

# Worksheet 9

Dondi Ellis

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$$\text{Average rate of change of } f \text{ over the interval from } a \text{ to } a+h = \frac{f(a+h) - f(a)}{h}.$$

The **derivative of  $f$  at  $a$** , written  $f'(a)$ , is defined as

$$\text{Rate of change of } f \text{ at } a = f'(a) = \lim_{h \rightarrow 0} \frac{f(a+h) - f(a)}{h}.$$

If the limit exists, then  $f$  is said to be **differentiable at  $a$** .

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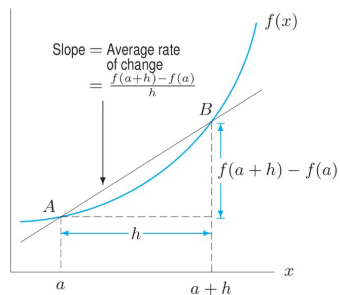
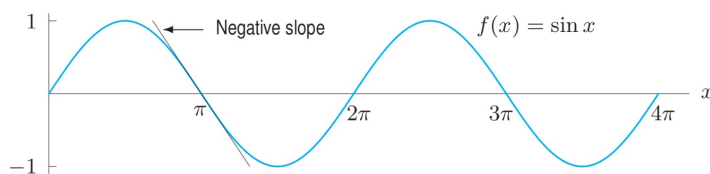


Figure 2.12: Visualizing the average rate of change of  $f$

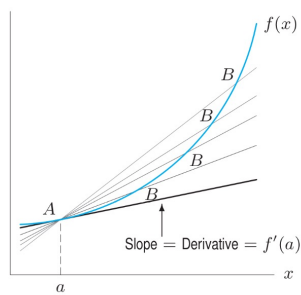


Figure 2.13: Visualizing the instantaneous rate of change of  $f$

The derivative at point  $A$  can be interpreted as:

- The slope of the curve at  $A$ .
- The slope of the tangent line to the curve at  $A$ .

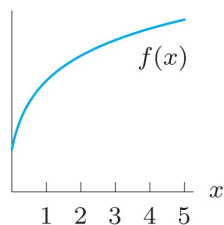


Figure 2.21

15. For each of the following pairs of numbers, use Figure 2.21 to decide which is larger. Explain your answer.

- (a)  $f(3)$  or  $f(4)$ ?
- (b)  $f(3) - f(2)$  or  $f(2) - f(1)$ ?
- (c)  $\frac{f(2) - f(1)}{2 - 1}$  or  $\frac{f(3) - f(1)}{3 - 1}$ ?
- (d)  $f'(1)$  or  $f'(4)$ ?

16. With the function  $f$  given by Figure 2.21, arrange the following quantities in ascending order:

$$0, \quad f'(2), \quad f'(3), \quad f(3) - f(2)$$

- 22. (a) If  $f$  is even and  $f'(10) = 6$ , what is  $f'(-10)$ ?
- (b) If  $f$  is any even function and  $f'(0)$  exists, what is  $f'(0)$ ?
- 23. If  $g$  is an odd function and  $g'(4) = 5$ , what is  $g'(-4)$ ?

Use algebra to evaluate the limits in Problems 35–40.

- 35.  $\lim_{h \rightarrow 0} \frac{(-3 + h)^2 - 9}{h}$
- 36.  $\lim_{h \rightarrow 0} \frac{(2 - h)^3 - 8}{h}$
- 37.  $\lim_{h \rightarrow 0} \frac{1/(1 + h) - 1}{h}$
- 38.  $\lim_{h \rightarrow 0} \frac{1/(1 + h)^2 - 1}{h}$