

1.2 Linear Equations & Rational Equations

GOALS:

1. Recognize equations as linear
2. Solve linear equations using the *Addition Property of Equality* and the *Multiplication Property of Equality*
3. Solve rational equations using the *Multiplication Property of Equality*
4. Classify equations as *Conditional, Inconsistent, or Identities*

Study 1.2 CVC 1-11, 2 # 1- 15;
17, 21, 25, 29; 31, 35, ..., 59; 61 - 67, 95

Class Notes: Prof. G. Battaly, Westchester Community College, NY

Homework

 College Algebra & Trig Home Page



1.2 Linear Equations & Rational Equations

Linear Equation in 1 variable:
can be written in the form

$$ax + b = 0, \quad a \neq 0$$

where x is variable
and a, b are constant

Class Notes: Prof. G. Battaly, Westchester Community College, NY

Homework

 College Algebra & Trig Home Page



1.2 Linear Equations & Rational Equations

$$ax + b = 0, a \neq 0$$

Which is a linear equation?

$$2x + 9 = 0$$

$$2\sqrt{x} + 9 = 0$$

$$2x^2 - 9 = 0$$

$$2x + 9 = 29$$

$$2x + 3(x - 2) = 9$$

Class Notes: Prof. G. Battaly, Westchester Community College, NY

Homework

College Algebra & Trig Home Page

1.2 Linear Equations & Rational Equations

$$ax + b = 0, a \neq 0$$

Which is a linear equation?

$$2x + 9 = 0$$

$$2\sqrt{x} + 9 = 0$$

$$2x^2 - 9 = 0$$

$$2x + 9 = 29$$

$$2x + 3(x - 2) = 9$$

Class Notes: Prof. G. Battaly, Westchester Community College, NY

Homework

College Algebra & Trig Home Page

1.2 Linear Equations & Rational Equations

Is this a linear equation?
 $2x + 3(x - 2) = 9$

Can it be converted to the form
 $ax + b = 0, a \neq 0$
 where x is variable
 and a, b are constant ?

$2x + 3x - 6 = 9$ DP
 $5x - 6 = 9$ CLT
 $5x - 15 = 0$ APE

Yes. This is linear. $a = 5, b = -15$

Class Notes: Prof. G. Battaly, Westchester Community College, NY

College Algebra & Trig Home Page [Homework](#)

1.2 Linear Equations & Rational Equations

Solve the equation:
 $2x + 3(x - 2) = 9$

Find values that make the equation true.

$2x + 3x - 6 = 9$ DP
 $5x - 6 = 9$ CLT
 $5x = 15$ APE
 $x = 3$ MPE

Class Notes: Prof. G. Battaly, Westchester Community College, NY

College Algebra & Trig Home Page [Homework](#)

1.2 Linear Equations & Rational Equations

To Solve a Linear Equation

1. Simplify using CLT, DP, etc
2. Use the Addition Property of Equality (APE) to isolate the variable term as one member of the equation
3. Use the Multiplication Property of Equality (MPE) to isolate the variable $1x = c$

Class Notes: Prof. G. Battaly, Westchester Community College, NY

[Homework](#)[College Algebra & Trig Home Page](#)

1.2 Linear Equations & Rational Equations

$$3x + 5 = 2x + 13$$

$$x = c$$

Class Notes: Prof. G. Battaly, Westchester Community College, NY

[Homework](#)[College Algebra & Trig Home Page](#)

1.2 Linear Equations & Rational Equations

$$3x + 5 = 2x + 13$$

$$X = C$$

Subtract 2x
also subtract 5

How? Why?

Use APE to add equal amounts to both members.

Subtraction is addition of the opposite.

Class Notes: Prof. G. Battaly, Westchester Community College, NY

Homework

College Algebra & Trig Home Page

1.2 Linear Equations & Rational Equations

Use APE to add amounts to both members.

Can do one at a time.

$$3x + 5 = 2x + 13$$

$$-2x \quad = -2x$$

$$\begin{array}{r}
 x + 5 = +13 \\
 -5 = -5 \\
 \hline
 x = 8
 \end{array}$$

$$X = C$$

check:

$$\begin{array}{r}
 3(8) + 5 \quad ? \quad 2(8) + 13 \\
 24 + 5 \quad \quad 16 + 13 \\
 29 = 29 \quad \checkmark
 \end{array}$$

Class Notes: Prof. G. Battaly, Westchester Community College, NY

Check helpful, but not required. Have not multiplied or divided by a variable.

College Algebra & Trig Home Page

Homework

1.2 Linear Equations & Rational Equations

$$3x + 5 = 2x + 13$$

X = C

Use APE to add equal amounts to both members.

Can do both at once.

$$3x + 5 = 2x + 13$$

$$\underline{-2x - 5 = -2x - 5}$$

$$x = 8$$

Addition Property of Equality

Class Notes: Prof. G. Battaly, Westchester Community College, NY

Homework

College Algebra & Trig Home Page

1.2 Linear Equations & Rational Equations

$$6x - 3 = 63$$

Class Notes: Prof. G. Battaly, Westchester Community College, NY

Homework

College Algebra & Trig Home Page

1.2 Linear Equations & Rational Equations

$$6x - 3 = 63$$

$$\begin{array}{r} 6x - 3 = 63 \\ + 3 = + 3 \\ \hline 6x = 66 \\ x = 11 \end{array}$$

APE
MPE (x 1/6)

Ch: $6(11) - 3 \stackrel{?}{=} 63$
 $66 - 3 = 63 \checkmark$

Check helpful, but not required. Have not multiplied or divided by a variable.

Class Notes: Prof. G. Battaly, Westchester Community College, NY

Homework

College Algebra & Trig Home Page

1.2 Linear Equations & Rational Equations

$$2(x - 1) + 3 = x - 3(x + 1)$$

1. Simplify using CLT, DP, etc
2. Use the Addition Property of Equality (APE) to isolate the variable term as one member of the equation
3. Use the Multiplication Property of Equality (MPE) to isolate the variable $1x = c$

Class Notes: Prof. G. Battaly, Westchester Community College, NY

Homework

College Algebra & Trig Home Page

1.2 Linear Equations & Rational Equations

$$2(x - 1) + 3 = x - 3(x + 1)$$

$$2(x - 1) + 3 = x - 3(x + 1)$$

$$2x - 2 + 3 = x - 3x - 3$$

$$2x + 1 = -2x - 3$$

$$\frac{+2x - 1 = +2x - 1}{4x = -4}$$

$$4x = -4$$

$$x = -1$$

DP

CLT

APE

APE

MPE multiply by 1/4

Check: $2(-1-1)+3 \stackrel{?}{=} -1-3(-1+1)$
 $2(-2)+3 \stackrel{?}{=} -1+0$
 $-4+3 = -1 \checkmark$

Check helpful, but not required. Have not multiplied or divided by a variable.

Class Notes: Prof. G. Battaly, Westchester Community College, NY

Homework

College Algebra & Trig Home Page

1.2 Linear Equations & Rational Equations

$$\frac{x}{5} - \frac{1}{2} = \frac{x}{6}$$

1st Find LCD = 5(6)=30

Class Notes: Prof. G. Battaly, Westchester Community College, NY

Homework

College Algebra & Trig Home Page

1.2 Linear Equations & Rational Equations

$$\frac{x}{5} - \frac{1}{2} = \frac{x}{6} \quad \text{1st Find LCD} = 5(6)=30$$

$$30 \left[\frac{x}{5} - \frac{1}{2} = \frac{x}{6} \right]$$

Class Notes: Prof. G. Battaly, Westchester Community College, NY

Homework

College Algebra & Trig Home Page

1.2 Linear Equations & Rational Equations

$$30 \left[\frac{x}{5} - \frac{1}{2} = \frac{x}{6} \right]$$

$$30 \cdot \frac{x}{5} - 30 \cdot \frac{1}{2} = 30 \cdot \frac{x}{6}$$

$$6x - 15 = 5x$$

$$-5x + 15 = -5x + 15$$

$$x = 15$$

Check:

$$\frac{15}{5} - \frac{1}{2} \stackrel{?}{=} \frac{15}{6}$$

$$3 - \frac{1}{2} = \frac{5}{2} = 2.5 \quad \checkmark$$

Check helpful, but not required. Have not multiplied or divided by a variable.

Class Notes: Prof. G. Battaly, Westchester Community College, NY

Homework

College Algebra & Trig Home Page

1.2 Linear Equations & Rational Equations

$$\frac{x}{5} = \frac{x}{6} + 1$$

What approach?

MPE

Class Notes: Prof. G. Battaly, Westchester Community College, NY

Homework

College Algebra & Trig Home Page

1.2 Linear Equations & Rational Equations

$$30 \left[\frac{x}{5} = \frac{x}{6} + 1 \right] \quad \text{MPE}$$

$$\frac{30}{1} \cdot \frac{x}{5} = \frac{30}{1} \cdot \frac{x}{6} + 30 \cdot 1$$

$$6x = 5x + 30$$

$$-5x = -5x$$

$$x = 30$$

Check:

$$\frac{30}{5} \stackrel{?}{=} \frac{30}{6} + 1$$

$$6 \stackrel{?}{=} 5 + 1$$

Check helpful, but not required. Have not multiplied or divided by a variable.

Class Notes: Prof. G. Battaly, Westchester Community College, NY

Homework

College Algebra & Trig Home Page

1.2 Linear Equations & Rational Equations

$$\frac{5}{x} = \frac{10}{3x} + 4 \quad x \neq 0 \quad \text{LCD} = 3x$$

Class Notes: Prof. G. Battaly, Westchester Community College, NY

College Algebra & Trig Home Page Homework

1.2 Linear Equations & Rational Equations LCD = 3x

$$3x \left[\frac{5}{x} = \frac{10}{3x} + 4 \right] \quad x \neq 0$$

$$\frac{3x \cdot 5}{1 \cdot x} = \frac{3x \cdot 10}{3x} + 3x \cdot 4$$

$$15 = 10 + 12x$$

$$-10 = -10$$

$$\frac{5}{12} = \frac{12x}{12}$$

$$\frac{5}{12} = x \quad x = \frac{5}{12}$$

Check:

$$\frac{5}{\frac{5}{12}} \stackrel{?}{=} \frac{10}{\frac{5}{12}} + 4$$

$$5 \cdot \frac{12}{5} \stackrel{?}{=} \frac{10 \cdot 12}{5} + 4$$

$$12 = 8 + 4 \quad \checkmark$$

Check is required!
Have multiplied by a variable.

Class Notes: Prof. G. Battaly, Westchester Community College, NY

College Algebra & Trig Home Page Homework

1.2 Linear Equations & Rational Equations

$$\frac{8x}{x+1} = 4 - \frac{8}{x+1}$$

$$\begin{aligned} \text{LCD} &= x+1 \\ x &\neq -1 \end{aligned}$$

Class Notes: Prof. G. Battaly, Westchester Community College, NY

Homework

College Algebra & Trig Home Page

1.2 Linear Equations & Rational Equations

$$(x+1) \left[\frac{8x}{x+1} = 4 - \frac{8}{x+1} \right]$$

$$\begin{aligned} \text{LCD} &= x+1 \\ x &\neq -1 \end{aligned}$$

$$\frac{\cancel{(x+1)} \cdot 8x}{1 \cdot \cancel{(x+1)}} = (x+1)4 - \frac{\cancel{(x+1)} \cdot 8}{1 \cdot \cancel{(x+1)}}$$

$$8x = 4(x+1) - 8$$

$$8x = 4x + 4 - 8$$

$$8x = 4x - 4$$

$$-4x = -4x$$

$$4x = -4$$

$$x = -1$$

~~⊙~~ DOES NOT EXIST $x \neq -1$

Inconsistent equation

Class Notes: Prof. G. Battaly, Westchester Community College, NY

Homework

College Algebra & Trig Home Page

1.2 Linear Equations & Rational Equations

1. Conditional equation:
 ■ has a finite number of solutions

2. Inconsistent equation:
 ■ has no solution
 ■ solution is empty set

3. Identity:
 ■ has a infinite number of solutions
 ie: true for all values of x

Class Notes: Prof. G. Battaly, Westchester Community College, NY

College Algebra & Trig Home Page Homework

1.2 Linear Equations & Rational Equations

$$\frac{3}{x+3} = \frac{5}{2x+6} + \frac{1}{x-2}$$

$LCD = 2(x+3)(x-2)$
 Check Required!

Class Notes: Prof. G. Battaly, Westchester Community College, NY

College Algebra & Trig Home Page Homework

1.2 Linear Equations & Rational Equations

$$\frac{3}{x+3} = \frac{5}{2x+6} + \frac{1}{x-2}$$

$LCD = 2(x+3)(x-2)$

$x \neq -3, 2,$

$$2(x+3)(x-2) \cdot \frac{3}{x+3} = 2(x+3)(x-2) \cdot \frac{5}{2(x+3)} + 2(x+3)(x-2) \cdot \frac{1}{x-2}$$

$$\frac{2(x-2)(3)}{6(x-2)} = \frac{5(x-2)}{1} + 2(x+3)$$

$$6x - 12 = 5x - 10 + 2x + 6$$

$$6x - 12 = 7x - 4$$

$$-7x + 12 = -7x + 12$$

$$-x = 8 \quad \therefore x = -8$$

Ch.
 $\frac{3}{-8+3} = \frac{5}{-16+6} + \frac{1}{-8-2}$
 $\frac{3}{-5} = \frac{5}{-10} + \frac{1}{-10}$
 $= \frac{6}{-10} = -\frac{3}{5} \checkmark$

Check is required!
Have multiplied by a variable.

Class Notes: Prof. G. Battaly, Westchester Community College, NY

College Algebra & Trig Home Page

Homework

1.2 Linear Equations & Rational Equations

G: $4x + 7 = 7(x + 1) - 3x$

F: Is equation an identity, conditional, or inconsistent?

Identity: True for all values of x.

Class Notes: Prof. G. Battaly, Westchester Community College, NY

College Algebra & Trig Home Page

Homework

1.2 Linear Equations & Rational Equations

G: $4x + 7 = 7(x + 1) - 3x$

F: Is equation an identity, conditional, or inconsistent?

$$4x + 7 = \underline{7x + 7} - \underline{3x}$$

$$4x + 7 = 4x + 7$$

Identity
true for all x

$\begin{array}{r} -7 \qquad -7 \\ \hline 4x = 4x \\ -4x = -4x \\ \hline 0 = 0 \end{array}$	<p>not needed, but may help to understand</p>
--	---

Identity: True for all values of x.

Class Notes: Prof. G. Battaly, Westchester Community College, NY

Homework

College Algebra & Trig Home Page

1.2 Linear Equations & Rational Equations

G: $4(x + 5) = 2 + 4x$

F: Is equation an identity, conditional, or inconsistent?

inconsistent equation: has no solution, solution is empty set

Class Notes: Prof. G. Battaly, Westchester Community College, NY

Homework

College Algebra & Trig Home Page

1.2 Linear Equations & Rational Equations

G: $4(x + 5) = 2 + 4x$

$4x + 20 = 2 + 4x$

$-4x \quad = \quad -4x$

$20 \neq 2$ NOT TRUE

ϕ

F: Is equation an identity, conditional, or inconsistent?

inconsistent equation: has no solution, solution is empty set

Class Notes: Prof. G. Battaly, Westchester Community College, NY

College Algebra & Trig Home Page

Homework

1.2 Linear Equations & Rational Equations

G: $5x + 7 = 2x + 7$

F: Is equation an identity, conditional, or inconsistent?

Conditional equation: has a finite number of solutions

$0 = x$

Class Notes: Prof. G. Battaly, Westchester Community College, NY

College Algebra & Trig Home Page

Homework

1.2 Linear Equations & Rational Equations

G: $5x + 7 = 2x + 7$

$$\underline{-7 = -7}$$

$$5x = 2x$$

$$\underline{-2x = -2x}$$

$$3x = 0$$

$$x = 0$$

Conditional

F: Is equation an identity, conditional, or inconsistent?

Conditional equation:
has a finite number
of solutions
 $0 = x$

Class Notes: Prof. G. Battaly, Westchester Community College, NY

Homework

College Algebra & Trig Home Page