Sec 1.4 Rewrite Formulas and Equations

Before	You solved equations.
Now	You will rewrite and evaluate formulas and equations.
Why?	So you can apply geometric formulas, as in Ex. 36.

Goals

- **Goal 1: To rewrite common formulas**
- **Goal 2: To rewrite equations with more than one variable**

Formulas

- It is essential to use formulas in the study of algebra because many formulas are the link between mathematics and real-life.
- Throughout this course we will be rewriting many formulas by solving for various variables in the formulas.
- A **formula** is an equation that relates two or more quantities, usually represented by variables. Some common formulas will be given.

Common Formulas

	Formula	**Variables**
Distance	$d = r t$	d = distance, r = rate, t = time
Temperature	$F = \frac{9}{5}C + 32$	F= degrees Fahrenheit, C = degrees Celsius
Area of a Triangle	$A = \frac{1}{2} b h$	A = area, b = base, h = height
Area of a Rectangle	$A = l w$	A = area, l = length, w = width
Perimeter of a Rectangle	$P = 2l + 2w$	P = perimeter, l = length, w = width
Area of a Trapezoid	$A = \frac{1}{2}(b_1 + b_2) h$	A= area, b_1 = length of one base, b_2 = length of other base, h = height
Area of a Circle	$A = \pi r^2$	A = area, r = radius
Circumference of a Circle	$C = 2\pi r$	C = circumference, r = radius

Definition

- To **solve for a variable** means to write an equation as an equivalent equation in which the variable **is alone on one side** and **does not appear on the other side.**

Example 1 Rewriting Formulas

- Solve the formula $\boxed{C=2\pi r}$ for r. Then find the radius of a circle with a circumference of 44 inches.

ⓖ $\frac{C}{2\pi} = \frac{\cancel{2\pi} r}{\cancel{2\pi}}$

$\boxed{\frac{C}{2\pi} = r}$

ⓑ $r = \frac{C}{2\pi}$

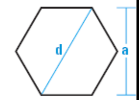
$r = \frac{\cancel{44}\,22}{\cancel{2}\pi}$

$\boxed{r = \frac{22}{\pi} \quad r \approx 7.00}$

Emphasize the process, not the answer.

GUIDED PRACTICE for Example 1

1. Find the radius of a circle with a circumference of 25 feet.
2. The formula for the distance d between opposite vertices of a regular hexagon is $d = \frac{2a}{\sqrt{3}}$ where a is the distance between opposite sides. Solve the formula for a. Then find a when $d = 10$ centimeters.



$\sqrt{3} \cdot d = \frac{2a}{\cancel{\sqrt{3}}} \cdot \frac{\cancel{\sqrt{3}}}{1}$

$\frac{d\sqrt{3}}{2} = \frac{\cancel{2}a}{\cancel{2}}$

$\boxed{\frac{d\sqrt{3}}{2} = a}$

$\frac{\cancel{10}^{5} \cdot \sqrt{3}}{\cancel{2}_{1}} = a$

$5\sqrt{3} = a$

$8.66 \approx a$

Example 2 Rewriting Formulas

- The formula for perimeter of a rectangle is P = 2l + 2w. Solve this formula for w.

$P = \cancel{2l} + \boxed{2w}$
$\boxed{-2l} \; \cancel{-2l}$

$\frac{P-2l}{2} = \frac{\cancel{2}w}{\cancel{2}}$

$\boxed{\frac{P-2l}{2} = w}$

~~$\frac{15 - \cancel{2}(5)}{\cancel{2}}$~~ $= 2.5$

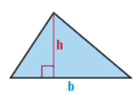
can't cancel

GUIDED PRACTICE for Example 2 START HERE

3. Solve the formula $P = 2\ell + 2w$ for ℓ. Then find the length of a rectangle with a width of 7 inches and a perimeter of 30 inches.
4. Solve the formula $A = \ell w$ for w. Then find the width of a rectangle with a length of 16 meters and an area of 40 square meters.

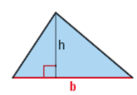
Solve the formula for the variable in red. Then use the given information to find the value of the variable.

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



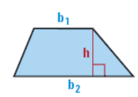
Find h if $b = 12$ m and $A = 84$ m^2.

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



Find b if $h = 3$ cm and $A = 9$ cm^2.

7. $A = \frac{1}{2}(b_1 + b_2)h$



Find h if $b_1 = 6$ in., $b_2 = 8$ in., and $A = 70$ in.^{2}

also talk about units

Equations

- The approach we used to solve a formula for a variable can be applied to other algebraic equations.

Example 3

$y = \frac{-5(-3)+7}{3}$

$y = \frac{15+7}{3}$ or $\boxed{y = \frac{22}{3}}$

- Solve for *y*. ***Then*** find the value of *y* when *x* = -3.

$$5x + 3y = 7$$

$-5x \qquad\qquad -5x$

$\frac{\cancel{3}y}{\cancel{3}} = \frac{-5x+7}{3}$

$\boxed{y = \frac{-5x+7}{3}}$ or $y = -\frac{5x}{3} + \frac{7}{3}$

or $y = -\frac{5}{3}x + \frac{7}{3}$

$-\frac{5}{3}x = -\frac{5}{3} \cdot \frac{x}{1} = \frac{-5x}{3}$

Example 4: Rewrite a nonlinear equation

- Solve $2x + xy = 6$ for y. Then find the value of y when $x = 2$.

$$2x + xy = +6$$
$$-2x \qquad -2x$$
$$\frac{xy}{x} = \frac{-2x+6}{x}$$
$$\boxed{y = \frac{-2x+6}{x}}$$
$$y = \frac{-2(2)+6}{2}$$
$$y = \frac{-4+6}{2}$$
$$y = \frac{2}{2} = 1$$

When $x=2$, $y=1$

Solve for *y* ***first***.

GUIDED PRACTICE for Examples 3 and 4

Solve the equation for y. ~~Then find the value of y when $x = 2$.~~

8. $y - 6x = 7$	9. $5y - x = 13$	10. $3x + 2y = 12$
11. $2x + 5y = -1$	12. $3 = 2xy - x$	13. $4y - xy = 28$

$$\frac{y(\cancel{4-x})}{\cancel{4-x}} = \frac{28}{4-x}$$
$$y = \frac{28}{4-x}$$

Example 5 Real-Life Model

- MOVIE RENTAL: A video store rents new movies for one price (\$5) and older movies for a lower price (\$3).
- Write an equation that represents the store's monthly revenue. (What is revenue?)
- Solve the revenue equation for the variable representing the number of new movies rented.
- The owner wants \$12,000 in revenue per month. How many new movies must be rented if the number of older movies rented is 500? 1000?

Example 5 Real-Life Model

- MOVIE RENTAL: A video store rents new movies for one price (\$5) and older movies for a lower price (\$3).
- Write an equation that represents the store's monthly revenue.
- First creative verbal model and label the model:

Monthly revenue (dollars)	=	Price of new movies (dollars/movie)	·	Number of new movies (movies)	+	Price of older movies (dollars/movie)	·	Number of older movies (movies)
R	=	5	·	n_1	+	3	·	n_2

Example 5 Real-Life Model

$$R = 5 \cdot n_n + 3 \cdot n_2$$

- Solve the revenue equation for the variable representing the number of new movies rented.

$$R = 5n_n + 3n_o$$
$$-3n_o \qquad -3n_o$$
$$\frac{R-3n_o}{5} = \frac{\cancel{5}\cdot n_n}{\cancel{5}}$$
$$n_n = \frac{R-3n_o}{5}$$

Example 5 Real-Life Model

$$R = 5 \cdot n_1 + 3 \cdot n_2$$

- The owner wants \$12,000 in revenue per month. How many new movies must be rented if the number of older movies rented is 500? 1000?

$$n_n = \frac{R-3n_o}{5}$$
$$n_n = \frac{12000-3n_o}{5}$$
$$n_n = \frac{12000-3(500)}{5} = 2100$$
$$n_n = \frac{12000-3(1000)}{5} = 1800$$

GUIDED PRACTICE for Example 5

14. **WHAT IF?** In Example 5, how many new movies must be rented if the number of older movies rented is 1500?

15. **WHAT IF?** In Example 5, how many new movies must be rented if customers rent *no* older movies at all?

16. Solve the equation in Step 1 of Example 5 for n_2.

Assignment

- Sec 1.4
  - 1-3, 5, 6, 7-15 odd, 16, 18, 20, 21, 24, 29, 30, 33, 34, 36, 38, 40, 41, 47, 53

Additional Examples

Additional Examples