

## Polynomial Operations Lesson #6: Problem Solving with Polynomial Products



Bentwood boxes are containers traditionally constructed by the Northwest Coast Aboriginal peoples. An artist typically uses a single piece of wood that is bent to form a box in the shape of a rectangular prism using only steam and strategically placed grooves. Traditional uses of these boxes range from food and clothing storage to burials.

The images below are examples of a bentwood box and can be referenced at the following website <https://www.rmcommunity.org/items/3442#>

Front View



Back and Side View



Additional information on Bentwood art can be found at <https://en.wikipedia.org/wiki/Bentwood>

A Haida artist constructs a bentwood box with the following dimensions:  
length  $(5x - 2)$  cm, width  $(3x - 1)$  cm, and height  $(3x + 1)$  cm.

a) Write and simplify an expression for the volume of the bentwood box in  $\text{cm}^3$ .

$$\begin{aligned}
 V &= lwh \\
 &= (5x-2)(3x-1)(3x+1) \\
 &= (15x^2 - 5x - 6x + 2)(3x+1) \\
 &= (15x^2 - 11x + 2)(3x+1) \\
 &= 3x(15x^2 - 11x + 2) + 1(15x^2 - 11x + 2) \\
 &= 45x^3 - 33x^2 + 6x + 15x^2 - 11x + 2 \\
 &= (45x^3 - 18x^2 - 5x + 2) \text{ cm}^3
 \end{aligned}$$

b) Write and simplify an expression for the surface area of the bentwood box in  $\text{cm}^2$ .

c) If  $x = 20$ , calculate the volume and surface area of the bentwood box.

$$\begin{aligned}
 &= 45(20^3) - 18(20^2) - 5(20) + 2 \\
 &= 352702 \text{ cm}^3
 \end{aligned}$$

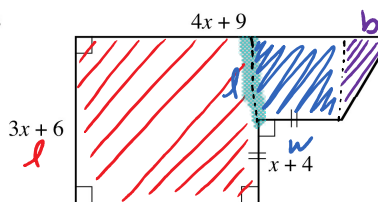
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a) The area of the given figure can be written as a trinomial in the form  $ax^2 + bx + c$ . Determine the values of  $a$ ,  $b$ , and  $c$ .

$$\begin{aligned}
 A &= lw \\
 &= (3x+6)(2x+3) \\
 &= 6x^2 + 30x + 18
 \end{aligned}$$



$$\begin{aligned}
 A\Delta &= \frac{bh}{2} \\
 &= \frac{x(3x+6)}{2}
 \end{aligned}$$

$$\begin{aligned}
 A &= lw \\
 &= (3x+6)(2x+3) \\
 &= 6x^2 + 9x + 12x + 18 \\
 &= 6x^2 + 21x + 18
 \end{aligned}$$

unknown  $l$

$$\begin{array}{r}
 3x+6 \\
 -(x+4) \\
 \hline
 2x+2
 \end{array}$$

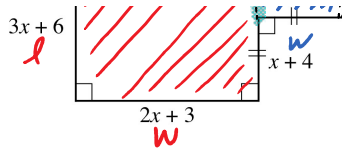
$$\begin{aligned}
 (x+4)(2x+2) \\
 = 2x^2 + 2x + 6x + 8 \\
 = 2x^2 + 8x + 8
 \end{aligned}$$

b) Calculate the area if  $x = 2.5$ .

$$9(2.5^2) + 32(2.5) + 28 = 69.25 \text{ cm}^2$$



The hypotenuse of a right triangle is  $(5x+5)$  cm long and the lengths of the other two sides are  $(4x+8)$  cm and  $(3x-5)$  cm. Form an equation and solve it to determine the lengths of the three sides of the triangle.



$$\begin{aligned}
 &\surd (2x+2)(x+2) \\
 &= \frac{2x^2 + 4x + 2x + 4}{2} \\
 &= \frac{2x^2 + 6x + 4}{2} \\
 &= x^2 + 3x + 2
 \end{aligned}$$

$$\begin{array}{r}
 \overline{)4x+9} \\
 2x+3 \quad \overline{)x+4} \\
 \underline{4x+9} \\
 -(2x+3) \\
 \underline{-(x+4)} \\
 x+2
 \end{array}$$

Total Area

$$\begin{aligned}
 &\square + \square + \surd \\
 &6x^2 + 21x + 18 \\
 &2x^2 + 8x + 8 \\
 &+ x^2 + 3x + 2
 \end{aligned}$$

$$9x^2 + 32x + 28$$

Complete Assignment Questions #1 - #15

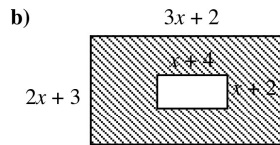
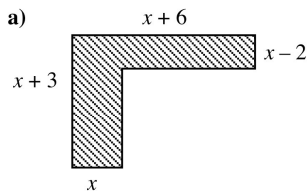
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# 1, 5, 9, 10

Quiz next day!  
HW & workbook  
hand-in next day

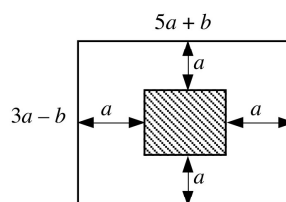
Assignment

- In each case, the figures consist of a series of horizontal and vertical lines. The area of each figure can be written as a trinomial in the form  $ax^2 + bx + c$ . Determine the values of  $a$ ,  $b$ , and  $c$ , and calculate the area when  $x = 2.4$ .



2. The figure consists of a rectangle within a rectangle.

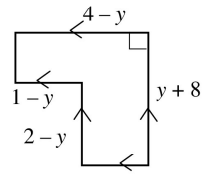
a) Determine a simplified expression of the shaded area in terms of  $a$  and  $b$ .



b) Calculate the area when  $a = 2.8$  and  $b = -3.5$ .

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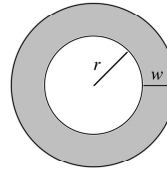
3. a) Determine the area of the figure in the form  $ay^2 + by + c$ .



- b) Determine the area of the figure when  $y = -2$ .
4. A square metal plate of side 25 cm is heated so that each side increases in length by  $x$  cm.
- a) Write and simplify an expression for the area of the heated plate.
- b) Write and simplify an expression for the increase in area of the plate.
- c) If  $x = 0.2$ , calculate the increase in area.
5. A square garden with a side length of  $(3x + 1)$  m contains two square flower beds each with a side length of  $(x + 1)$  m. The remainder of the garden is grass.
- a) Draw a diagram to illustrate this information.
- b) Write and simplify an expression for the area of grass in the garden.

6. A metal washer has internal radius  $r$  mm and width  $w$  mm as shown.

a) Write an expression for the outer radius of the washer.



b) Show that the area of the washer,  $A$  mm<sup>2</sup>, is given by  $A = 2\pi rw + \pi w^2$ .

7. Solve the following equations where the variable is in the set of real numbers.

a)  $(3x - 1)(x - 1) = 3x(x + 1)$

b)  $(y + 2)^2 = y^2 + 2$

c)  $t^2 - (t - 9)^2 = 9$

d)  $2a^2 - (a - 3)^2 = (a + 2)(a - 1)$

8. The hypotenuse of a right triangle is  $(5x - 6)$  cm long and the lengths of the other two sides are  $(4x - 7)$  cm and  $(3x - 1)$  cm. Form an equation and solve it to determine the value of  $x$  and the lengths of the three sides of the triangle.

9. Consider a set of rectangles with sides  $(4a - 3)$  cm and  $(2a + 7)$  cm.
- Write and simplify an expression in  $a$  for the area of one of these rectangles.
  - If one of these rectangles has a perimeter of 50 cm, determine the length and width of this rectangle.
  - If another of these rectangles is a square, determine the length of each side.
10. A rectangle has length  $(x^2 + 4x - 1)$  cm and width  $(3x - 2)$  cm.
- Write and simplify an expression for the area of the rectangle in  $\text{cm}^2$ .
  - If  $x = 2.5$ , calculate the area of the rectangle.
11. Dice for a children's board game are cubes with an edge length of  $(3x - 2)$  mm.
- Write and simplify an expression for the volume of a die in  $\text{mm}^3$ .
  - The manufacturer packages dice in cubic containers containing 64 dice. Determine the volume of the container in  $\text{cm}^3$  if  $x = 4$ .

12. A rectangular garden with length  $(8 - 3a)$  m and width  $(a + 8)$  m contains three square flower beds, each with a side length of  $(2a + 5)$  m. The remainder of the garden is grass.
- a) Draw a diagram to illustrate this information.

b) Write and simplify an expression for the area of grass in the garden.

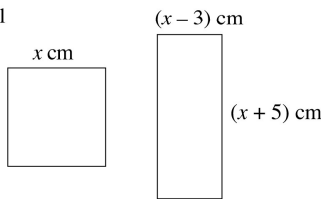
c) Determine the area of grass if  $a = -1.5$ .

**Multiple Choice**

13. A box is in the shape of a rectangular prism. The length of the box is  $y$  cm. The width is 2 cm less than the length, and the height is 2 cm more than the length. If the volume of the box can be written in the form  $V = ay^3 + by^2 + cy + d$  where  $a$ ,  $b$ ,  $c$ , and  $d$  are integers, then how many of the parameters  $a$ ,  $b$ ,  $c$ , and  $d$  are equal to zero?
- A. 0  
B. 1  
C. 2  
D. 3

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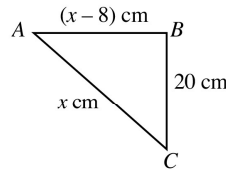
14. The square and the rectangle in the diagram are equal in area.  
The value of  $x$ , to the nearest tenth, is \_\_\_\_\_.



(Record your answer in the numerical response box from left to right)

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15. The diagram shows the lengths of the sides of right triangle  $ABC$ .  
The perimeter (to the nearest tenth of a cm) of triangle  $ABC$  is \_\_\_\_\_.



(Record your answer in the numerical response box from left to right)

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**Answer Key**

1. a)  $a = 1, b = 9, c = -12$ , area = 15.36 units<sup>2</sup>      b)  $a = 5, b = 7, c = -2$ , area = 43.6 units<sup>2</sup>  
 2. a)  $3a^2 - 2ab - b^2$     b) 30.87 units<sup>2</sup>      3. a)  $30 - y - 2y^2$     b) 24 units<sup>2</sup>  
 4. a)  $625 + 50x + x^2$  cm<sup>2</sup>    b)  $50x + x^2$  cm<sup>2</sup>      c) 10.04 cm<sup>2</sup>  
 5. b)  $(3x + 1)^2 - 2(x + 1)^2 = 7x^2 + 2x - 1$  m<sup>2</sup>      6. a)  $(r + w)$  mm  
 7. a)  $\frac{1}{7}$     b)  $-\frac{1}{2}$     c) 5    d)  $\frac{7}{5}$   
 8.  $(5x - 6)^2 = (4x - 7)^2 + (3x - 1)^2$ ;  $x = 7$ ;    29 cm, 21 cm 20 cm  
 9. a)  $(4a - 3)(2a + 7) = 8a^2 + 22a - 21$  cm<sup>2</sup>      b) 11 cm by 14 cm      c) 17 cm  
 10. a)  $(x^2 + 4x - 1)(3x - 2) = 3x^3 + 10x^2 - 11x + 2$  cm<sup>2</sup>    b) 83.875 cm<sup>2</sup>  
 11. a)  $(3x - 2)^3 = 27x^3 - 54x^2 + 36x - 8$  mm<sup>3</sup>      b) 64 cm<sup>3</sup>  
 12. b)  $-15a^2 - 76a - 11$  m<sup>2</sup>      c) 69.25 m<sup>2</sup>  
 c) volume = 2574 cm<sup>3</sup>, surface area = 1150 cm<sup>2</sup>

13. C      14. 

7	.	5	
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      15. 

7	0	.	0
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