1. Suppose we take the region bounded by the curves

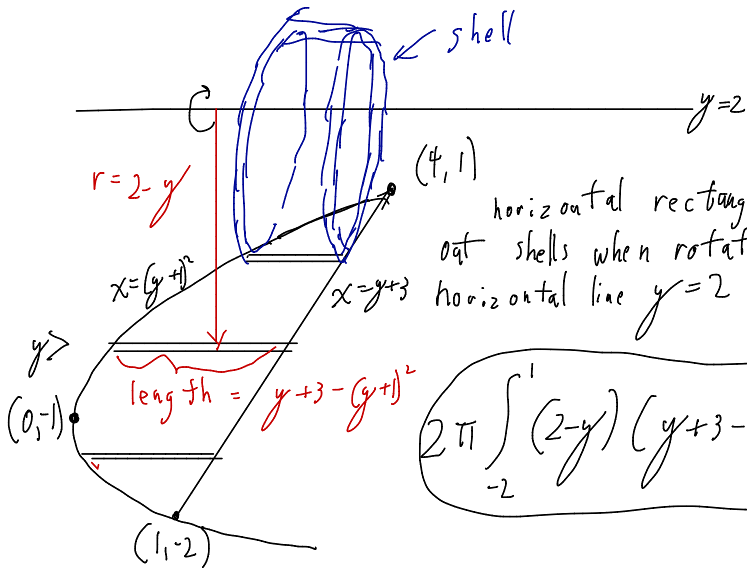
$$x = (y+1)^2$$

$$y = x - 3$$

and rotate it around the line

$$y = 2$$

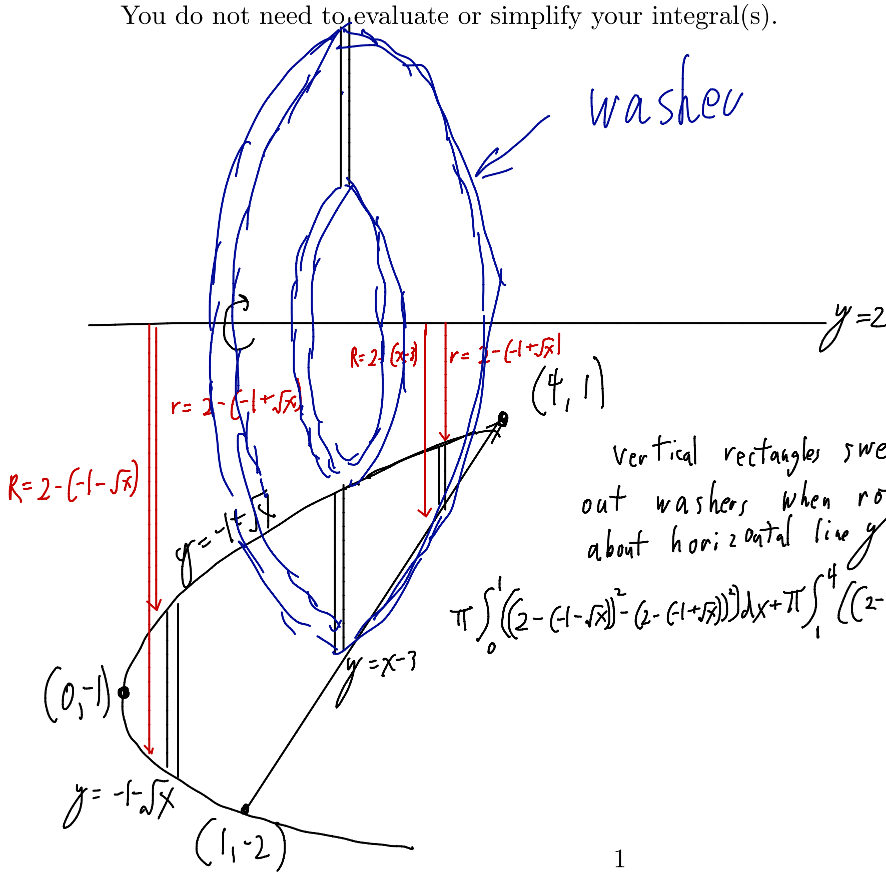
(a) Write an integral(s) with respect to y representing the volume of the resulting solid of revolution. You do not need to evaluate or simplify your integral(s).



horizontal rectangles sweep out shells when rotated about horizontal line $y=2$

$$2\pi\int_{-2}^{1}(2-y)\left(y+3-(y+1)^2\right)dy$$

(b) Write an integral(s) with respect to x representing the volume of the resulting solid of revolution. You do not need to evaluate or simplify your integral(s).

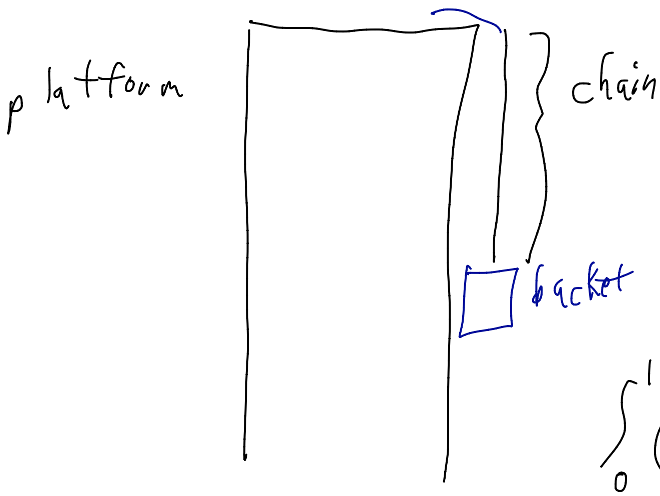


$$x=(y+1)^2$$
$$y+1=\pm\sqrt{x}$$
$$y=-1\pm\sqrt{x}$$

vertical rectangles sweep out washers when rotated about horizontal line $y=2$

$$\pi\int_0^1\left((2-(-1-\sqrt{x}))^2-(2-(-1+\sqrt{x}))^2\right)dx+\pi\int_1^4\left((2-(x-3))^2-(2-(-1+\sqrt{x}))^2\right)dx$$

2. A 10 foot chain weighing 20 pounds hangs off the side of a platform. At the end of the chain is a bucket weighting 5 pounds. How much work is needed to pull both the chain and the bucket to the platform? Show your work, writing and evaluating an appropriate integral.



weight density of chain is 2 lb/~~ft~~

x = chain pulled up so far (feet)

remaining weight of chain & bucket $= 2(10-x)+5$

$$\int_0^{10} \left(2(10-x)+5\right) dx = \int_0^{10} (25-2x)\,dx$$

$$= 25x - x^2 \Big|_0^{10} = 150 \text{ foot pounds}$$

3. We heat an oven. Suppose that

$$f(t) = \text{The temperature of the oven (°F) at time } t \text{ (minutes)}$$

$$g(t) = \text{The rate the temperature of the oven increases (°F / minute) at time } t \text{ (minutes)}$$

(a) Write an expression using $f(t)$ and no other variables representing the average temperature of the oven from 10 minutes to 30 minutes. Include appropriate units in your answer.

$$\frac{1}{30-10}\int_{10}^{30} f(t)\,dt \quad {}^\circ F$$

(b) Write an expression using $f(t)$ and no other variables representing the average rate the temperature of the oven increases from 10 minutes to 30 minutes. Include appropriate units in your answer.

$$\frac{f(30)-f(10)}{30-10} \quad \frac{{}^\circ F}{\text{min}}$$

(c) Write an expression using $g(t)$ and no other variables representing the average rate the temperature of the oven increases from 10 minutes to 30 minutes. Include appropriate units in your answer.

$$\frac{1}{30-10}\int_{10}^{30} g(t)\,dt \quad \frac{{}^\circ F}{\text{min}}$$