MULTIPLYING LINEAR FUNCTIONS

Multiplying Linear Functions

- Multiplication is an operation that can be used to represent several actions including:
  - equal-sized groups that are joined together;
  - area;
  - repeated addition; and
  - scaling the size of an object.

Multiplying Linear Functions

- A linear function with a constant rate of change is one type of polynomial function. You can multiply linear functions two ways:
- 1. Make a table of values for each factor to generate the values of the function that is the product of the factors. Then, use finite differences to generate a symbolic function rule.
- 2. Multiply the symbolic function rules and use the properties of algebra and laws of exponents to simplify the expressions.

Examples

- The Sign of the Times Company markets a variety of rectangular signs made of a durable weatherproof material mounted on a frame. The table shows the dimensions of the signs in feet and the resulting area of the face of the signs in square feet. Use the table values to write a function rule for the surface area. Verify your rule by writing the function rule for $A(n)$ as a product of the functions for length and width.

SIGN NUMBER, n	LENGTH, $L(n)$	WIDTH, $W(n)$	AREA, $A(n)$
0	1	2	2
1	2	3	6
2	3	4	12
3	4	5	20
4	5	6	30
5	6	7	42

Examples

- Step 1: Find the function of the length, L(n).
  - $\Delta x = 1; \Delta y = 1;$ y-int $= 1$
    - $L(n) = \frac{1}{1}n + 1 = n + 1$

- Step 2: Find the function of the width, W(n).
  - $\Delta x = 1; \Delta y = 1;$ y-int $= 2$
    - $W(n) = \frac{1}{1}n + 2 = n + 2$

Examples

- Step 3: Multiply the length and width to find the area of the signs.
  - $L(n) * W(n) = (n + 1) * (n + 2)$
  - $L(n) * W(n) = [(n * n) + (n * 2) + (1 * n) + (1 * 2)]$
  - $L(n) * W(n) = [n^2 + 2n + 1n + 2]$
  - $L(n) * W(n) = n^2 + 3n + 2$

Examples

- Step 4: Use the calculator to find the function for the area, A(n), and compare it to the function for L(n) * W(n).
  - $A(n) = L(n) * W(n)$
  - $n^2 + 3n + 2 = n^2 + 3n + 2$
- The functions are the same

Examples

- A metal baking pan is constructed by cutting a square out of each corner of a rectangular sheet of aluminum measuring 12 inches by 18 inches. The sides created are then folded up to form the height of the pan. Use the table of values to write a function rule, $V(x)$, for the volume of the baking pan. Use your function rule to predict the volume of a pan that has a square of 2.5 inches cut out of each corner.

SIDE LENGTH OF SQUARE, IN INCHES, x	WIDTH OF PAN, IN INCHES, $w(x)$	LENGTH OF PAN, IN INCHES, $l(x)$	HEIGHT OF SIDES, IN INCHES, $h(x)$	VOLUME OF PAN, IN CU. IN., $V(x)$
0	12	18	0	0
1	10	16	1	160
2	8	14	2	224
3	6	12	3	216
4	4	10	4	160
5	2	8	5	80

Examples

- Step 1: Write a function rule for the volume of the pan, $\boldsymbol{V}(\boldsymbol{x})$.
  - $V(x) = 4x^3 - 60x^2 + 216x$.
- Step 2: Substitute $\boldsymbol{x} = 2.5$ into the function to determine the volume of the resulting pan.
  - $V(x) = 4x^3 - 60x^2 + 216x$
  - $V(2.5) = 4(2.5)^3 - 60(2.5)^2 + 216(2.5)$
  - $V(2.5) = 4(15.625) - 60(6.25) + 216(2.5)$
  - $V(2.5) = 62.5 - 375 + 540$
  - $V(2.5) = 227.5$
- The volume of the resulting pan will be 227.5 cubic inches.