1. Sketch the area represented by $g(x)$. Then find $g'(x)$ in two ways: (a) by using Part 1 of the Fundamental Theorem and (b) by evaluating the integral using Part 2 and then differentiating.

$$g(x) = \int_0^x (1 + \sqrt{t})\, dt$$

2. Use Part 1 of the Fundamental Theorem of Calculus to find the derivative of the function.

$$y = \int_{\sin(x)}^{\cos(x)} (1 + v^2)^{10}\, dv$$

3. On what interval is the curve

$$y = \int_0^x \frac{t^2}{t^2 + t + 2}\, dt$$

concave downward?

4. Let

$$f(x) = \begin{cases} 0 & \text{if } x < 0 \\ x & \text{if } 0 \le x \le 1 \\ 2 - x & \text{if } 1 < x \le 2 \\ 0 & \text{if} x > 2 \end{cases}$$

and

$$g(x) = \int_0^x f(t)\, dt$$

(a) Find an expression for $g(x)$ similar to the one for $f(x)$.

(b) Sketch the graphs of f and g.

(c) Where is f differentiable? Where is g differentiable?

5. Evaluate the indefinite integral

$$\int \frac{dx}{5 - 3x}$$

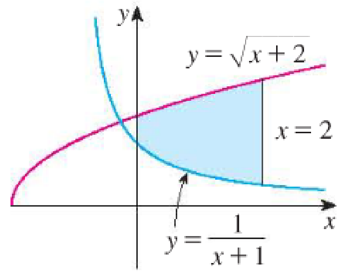
6. If f is continuous and $\int_0^9 f(x)\, dx = 4$, find $\int_0^3 x f(x^2)\, dx$.

7. If f is continuous on $\mathbb{R}$, prove that

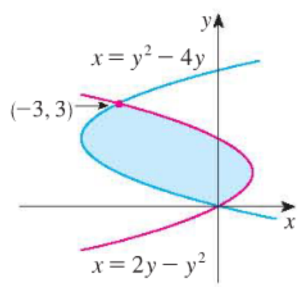
$$\int_a^b f(x+c)\,dx = \int_{a+c}^{b+c} f(x)\,dx$$

For the case where $f(x) \geq 0$, draw a diagram to interpret this equation geometrically as an equality of areas.

8. Find the area of the shaded region.



(a)



(b)

9. Sketch the region enclosed by the given curves. Decide whether to integrate with respect to x or y. Draw a typical approximating rectangle and label its height and width. Then find the area of the region.

$$4x + y^2 = 12,\ x = y$$

Optional Challenge Problem

Evaluate exactly the following integrals

1. $\displaystyle\int_0^{\sqrt[4]{3}} \frac{x}{1+x^4}\,dx$
2. $\displaystyle\int_0^{\pi/4} \sec^6(x)\tan(x)\,dx$