

## Chapter 3 Section 5 Lesson Evaluation Expressions

### Introduction

We've seen how to use variables to represent numbers in algebraic expressions. In this lesson, you will learn how to **evaluate** such expressions. As you go through the lesson, notice how the value of an algebraic expression changes as the variables are assigned different values.

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**Evaluate** means to substitute the given number for the variable and then simplify the expression.

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### **Example A**

Evaluate the monomial  $3x^2$  when  $x = 5$ .

$$\text{If } x = 5, \text{ then } 3x^2 = 3(5)^2 = 3 \cdot 25 = 75.$$

Evaluate  $3x^2$  when  $x = 5$

$$3 \cdot (5)^2 = 3 \cdot 25 = 75$$

*This image represents an animation that can only be seen in the course online.*

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### **Example B**

Evaluate  $3x^2$  when  $x = -2$  and then when  $x = 2$ .

$$\text{If } x = -2, \text{ then } 3x^2 = 3(-2)^2 = 3 \cdot 4 = 12.$$

$$\text{If } x = 2, \text{ then } 3x^2 = 3(2)^2 = 3 \cdot 4 = 12.$$

Evaluate  $3x^2$  when  $x = 2$

$$3 \cdot (2)^2 = 3 \cdot 4 = 12$$

*This image represents an animation that can only be seen in the course online.*

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### **Example C**

Evaluate the monomial  $-5s^3$  when  $s = 4$ ,  $s = 1$ ,  $s = -2$ , and  $s = -\frac{1}{2}$ .

$$\text{If } s = 4, \text{ then } -5s^3 = -5(4)^3 = -5 \cdot 64 = -320.$$

$$\text{If } s = 1, \text{ then } -5s^3 = -5(1)^3 = -5 \cdot 1 = -5.$$

$$\text{If } s = -2, \text{ then } -5s^3 = -5(-2)^3 = (-5)(-8) = 40.$$

$$\text{If } s = -\frac{1}{2}, \text{ then } -5s^3 = -5\left(-\frac{1}{2}\right)^3 = (-5)\left(-\frac{1}{8}\right) = \frac{5}{8}.$$

In this case, the value of the monomial changes a lot even when the value of the variable changes very little.

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**Example D**

Evaluate  $a - b + 7$  when  $a = 14$  and  $b = 3$ .

Replace  $a$  with 14 and  $b$  with 3:  $a - b + 7 = 14 - 3 + 7 = 18$ .

Evaluate  $a - b + 7$  when  $a = 14$  and  $b = 3$

$$(14) - (3) + 7 = 11 + 7 = 18$$

*This image represents an animation that can only be seen in the course online.*

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**Example E**

Evaluate  $9xy$  when  $x = 5$  and  $y = 3$ .

$$\text{If } x = 5 \text{ and } y = 3, \text{ then } 9xy = 9(5)(3) = 135.$$

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**Example F**

Evaluate  $\frac{m}{n}$  when  $m = 57$  and  $n = 6$ . Write your answer in lowest terms.

$$\frac{m}{n} = \frac{57}{6} \quad \text{You can reduce this fraction: } \frac{57}{6} = \frac{\cancel{3} \cdot 19}{2 \cdot \cancel{3}} = \frac{19}{2}.$$

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**Example G**

Evaluate the monomial  $Ax^4$  when  $A = 2$  and  $x = -3$ ,  $x = -2$ ,  $x = -1$ ,  $x = 0$ ,  $x = 1$ ,  $x = 2$ , and  $x = 3$ .

$$Ax^4 = (2)(-3)^4 = 2 \cdot 81 = 162$$

$$Ax^4 = (2)(-2)^4 = 2 \cdot 16 = 32$$

$$Ax^4 = (2)(-1)^4 = 2 \cdot 1 = 2$$

$$Ax^4 = (2)(0)^4 = 2 \cdot 0 = 0$$

$$Ax^4 = (2)(1)^4 = 2 \cdot 1 = 2$$

$$Ax^4 = (2)(2)^4 = 2 \cdot 16 = 32$$

$$Ax^4 = (2)(3)^4 = 2 \cdot 81 = 162$$

*Note:*

- When you substitute a negative number for a variable, use parentheses.
  - You could have saved time by noting that  $(-3)^4 = 3^4$  and  $(-2)^4 = 2^4$ .
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**Question:** Evaluate  $2x^2 + 3x + 5$  when  $x = -2$ .

*Answer:* Substitute the value into the expression in place of  $x$ , using parentheses:

$$2(-2)^2 + 3(-2) + 5$$

Then simplify the expression using the correct order of operations.

$$= 2(4) + 3(-2) + 5$$

$$= 8 + (-6) + 5$$

$$= 2 + 5$$

$$= 7$$

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**Question:** Evaluate  $\frac{x}{3} + \frac{2y}{3}$  when  $x = 4$  and  $y = 7$ .

*Answer:* Substitute the values into the expression:

$$\frac{(4)}{3} + \frac{2(7)}{3}$$

Then simplify.

$$= \frac{4}{3} + \frac{14}{3}$$

$$= \frac{18}{3}$$

$$= 6$$

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### **Example H**

Renting a truck costs \$19.95 per day and \$0.45 for each mile driven. Write an expression for the cost,  $C$ , to rent a truck for one day and drive  $m$  miles. Then use the expression to determine the cost to rent a truck for one day and drive 200 miles.

We are assuming that  $m$  miles are driven, at \$0.45 per mile, so the cost for these miles is:  
 $0.45m$ .

Add the \$19.95 daily fee to the cost for the miles to find the total cost.

$$C = 0.45m + 19.95$$

To rent for one day and drive 200 miles, it will cost:

$$C = 0.45m + 19.95 = 0.45 \cdot 200 + 19.95 = 90 + 19.95 = \$109.95$$

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**Example I**

Your boss asks you to make copies of an employee training manual. It costs \$0.15 per page to copy the manual and \$2.00 to bind each manual.

- a) Write an expression for the total cost,  $C$ , to print and bind a training manual that is  $p$  pages long.
- b) How much does it cost to make a copy of a 75-page manual?
- c) Write an expression for the cost,  $C$ , to produce  $m$  manuals that contain  $p$  pages each.
- d) How much does it cost to make 12 copies of a 50-page manual?

a)  $C = \$0.15p + \$2$

b)  $C = \$0.15(75) + \$2 = \$13.25$

c)  $C = m(\$0.15p + \$2)$

d)  $C = 12[\$0.15(50) + \$2] = \$114$

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**Question:** José lives 150 miles east of Las Vegas. He drives west toward the city at 60 mph. Write an expression for Jose's distance,  $D$ , from the city after  $t$  hours. Then, use the expression to find his distance after 2.25 hours.

*Answer:* The distance is originally 150 miles, and is decreasing as the car drives west at the rate of 60 mph:  $D = 150 - 60t$ .

Substitute the given time for  $t$ , and simplify:

$$D = 150 - 60(2.25)$$

$$D = 150 - 135$$

$$D = 15$$

After 2.25 hours, the car is 15 miles from the city.

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**End of Lesson**