2.3
Solving Equations Using More than 1 Property of Equality

Recall: To solve an equation we "undo" the math until the variable is all by itself on one side of the =.

ex $x+6=10$
$-6 \quad -6$ "undo" the +6 by −6
$x=4$

$\frac{2x}{2}=\frac{10}{2}$ "undo" the 2* by ÷2
$x=5$

What if I have
$2x+6=10$
now I have 2* and +6.

Steps (Do order of ops in reverse!)
1. Undo any +, −
2. Undo any ÷ then *

ex $2x+6=10$
$-6 \quad -6$ undo +6
$\frac{2x}{2}=\frac{4}{2}$ undo 2*
$x=2$
check: $2(2)+6=4+6=10$ ✓

ex $\frac{3x}{4} - 8 = 4$
$+8 \quad +8$

undo -8

$4\left(\frac{3x}{4}\right) = (12)4$

undo $\div 4$

$\frac{3x}{3} = \frac{48}{3}$

undo 3

$x = 16$

or

$\frac{3x}{4} - 8 = 4$
$+8 \quad +8$

undo -8

$\frac{3x}{4} = 12$

$\frac{\frac{3}{4}x}{\frac{3}{4}} = \frac{12}{\frac{3}{4}}$

undo $\frac{3}{4}*$

$x = 16$

Check: $\frac{3(16)}{4} - 8 = \frac{48}{4} - 8 = 12 - 8 = 4$ ✓

Simplifying to Solve

If we can simplify an equation it's usually easier to solve.

ex $3(x+4)-2x=18$

$3x+12-2x=18$ Simplify

$x+12=18$

$-12 \quad -12$ undo +12

$x=6$

Check: $3(6+4)-2(6)=3(10)-12=30-12=18$ ✓

You might have a variable on both sides
- add/subtract all to one side.

ex $5x+4=3x-2$

$-3x \quad -3x$ move 3x over by -3x from both

$5x+4-3x=-2$

$2x+4=-2$ combine like terms

$-4 \quad -4$ undo +4

$\frac{2x}{2}=\frac{-6}{2}$ undo 2*

$x=-3$

Check: $5(-3)+4=-15+4=-11$ ✓

$3(-3)-2=-9-2=-11$

Clearing Fractions

In some equations you may want to clear the fractions (since integers are easier to work with.)

ex $12\left(\frac{x}{4}+\frac{2}{3}\right)=-\frac{5}{6}\,12$ LCD is 4, 8, 12, 16, 20

* both sides by 12. 3, 6, 9, 12

6, 12

$12\left(\frac{x}{4}+\frac{2}{3}\right)=\left(-\frac{5}{6}\right)12$

$12\cdot\frac{x}{4}+12\cdot\frac{2}{3}=-\frac{5}{6}\cdot 12$

$3x+4\cdot 2=-5\cdot 2$

$3x+8=-10$

$-8 \quad -8$ undo +8

$\frac{3x}{3}=\frac{-18}{3}$ undo *3

$x=-6$

check: $\frac{-6}{4}+\frac{2}{3}=\frac{-18}{12}+\frac{8}{12}=\frac{-10}{12}=-\frac{5}{6}$ ✓

Could do

$\frac{x}{4}+\frac{2}{3}=-\frac{5}{6}$

$-\frac{2}{3} \quad -\frac{2}{3}$ undo $+\frac{2}{3}$

$\frac{x}{4}=-\frac{5}{6}-\frac{4}{6}$

$4\left(\frac{x}{4}\right)=\left(-\frac{9}{6}\right)4$

$x=-\frac{36}{6}$ undo ÷4

$x=-6$

check: $\frac{-6}{4}+\frac{2}{3}=-\frac{10}{12}=-\frac{5}{6}$

Steps to Solving Equations

1. Clear all fractions
2. remove parentheses (by Distributive)
3. Combine like terms
4. Undo + and − to get all variables on one side and all constants on the other
5. Undo * and ÷ to get variable alone.
6. Check the result.

(ex) $\frac{5x+2}{11} = x+1$

1. $5x+2 = 11x+11$
2.
3.
4. $2 = 6x+11$

   $-9 = 6x$
5. $-9/6 = x$, $\boxed{x = -3/2}$
6. $\frac{5(-3/2)+2}{11} = \frac{-15/2 + 4/2}{11} = \frac{-11/2}{11} = -\frac{1}{2}$

   $-3/2 + 1 = -3/2 + 2/2 = -1/2$ ✓

Identities & Impossible Equations

Some equations are ALWAYS true

ex $x+x=2x$

no matter what # you put in for x, this will always be true.

These are called identities.

Some equations are NEVER true

ex $x=x+1$

These are called impossible equation.

How to find identities & impossible equations

1. Try to solve the equation
2. If you get something obviously true, it's identity
   "false, it's I.E.

ex $2(x+5)=2x+12$

$2x+10=2x+12$

$-2x \quad -2x$

$10=12$ This is I.E.

ex $3(x+2)=2(x+3)+x$

$3x+6=2x+6+x$

$3x+6=3x+6$

$-3x \quad -3x$

$6=6$ This is Id.