

DEFINITION A **function** f from a set D to a set Y is a rule that assigns a *unique* (single) element $f(x) \in Y$ to each element $x \in D$.



FIGURE 1.1 A diagram showing a function as a kind of machine.

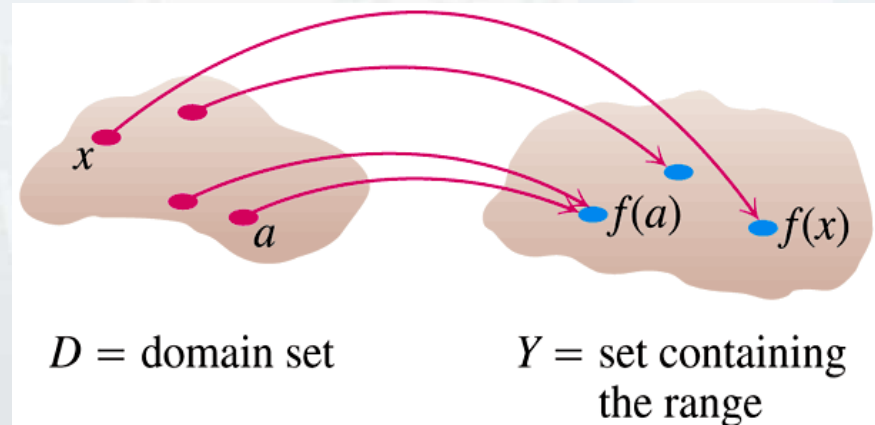


FIGURE 1.2 A function from a set D to a set Y assigns a unique element of Y to each element in D .

Shift Formulas

Vertical Shifts

$$y = f(x) + k$$

Shifts the graph of f *up* k units if $k > 0$

Shifts it *down* $|k|$ units if $k < 0$

Horizontal Shifts

$$y = f(x + h)$$

Shifts the graph of f *left* h units if $h > 0$

Shifts it *right* $|h|$ units if $h < 0$

1. $D_f: -\infty < x < \infty, D_g: x \geq 1 \Rightarrow D_{f+g} = D_{fg}: x \geq 1. R_f: -\infty < y < \infty, R_g: y \geq 0, R_{f+g}: y \geq 1, R_{fg}: y \geq 0$

2. $D_f: x + 1 \geq 0 \Rightarrow x \geq -1, D_g: x - 1 \geq 0 \Rightarrow x \geq 1. \text{ Therefore } D_{f+g} = D_{fg}: x \geq 1.$
 $R_f = R_g: y \geq 0, R_{f+g}: y \geq \sqrt{2}, R_{fg}: y \geq 0$

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$$7. (f \circ g \circ h)(x) = f(g(h(x))) = f(g(4 - x)) = f(3(4 - x)) = f(12 - 3x) = (12 - 3x) + 1 = 13 - 3x$$

$$8. (f \circ g \circ h)(x) = f(g(h(x))) = f(g(x^2)) = f(2(x^2 - 1)) = f(2x^2 - 1) = 3(2x^2 - 1) + 4 = 6x^2 + 1$$

$$9. (f \circ g \circ h)(x) = f(g(h(x))) = f\left(g\left(\frac{1}{x}\right)\right) = f\left(\frac{1}{\frac{1}{x} + 4}\right) = f\left(\frac{x}{1 + 4x}\right) = \sqrt{\frac{x}{1 + 4x} + 1} = \sqrt{\frac{5x + 1}{1 + 4x}}$$

$$10. (f \circ g \circ h)(x) = f(g(h(x))) = f\left(g\left(\sqrt{2 - x}\right)\right) = f\left(\frac{(\sqrt{2 - x})^2}{(\sqrt{2 - x})^2 + 1}\right) = f\left(\frac{2 - x}{3 - x}\right) = \frac{\frac{2 - x}{3 - x} + 2}{3 - \frac{2 - x}{3 - x}} = \frac{8 - 3x}{7 - 2x}$$