



Literal Equations and Formulas

Section 2.5

Goals



Goal

- To rewrite and use literal equations and formulas.

Vocabulary



- Literal Equation
- Formula

Definition



- *Literal Equation* – an equation with two or more variables.
 - You can "rewrite" a literal equation to isolate any one of the variables using inverse operations. This is called *solving for a variable*.
 - When you rewrite literal equations, you may have to divide by a variable or variable expression. In this lesson, assume that the variable or variable expression is not equal to zero. Division by zero is not defined.
- Examples: $x = \frac{b - c}{a}$, $z = \frac{2}{5}xy + 3$

Solving a Literal Equation



Solving for a Variable

Step 1 Locate the variable you are asked to solve for in the equation.

Step 2 Identify the operations on this variable and the order in which they are applied.

Step 3 Use inverse operations to undo operations and isolate the variable.

Example: Solving Literal Equations



A. Solve $x + y = 15$ for x .

$$x + y = 15$$

$$\underline{-y} \quad \underline{-y}$$

$$x = -y + 15$$

Locate x in the equation.

Since y is added to x , subtract y from both sides to undo the addition.

B. Solve $pq = x$ for q .

$$pq = x$$

$$\underline{p} = \underline{p}$$

$$p = p$$

$$q = \frac{x}{p}$$

Locate q in the equation.

Since q is multiplied by p , divide both sides by p to undo the multiplication.

Your Turn:



Solve $5 - b = 2t$ for t .

$$5 - b = 2t$$

$$\frac{5 - b}{2} = \frac{2t}{2}$$

$$\frac{5 - b}{2} = t$$

Locate t in the equation.

Since t is multiplied by 2, divide both sides by 2 to undo the multiplication.

Your Turn:



Solve $D = \frac{m}{V}$ for V

$$D = \frac{m}{V}$$

$$V(D) = V \frac{m}{V}$$

$$VD = m$$

$$\frac{VD}{D} = \frac{m}{D}$$

$$V = \frac{m}{D}$$

Locate V in the equation.

Since m is divided by V , multiply both sides by V to undo the division.

Since V is multiplied by D , divide both sides by D to undo the multiplication.

Your Turn: More Practice



Solve for the indicated variable.

1. $V = \frac{1}{3}Ah$ for h $h = \frac{3V}{A}$

2. $P = R - C$ for C $C = R - P$

3. $2x + 7y = 14$ for y $y = \frac{14 - 2x}{7}$

4. $\frac{m}{x} = k - 6$ for m $m = x(k - 6)$

5. $R = \frac{C - S}{t}$ for C $C = Rt + S$

Definition



- *Formula* – is an equation that states a rule for a relationship among quantities.
 - A formula is a type of *literal equation*.
 - In the formula $d = rt$, d is isolated. You can "rearrange" a formula to isolate any variable by using inverse operations.
- Examples:
 - Circumference: $C = 2\pi r$
 - Area of Triangle: $A = 1/2bh$

Example: Solving Formulas



The formula for the area of a triangle is $A = \frac{1}{2}bh$, where b is the length of the base, and h is the height. Solve for h .

$$A = \frac{1}{2}bh$$

Locate h in the equation.

$$\frac{2A}{1} = \frac{2}{1} \left(\frac{1}{2}bh \right)$$

Since bh is multiplied by $\frac{1}{2}$, divide both sides by $\frac{1}{2}$ to undo the multiplication.

$$\frac{2A}{b} = \frac{bh}{b}$$

Since h is multiplied by b , divide both sides by b to undo the multiplication.

$$\frac{2A}{b} = h$$



Remember!

Dividing by a fraction is the same as multiplying by the reciprocal.

Example: Solving Formulas



The formula for a person's typing speed is

$$s = \frac{w - 10e}{m}, \text{ where } s \text{ is speed in words per minute,}$$

w is number of words typed, e is number of errors, and m is number of minutes typing. Solve for e .

$$s = \frac{w - 10e}{m}$$

$$m(s) = m \left(\frac{w - 10e}{m} \right)$$

$$ms = w - 10e$$

$$\begin{array}{r} \underline{-w} \quad \underline{-w} \\ ms - w = -10e \end{array}$$

Locate e in the equation.

Since $w - 10e$ is divided by m , multiply both sides by m to undo the division.

Since w is added to $-10e$, subtract w from both sides to undo the addition.

Example: Continued



$$\frac{ms - w}{-10} = \frac{-10e}{-10}$$

$$\frac{ms - w}{-10} = e$$

Since e is multiplied by -10 , divide both sides by -10 to undo the multiplication.

Your Turn:



The formula for an object's final velocity is $f = i - gt$, where i is the object's initial velocity, g is acceleration due to gravity, and t is time. Solve for i .

$$f = i - gt$$

Locate i in the equation.

$$\begin{array}{r} f = i - gt \\ + \underline{gt} \quad + \underline{gt} \end{array}$$

*Since gt is subtracted from i ,
add gt to both sides to undo
the subtraction.*

$$f + gt = i$$

Example: Application



The formula $C = \pi d$ gives the circumference of a circle C in terms of diameter d . The circumference of a bowl is 18 inches. What is the bowl's diameter? Leave the symbol π in your answer.

$$C = \pi d$$

Locate d in the equation.

$$\frac{C}{\pi} = \frac{\pi d}{\pi}$$

Since d is multiplied by π , divide both sides by π to undo the multiplication.

$$\frac{C}{\pi} = d, \text{ or } d = \frac{C}{\pi}$$

Now use this formula and the information given in the problem.

Example: Continued



The formula $C = \pi d$ gives the circumference of a circle C in terms of diameter d . The circumference of a bowl is 18 inches. What is the bowl's diameter? Leave the symbol π in your answer.

$$\frac{C}{\pi} = d, \text{ or } d = \frac{C}{\pi}$$

Now use this formula and the information given in the problem.

$$d = \frac{C}{\pi} = \frac{18}{\pi}$$

The bowl's diameter is $\frac{18}{\pi}$ inches.

Your Turn:



Solve the formula $d = rt$ for t . Find the time in hours that it would take Ernst Van Dyk to travel 26.2 miles if his average speed was 18 miles per hour.

$$d = rt$$

Locate t in the equation.

$$\frac{d}{r} = \frac{rt}{r}$$

Since t is multiplied by r , divide both sides by r to undo the multiplication.

$$\frac{d}{r} = t, \text{ or } t = \frac{d}{r}$$

Now use this formula and the information given in the problem.

$$t = \frac{d}{r} = \frac{26.2}{18} \approx 1.4\bar{5} \quad \text{Van Dyk's time was about 1.46 hrs.}$$

Joke Time



- How do you know when it's raining cats and dogs?
- When you step in a poodle!
- Why did the apple go out with a fig?
- Because it couldn't find a date.
- Which sea creature can add?
- An octoplus!