

## Section 5.4: The Fundamental Theorem of Calculus

These notes reflect material from our text, *Calculus, Concepts and Contexts, Third Edition*, by James Stewart, published by Brooks/Cole, Pacific Grove, CA, 2005.

*Key points from Stewart, Section 5.4: Fundamental Theorem of Calculus.*

### Concepts

**Theorem (Fundamental Theorem of Calculus).** If  $f(t)$  is a function whose derivative is continuous over the interval  $a \leq t \leq b$ , then

$$\int_a^b f'(t) dt = f(b) - f(a).$$

If  $f$  is continuous on the interval  $[a, b]$ , then the function

$$g(x) = \int_a^x f(t) dt$$

is an antiderivative of  $f$ . Thus,  $g'(x) = f(x)$ .

The Fundamental Theorem of Calculus relates integration and differentiation:

$$\int_a^b \frac{d}{dx} f(t) dt = f(x) \Big|_a^b$$

and

$$\frac{d}{dx} \int_a^x f(t) dt = f(x).$$

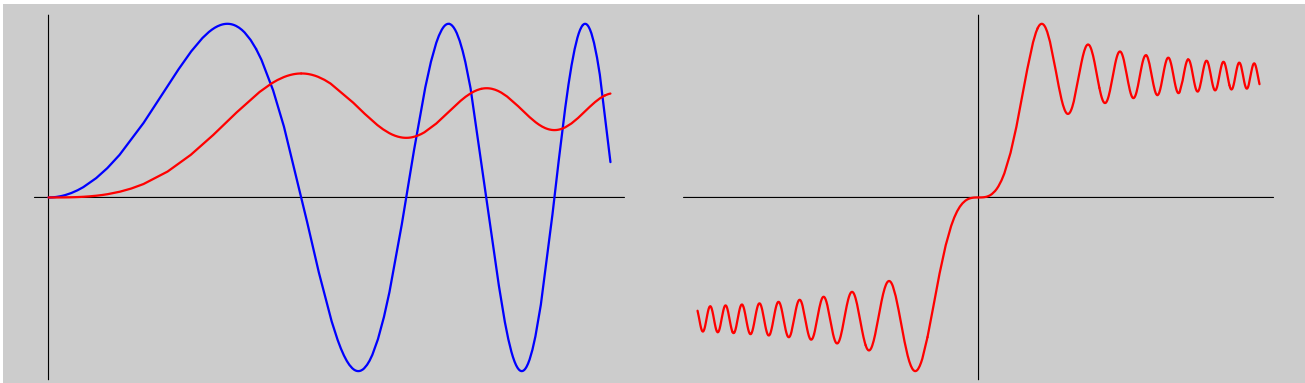


Fig. The Fresnel function  $S(x) = \int_0^x \sin(\pi t^2/2) dt$ .

### Exercises

*Exercises for Section 5.4, pp 383–385:* 3, 5, 9, 11, 15 (fundamental theorem of calculus), 19, 24 (sine integral function), 26, 27 (integral equation)