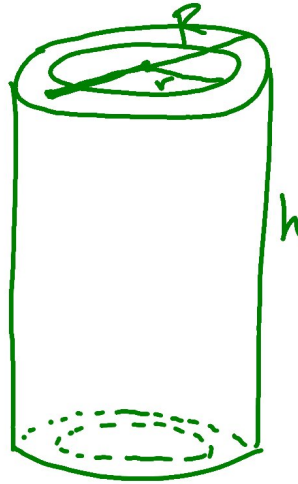
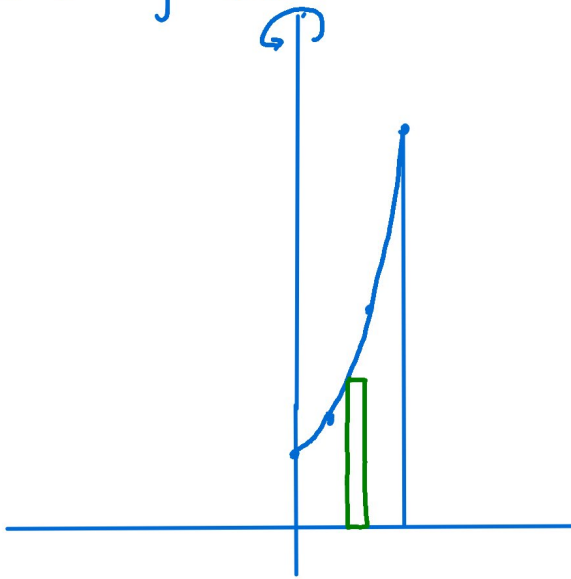


Volume by Cylindrical Shells

Suppose you rotate the region bounded by $y = x^2 + 2$, $x = 0$, $x = 3$, and the x -axis about the y -axis.



$$V = \pi R^2 h - \pi r^2 h$$

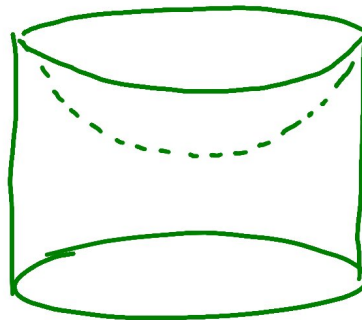
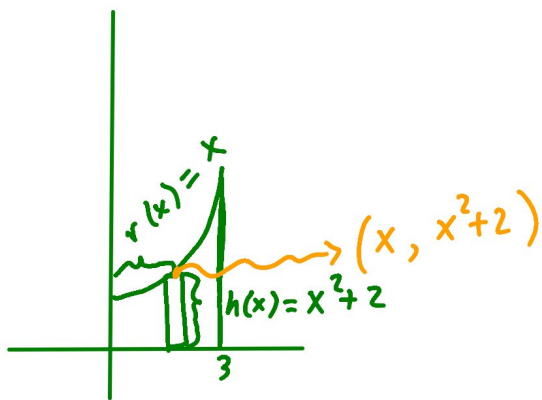
$$V = \pi (R^2 - r^2) h$$

$$V = \pi (R+r) \underbrace{(R-r)}_{\substack{\Delta x \\ dx}} h$$

$$V = \pi 2 \underbrace{\left(\frac{R+r}{2}\right)}_{\substack{\text{avg} \\ \text{radius}}} dx \cdot h$$

$$V = 2\pi \cdot r(x) \cdot h(x) dx$$

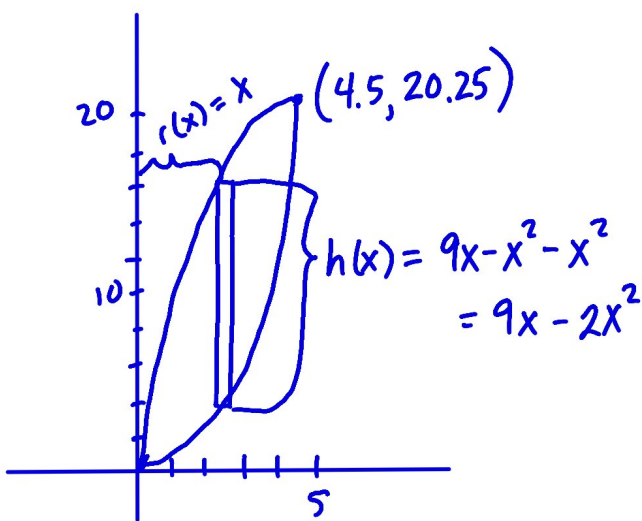
$$V = 2\pi \int_a^b r(x) \cdot h(x) dx$$



$$V = 2\pi \int_0^3 x(x^2+2) dx = \frac{117\pi}{2}$$

$$\text{fnInt}(x(x^2+2), x, 0, 3) * 2 \text{ } \blacktriangleright \text{FRAC}$$

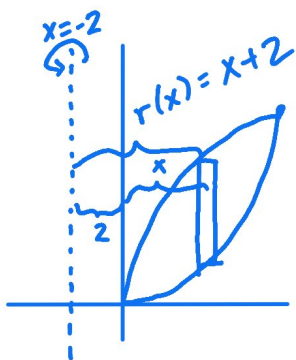
ex: Graph the region bounded by $y = 9x - x^2$ and $y = x^2$



a) Volume around the y-axis.

$$V = 2\pi \int_0^{4.5} x(9x - 2x^2) dx$$

$$V = \frac{2187\pi}{16}$$

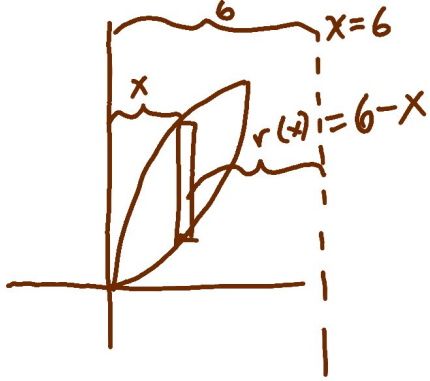


b) Volume around $x = -2$

$$V = 2\pi \int_0^{4.5} (x+2)(9x - 2x^2) dx$$

same

$$V = \frac{4131\pi}{16}$$



c) Volume around $x=6$

$$V = 2\pi \int_0^{4.5} (6-x)(9x-2x^2) dx$$

$$V = \frac{3645\pi}{16}$$

Volume/Area Assignment 2/22

Sketch the region bounded by the graphs of $y = -x^2 + 6x - 4$ and $y = x$

- 1) Find its area.
- 2) Find the volume when the region is rotated about
 - A) the y-axis
 - B) the line $x = -3$
 - C) the line $x = 10$