

1.3A Literal Equations Review

A. Introduction

These are equations with many variables in them.

The goal is to solve for one. To do this, treat all the other variables as if they were numbers.

B. Strategy

Follow the same procedure as for linear and rational equations.

Additional features:

1. Disallowed values only occur if the desired variable occurs in a denominator.
2. When isolating, move everything with the desired variable to one side and move everything else to the other side.
3. To finish isolating when the desired variable appears in more than one term, factor it out.

Note: The variable you want can not occur on both sides of the equation at the end, and we do not typically put the solutions to literal equations in set notation.

C. Examples

Example 1: Solve $2kx + 7 = 9ky$ for k

Solution

$$\underline{2kx} + \underline{7} = \underline{9ky}$$


$$2kx - 9ky = -7$$

Factor out k : $k(2x - 9y) = -7$

Divide by $2x - 9y$: $k = \frac{-7}{2x - 9y}$

Ans: $k = \frac{-7}{2x - 9y}$ or $k = \frac{7}{9y - 2x}$ $\leftarrow$ by multiplying top and bottom by -1

Example 2: Solve $y(x + 3) = 5xz + 4$ for x

Solution

$$\underline{xy} + \underline{3y} = \underline{5xz} + \underline{4}$$


$$xy - 5xz = 4 - 3y$$

Factor out x : $x(y - 5z) = 4 - 3y$

Divide by $y - 5z$: $x = \frac{4 - 3y}{y - 5z}$

Ans: $x = \frac{4 - 3y}{y - 5z}$

Example 3: Solve $d = \frac{fl}{f+w}$ for f

Solution

$$\text{LCD} = f+w$$

Disallowed value for f : $f+w=0$
 $f=-w$

Disallowed value for f : $f \neq -w$

Multiply both sides by $\text{LCD} = f+w$

$$(f+w)d = (f+w) \left[\frac{fl}{f+w} \right]$$

$$df + dw = fl$$

Now isolate f : $df - fl = -dw$

Factor out f : $f(d-l) = -dw$

Divide by $d-l$: $f = \frac{-dw}{d-l}$

Not a disallowed value!

Ans: $f = \frac{-dw}{d-l} \quad \text{OR} \quad f = \frac{dw}{l-d}$

Example 4: Solve $\frac{p}{3x+m} + \frac{q}{nx-1} = 0$ for x

Solution

$$\text{LCD} = (3x+m)(nx-1)$$

Disallowed values for x : set $3x+m=0 \Rightarrow 3x=-m$
 $x = -\frac{m}{3}$

set $nx-1=0 \Rightarrow nx=1$
 $x = \frac{1}{n}$

Disallowed values for x : $x \neq -\frac{m}{3}, \frac{1}{n}$

Multiply both sides by LCD:

$$(3x+m)(nx-1) \left[\frac{p}{3x+m} + \frac{q}{nx-1} \right] = (3x+m)(nx-1) \cdot 0$$

$$p(nx-1) + q(3x+m) = 0$$

$$\underbrace{np}_{\text{arrow}} \underbrace{x}_{\text{arrow}} - \underbrace{p}_{\text{arrow}} + \underbrace{3q}_{\text{arrow}} \underbrace{x}_{\text{arrow}} + \underbrace{mq}_{\text{arrow}} = 0$$

$$np x + 3q x = p - mq$$

Factor out x : $x(np+3q) = p-mq$

Divide by $np+3q$: $x = \frac{p-mq}{np+3q}$

Not a disallowed value!

Ans: $\boxed{x = \frac{p-mq}{np+3q}}$