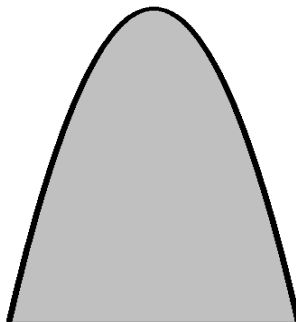
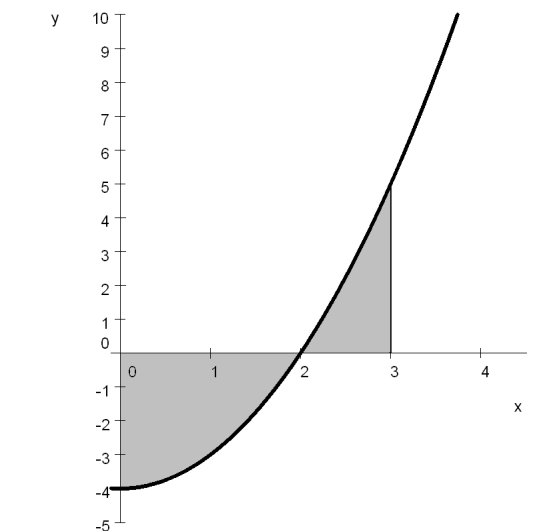


1. We need to build a door in the shape of a parabola. The door is to be of width of 6 feet and height of 9 feet. What is the surface area of this door?

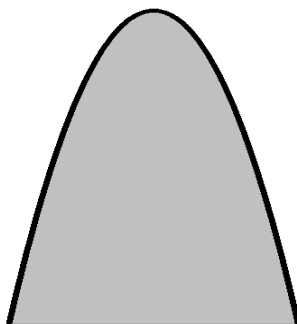


2. Redo the previous problem, this time the door needs to be of width of 4 feet and height of 8 feet.
3. Find the shaded area shown on the picture below. The function graphed there is $f(x) = x^2 - 4$.



4. Find the area enclosed by the graphs of
 - a) $f(x) = x^2 + 1$ and $g(x) = 2x + 4$
 - b) $f(x) = -x^2 + 9$ and $g(x) = -2x + 1$
 - c) $f(x) = x^2 + 6x - 7$ and $g(x) = 5x + 5$
5. Find the area between the graphs of $x = y^2 - 2$ and $y = x$.
6. The velocity of an object is $v(t) = -2t + 5$.
 - a) How much does the object travel between $t = 0$ and $t = 2$?
 - b) How much does the object travel between $t = 2$ and $t = 4$?
7. Water is flowing into a tub at a rate of $3t^2 + 2t$ liters per minute.
 - a) How many liters enter the tub between $t = 0$ and $t = 2$ minutes?
 - b) How many liters enter the tub between $t = 8$ and $t = 10$ minutes?

8. In a certain town, the rate of deaths at time t due to a particular disease is modeled by $250e^{-2t}$ where $t \geq 0$. What is the total number of deaths from this disease predicted by the model?
9. Find the average value of each of the following functions on the interval indicated.
- a) $f(x) = x^2$ on $[0, 6]$ d) $f(x) = \frac{1}{x}$ on $[1, 10]$
- b) $f(x) = \sin x$ on $[0, \pi]$ e) $f(x) = e^{-2x}$ on $[0, 2]$
- c) $f(x) = 2^x$ on $[1, 4]$



Answers

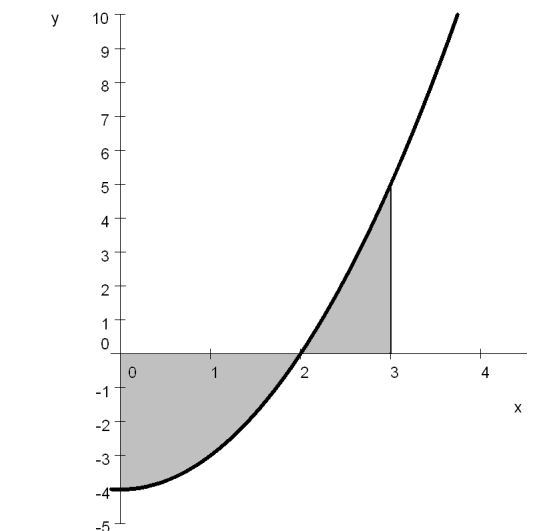
1. We need to build a door in the shape of a parabola. The door is to be of width of 6 feet and height of 9 feet. What is the surface area of this door? $\int_{-3}^3 (-x^2 + 9) dx = 36$

2. Redo the previous problem, this time the door needs to be of width of 4 feet and height of 8 feet.

$$\int_{-2}^2 2(-x^2 + 4) dx = \frac{64}{3} = 21\frac{1}{3}$$

3. Find the shaded area shown on the picture below. The function graphed there is $f(x) = x^2 - 4$. $\frac{23}{3}$

$$-\int_0^2 (x^2 - 4) dx + \int_2^3 (x^2 - 4) dx = \frac{23}{3}$$



4. Find the area enclosed by the graphs of

a) $f(x) = x^2 + 1$ and $g(x) = 2x + 4$. $\frac{32}{3}$

intersection points: $(-1, 2)$ and $(3, 10)$

$$\int_{-1}^3 ((2x + 4) - (x^2 + 1)) dx = \int_{-1}^3 (-x^2 + 2x + 3) dx = \frac{32}{3}$$

b) $f(x) = -x^2 + 9$ and $g(x) = -2x + 1$. 36

Intersection point: $(-2, 5)$ and $(4, -7)$

$$\int_{-2}^4 ((-x^2 + 9) - (-2x + 1)) dx = \int_{-2}^4 (-x^2 + 2x + 8) dx = 36$$

c) $f(x) = x^2 + 6x - 7$ and $g(x) = 5x + 5$ $\frac{343}{6}$

$x^2 + 6x - 7 = 5x + 5$, Solution is: $-4, 3$

$$\int_{-4}^3 ((5x + 5) - (x^2 + 6x - 7)) dx = \frac{343}{6}$$

5. Find the area between the graphs of $x = y^2 - 2$ and $y = x$.

$$\int_{-2}^{-1} (\sqrt{x+2} - (-\sqrt{x+2})) dx = \frac{4}{3} \int_{-1}^2 (\sqrt{x+2} - (x)) dx = \frac{19}{6}$$

$$\frac{19}{6} + \frac{4}{3} = \frac{9}{2}$$

6. The velocity of an object is $v(t) = -2t + 5$.

a) How much does the object travel between $t = 0$ and $t = 2$? 6

$$\int_0^2 (-2t + 5) dt = 6$$

b) How much does the object travel between $t = 2$ and $t = 4$? 2.5

$$\int_2^{2.5} (-2t + 5) dt = 0.25$$

$$\int_{2.5}^4 (-2t + 5) dt = -2.25$$

7. Water is flowing into a tub at a rate of $3t^2 + 2t$ liters per minute.

a) How many liters enter the tub between $t = 0$ and $t = 2$ minutes? $\int_0^2 (3t^2 + 2t) dt = 12$

b) How many liters enter the tub between $t = 8$ and $t = 10$ minutes? $\int_8^{10} (3t^2 + 2t) dt = 524$

8. In a certain town, the rate of deaths at time t due to a particular disease is modeled by $250e^{-2t}$ where $t \geq 0$. What is the total number of deaths from this disease predicted by the model? 125
9. Find the average value of each of the following functions on the interval indicated.

a) $f(x) = x^2$ on $[0, 6]$ $\frac{1}{6} \int_0^6 x^2 dx = 12$

b) $f(x) = \sin x$ on $[0, \pi]$ $\frac{1}{\pi} \int_0^{\pi} \sin x dx = \frac{2}{\pi}$

c) $f(x) = 2^x$ on $[1, 4]$ $\frac{1}{3} \int_1^4 2^x dx = \frac{14}{3 \ln 2} \cong 6.7326$

d) $f(x) = \frac{1}{x}$ on $[1, 10]$ $\frac{1}{9} \int_1^{10} \frac{1}{x} dx = \frac{1}{9} \ln 10 \cong 0.25584$

e) $f(x) = e^{-2x}$ on $[0, 2]$ $\frac{1}{2} \int_0^2 e^{-2x} dx = \frac{1}{4} - \frac{1}{4}e^{-4} \cong 0.24542$