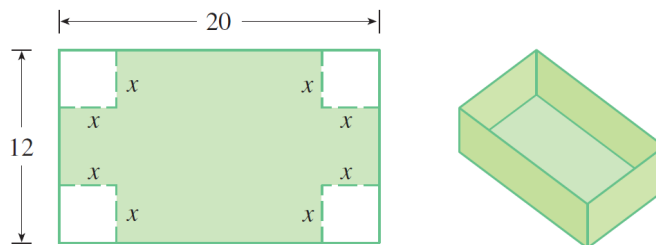
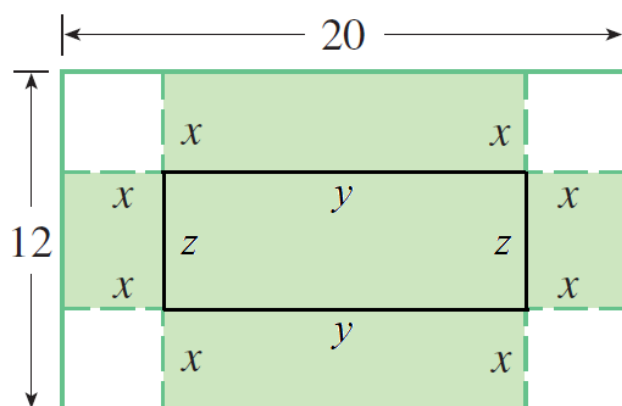


### Exercise 63

A box with an open top is to be constructed from a rectangular piece of cardboard with dimensions 12 in. by 20 in. by cutting out equal squares of side  $x$  at each corner and then folding up the sides as in the figure. Express the volume  $V$  of the box as a function of  $x$ .



### Solution



The volume of this box is the area of the base rectangle multiplied by the height.

$$V = xyz$$

Setup a system of equations to determine  $y$  and  $z$  in terms of  $x$ .

$$x + y + x = 20$$

$$x + z + x = 12$$

Solve for  $y$  and  $z$ .

$$y = 20 - 2x$$

$$z = 12 - 2x$$

Therefore, the volume becomes

$$\begin{aligned} V(x) &= x(20 - 2x)(12 - 2x) \\ &= 4x(10 - x)(6 - x) \\ &= 4x(x - 10)(x - 6) \\ &= 4x^3 - 64x^2 + 240x. \end{aligned}$$