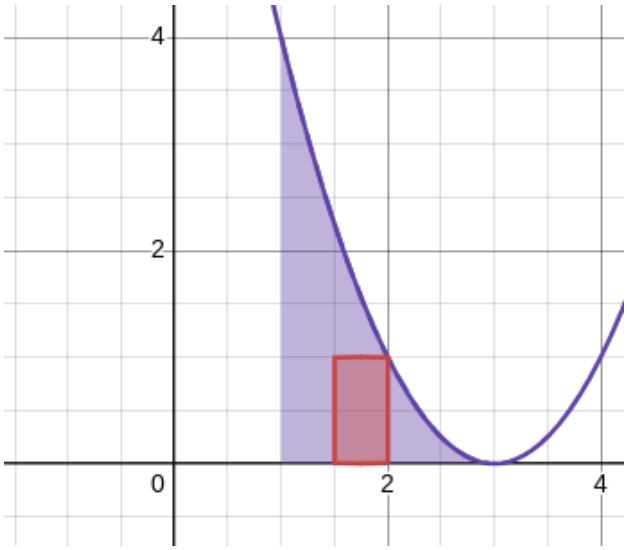
The shell method is an alternative to the disk method or washer method.

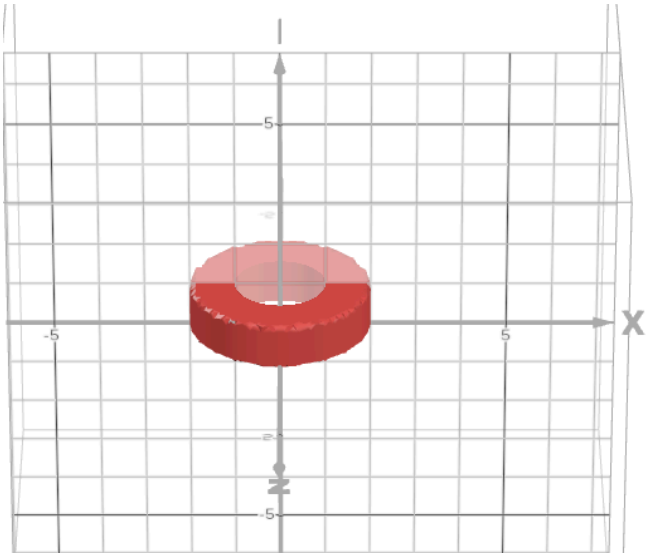
Suppose we want to find the volume of the solid created when we rotate the area under the curve of $f(x) = (x - 3)^2$ between $x = 1$ and $x = 3$ around the y-axis





One approach would be to use the washer method, but instead, we could also create "shells" and rotate each of these shells around the y-axis





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The volume of each shell is the circumference of the shell multiplied by the height and width of the shell, which is equal to $2\pi r \bullet f(x) \bullet \Delta x$

If we use integration to get an exact answer, the volume of the solid can be represented as $V = \int_1^3 (2\pi(x) \bullet (x - 3)^2)\, dx = 8\pi \approx 25.133\, un^3$

If instead we solved this problem using the washer method, we would get the same result: $V = \pi \int_0^4 ((-\sqrt{y} + 3)^2 - (1^2))\, dy = 8\pi \approx 25.133\, un^3$

The general equation for finding the volume of a solid with the shell method is $V = 2\pi \int_a^b (r(x)h(x))\, dx$

Notice that if you did use the washer method and integrated with respect to y, you would have to rewrite the function $f(x)$ in terms of y, which can be challenging with certain equations. Using the shell method may allow you to integrate without having to manipulate the function as much.

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