1.3 Algebraic Expressions

Focus Use a variable to represent a set of numbers.

We can use symbols to represent a pattern.

Explore

Tehya won some money in a competition.
She has two choices as to how she gets paid.
Choice 1: $20 per week for one year
Choice 2: $400 cash now plus $12 per week for one year

Which method would pay Tehya more money?
For what reasons might Tehya choose each method of payment?

Reflect & Share

Work with another pair of classmates.
For each choice, describe a rule you can use to calculate the total money Tehya has received at any time during the year.

Connect

We can use a variable to represent a number in an expression.
For example, we know there are 100 cm in 1 m.

We can write 1 × 100 cm in 1 m.
There are 2 × 100 cm in 2 m.
There are 3 × 100 cm in 3 m.

Recall that a variable is a letter, such as *n*, that represents a quantity that can vary.

To write an expression for the number of centimetres in any number of metres, we say there are $n \times 100$ cm in n metres.
n is a variable.
n represents any number we choose.

We can use any letter, such as n or x, as a variable.
The expression $n \times 100$ is written as $100n$.
$100n$ is an **algebraic expression**.

Variables are written in italics so they are not confused with units of measurement.

Here are some other algebraic expressions, and their meanings.
In each case, n represents the number.

- Three more than a number: $3 + n$ or $n + 3$
- Seven times a number: $7n$
- Eight less than a number: $n - 8$
- A number divided by 20: $\frac{n}{20}$

$7n$ means $7 \times n$.

When we replace a variable with a number in an algebraic expression, we *evaluate* the expression. That is, we find the value of the expression for a particular value of the variable.

Example

Write each algebraic expression in words.
Then evaluate for the value of the variable given.

a) $5k + 2$ for $k = 3$ **b)** $32 - \frac{x}{4}$ for $x = 20$

A Solution

a) $5k + 2$ means 5 times a number, then add 2.
Replace k with 3 in the expression $5k + 2$.
Then use the order of operations.

$5k + 2 = 5 \times 3 + 2$ Multiply first.
$= 15 + 2$ Add.
$= 17$

b) $32 - \frac{x}{4}$ means 32 minus a number divided by 4.
Replace x with 20 in the expression $32 - \frac{x}{4}$.
Then use the order of operations.

$\frac{x}{4}$ means $x \div 4$.

$32 - \frac{x}{4} = 32 - \frac{20}{4}$ Divide first.
$= 32 - 5$ Subtract.
$= 27$

In the expression $5k + 2$,

- 5 is the **numerical coefficient** of the variable.
- 2 is the **constant term**.
- k is the *variable*.
  The variable represents any number in a set of numbers.

Practice

1. Identify the numerical coefficient, the variable, and the constant term in each algebraic expression.

a) $3x + 2$ **b)** $5n$ **c)** $w + 3$ **d)** $2p + 4$

2. An algebraic expression has variable p, numerical coefficient 7, and constant term 9.
Write as many different algebraic expressions as you can that fit this description.

3. Write an algebraic expression for each phrase.

a) six more than a number
b) a number multiplied by eight
c) a number decreased by six
d) a number divided by four

4. A person earns $4 for each hour he spends baby-sitting.

a) Find the money earned for each time.
i) 5 h **ii)** 8 h
b) Write an algebraic expression you could use to find the money earned in t hours.

5. Write an algebraic expression for each sentence.

a) Double a number and add three.
b) Subtract five from a number, then multiply by two.
c) Divide a number by seven, then add six.
d) A number is subtracted from twenty-eight.
e) Twenty-eight is subtracted from a number.

6. **a)** Write an algebraic expression for each phrase.
i) four more than a number
ii) a number added to four
iii) four less than a number
iv) a number subtracted from four
b) How are the expressions in part a alike?
How are they different?

7. Evaluate each expression by replacing x with 4.

a) $x + 5$ **b)** $3x$ **c)** $2x - 1$

d) $\frac{x}{2}$ **e)** $3x + 1$ **f)** $20 - 2x$

8. Evaluate each expression by replacing z with 7.

a) $z + 12$ **b)** $10 - z$ **c)** $5z$

d) $3z - 3$ **e)** $35 - 2z$ **f)** $3 + \frac{z}{7}$

9. Assessment Focus Jason works at a local fish and chips restaurant.
He earns \$7/h during the week, and \$9/h on the weekend.

a) Jason works 8 h during the week and 12 h on the weekend.
Write an expression for his earnings.

b) Jason works x hours during the week and 5 h on the weekend.
Write an expression for his earnings.

c) Jason needs \$115 to buy sports equipment.
He worked 5 h on the weekend.
How many hours does Jason have to work during the week to have the money he needs?

10. Take It Further A value of n is substituted in each expression to get the number in the box.
Find each value of n.

a) $5n$	30	**b)** $3n - 1$	11
c) $4n + 7$	15	**d)** $5n - 4$	11
e) $4 + 6n$	40	**f)** $\frac{n}{8}$	5

Reflect

Explain why it is important to use the order of operations when evaluating an algebraic expression.
Use an example in your explanation.