Warm-Up

Name ______________________________

Date _______________ **Period** ________

Review: Algebra 5.0	**Review:** Algebra 5.0
Solve using 2 different methods. $2x+18=44$ a. 4 b. 13 c. 31 d. 52	Solve using 2 different methods. $2(4m+3)=54$ a. 6 b. $\frac{52}{4}$ c. $\frac{15}{2}$ d. 12

Current: Algebra 1.0	**Other:** Algebra 1.0
Multiply. Show using 2 different methods. $\left(\frac{4}{6}\right)\left(\frac{2}{8}\right)$	Divide. $\frac{0.05}{0.5}$ a. 0.001 b. 0.01 c. 0.1 **d.** 10

Today's Objective

To solve 2-step equations that includes rational number.

Solving 2-Step Equations with Rational Numbers

Introduction: After learning how to solve 2-step equations, today are 2-step equations are going to involve rational numbers.

"Today we are going to solve equations with rational numbers, fractions & decimals. I am going to show you a couple methods for solving these types of problems"

Example 1 Method 1: Traditional

$$\frac{1}{2}x + \frac{1}{5} = \frac{1}{4}$$

"The first method we will use is the tradition method where we leave the fractions the way they are and use fractions operations to solve the equation"

"Notice that we are multiplying *x* and adding with *x*. To begin, we will subtract $\frac{1}{5}$ to both sides."

$$\frac{1}{2}x + \frac{1}{5} - \frac{1}{5} = \frac{1}{4} - \frac{1}{5}$$

"to subtract $\frac{1}{4}$ and $\frac{1}{5}$ we need common denominators."

"What is the common denominator?" [20}

"What equivalent form of 1 will I multiply $\frac{1}{4}$ by? " $\left[\frac{5}{5}\right]$

"What equivalent form of 1 will I multiply $\frac{1}{5}$ by?" $\left[\frac{4}{4}\right]$

$$\frac{1}{2}x = \frac{1}{4}\left(\frac{5}{5}\right) - \frac{1}{5}\left(\frac{4}{4}\right)$$

"Now let's simplify."

$$\frac{1}{2}x = \frac{5}{20} - \frac{4}{20}$$

$$\frac{1}{2}x = \frac{1}{20}$$

"What should we do next?" [multiply by 2]

$$2 \bullet \frac{1}{2}x = 2 \bullet \frac{1}{20}$$

$$x = \frac{1 \bullet 2}{10 \bullet 2}$$

"Are there are equivalent forms of 1?" [yes, $\frac{2}{2}$]

"So, $x = \frac{1}{10}$"

$$x = \frac{1}{10}$$

Example 1: Method 2 Common Denominators

"That is how to solve this equation using fraction operations. Let's look at another strategy that will be useful. We are going to get common denominators."

Method 2: Common Denominators

$$\frac{1}{2}x+\frac{1}{5}=\frac{1}{4}$$

"What is the common denominator of 2, 5, and 4?" [20]

"What equivalent form of 1 will we multiply $\frac{1}{2}$ by? " $\left[\frac{10}{10}\right]$

"What equivalent form of 1 will we multiply $\frac{1}{5}$ by?" $\left[\frac{4}{4}\right]$

"What equivalent form of 1 will we multiply $\frac{1}{4}$ by? $\left[\frac{5}{5}\right]$

$$\frac{1}{2}\left(\frac{10}{10}\right)x+\frac{1}{5}\left(\frac{4}{4}\right)=\frac{1}{4}\left(\frac{5}{5}\right)$$

$$\frac{10}{20}x+\frac{4}{20}=\frac{5}{20}$$

"Now, we have all the denominators 20. We can do anything we want to an equation as long as we do it to everything on both sides. I am going to choose to multiply everything by 20."

$$\frac{10}{20}(20)x+\frac{4}{20}(20)=\frac{5}{20}(20)$$

Notice the equivalent form of 1 in each term. (show a a big 1 for each equivalent form of 1)

$$10x+4=5$$

"Let's decompose the 5 to 4+1"

$$10x+\not{4}=\not{4}+1$$

"What equal value can we remove from both sides?" [+4]

$$10x=1$$

"What's next?" [divide both sides by 10]

$$x=\frac{1}{10}$$

Example 1: Method 3 Clear Fractions

"One more strategy. We are going to clear the equation of the fractions."

Method 3: Clear Fractions

$$\frac{1}{2}x+\frac{1}{5}=\frac{1}{4}$$

"What is the Least Common Multiple of 2, 5, and 4?" Hint: think about common denominators [20}

"We are going to multiple everything by the LCM/LCD, 20"

$$\frac{1}{2}(20)x+\frac{1}{5}(20)=\frac{1}{4}(20)$$

"Now let's simplify."

$$\frac{20}{2}x+\frac{20}{5}=\frac{20}{4}$$

$$\frac{2\bullet 10}{2}x+\frac{5\bullet 4}{5}=\frac{4\bullet 5}{4}$$

"What are the equivalent forms of 1?" $\left[\frac{2}{2},\frac{5}{5},\frac{4}{4}\right]$

Cross out each equivalent form of 1 as students same it.

$$10x+4=5$$

"By multiplying everything by the LCD, we had equivalent forms of 1 that cleared the denominators. Now we have an equation with only integers."

"Let's finish solving for *x*."

$$10x+4=1+4$$

$$10x=1$$

$$\frac{\cancel{10}x}{\cancel{10}}=\frac{1}{10}$$

$$x=\frac{1}{10}$$

You Try 1 (Think-Pair-Share)

"Now I would like you to try a problem with your partner. Solve using 2 of the 3 methods"

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

Have students work on You Try 1**.** Students should work with their partner, but they each should be writing the solution in their notes.

When pairs have finished, have students come to the board and show their work for each of the 3 methods.

Debrief the You Try.

<u>**Solution**</u>:

<u>Method 1: Traditional</u>

$$\frac{2}{3}x - \frac{1}{5} = \frac{2}{5}$$
$$\frac{2}{3}x - \frac{1}{5} + \frac{1}{5} = \frac{2}{5} + \frac{1}{5}$$
$$\frac{2}{3}x = \frac{2}{5} + \frac{1}{5}$$
$$\frac{2}{3}x = \frac{3}{5}$$
$$\cancel{\frac{3}{2}} \bullet \cancel{\frac{2}{3}} x = \frac{3}{2} \bullet \frac{3}{5}$$
$$x = \frac{9}{10}$$

<u>Method 2: Common Denominators</u>

$$\frac{2}{3}x - \frac{1}{5} = \frac{2}{5}$$
$$\frac{2}{3} \bullet \left(\frac{5}{5}\right)x - \frac{1}{5} \bullet \left(\frac{3}{3}\right) = \frac{2}{5} \bullet \left(\frac{3}{3}\right)$$
$$\frac{10}{15}x - \frac{3}{15} = \frac{6}{15}$$
$$\frac{10}{15}x - \frac{3}{15} + \frac{3}{15} = \frac{6}{15} + \frac{3}{15}$$
$$\frac{10}{15}x = \frac{9}{15}$$
$$\frac{15}{10} \bullet \frac{10}{15}x = \frac{9}{15} \bullet \frac{15}{10}$$
$$x = \frac{9}{10}$$

<u>Method 3: Clear Fractions</u>

$$\frac{2}{3}x - \frac{1}{5} = \frac{2}{5}$$
$$(15) \bullet \frac{2}{3}x - \frac{1}{5} \bullet (15) = \frac{2}{5} \bullet (15)$$
$$\frac{\cancel{3} \bullet 5 \bullet 2}{\cancel{3}}x - \frac{1 \bullet 3 \bullet \cancel{5}}{\cancel{5}} = \frac{2 \bullet 3 \bullet \cancel{5}}{\cancel{5}}$$
$$10x - 3 = 6$$
$$10x - \cancel{3} = 6 + 3 - \cancel{3}$$
$$10x = 9$$
$$\frac{10x}{10} = \frac{9}{10}$$
$$x = \frac{9}{10}$$

Example 2: Method 1 Traditional + Decomposition

"Let's look at another example."

$$\frac{2}{5}-\frac{2}{15}x=\frac{14}{15}$$

"What do you notice about this problem? (Specifically about the denominators)" [2 of the denominators are 15, the other denominator is a factor of 15]

"That's interesting. Let's get common denominators."

"What is the LCD?" [15]

"What equivalent form of 1 will we multiply $\frac{2}{5}$ by? $\left[\frac{3}{3}\right]$

$$\frac{2}{5}\bullet\left(\frac{3}{3}\right)-\frac{2}{15}x=\frac{14}{15}$$

$$\frac{6}{15}-\frac{2}{15}x=\frac{14}{15}$$

"Let's use decomposition."

$$\frac{6}{15}-\frac{2}{15}x=\frac{6+8}{15}$$

$$\frac{6}{15}-\frac{2}{15}x=\frac{6}{15}+\frac{8}{15}$$

$$-\frac{2}{15}x=\frac{8}{15}$$

"Since the denominators are the same, then the numerators must be equal."

$$-2x=8$$

"How can we use decomposition to find x?" [show 8 as 2 and 4; show -2 as -1 and 2]

$$-1\bullet 2\bullet x=2\bullet 4$$

"What equal value can we remove from both sides?" [a product of 2]

$$-1\bullet x=4$$

$$x=-4$$

"If the opposite of *x* is 4, what is *x*?" [-4]

$$x=4$$

Example 2: Method 2 Clear Fractions

"Now let's try it by clearing the denominators"

$$\frac{2}{5}-\frac{2}{15}x=\frac{14}{15}$$

"What would be the LCD?" [15]

Let's get common denominators"

"What equivalent form of 1 do we multiply $\frac{2}{5}$ by?" $\left[\frac{3}{3}\right]$

$$\left(\frac{3}{3}\right)\frac{2}{5}-\frac{2}{15}x=\frac{14}{15}$$

$$\frac{6}{5}-\frac{2}{15}x=\frac{14}{15}$$

"Hw would we clear the fractions?"[multiply everything by 15]

$$\frac{6}{15}(15)-\frac{2}{15}(15)x=\frac{14}{15}(15)$$

Do we have any equivalent forms of 1?" {Yes, $\frac{15}{15},\frac{15}{15},\frac{15}{15}$]

$$6-2x=14$$

"How would we use decomposition to get x by itself? [break 14 into 8 + 6]

$$6-2x=8+6$$

"Now we have an addend of 6 on both sides we can remove."

$$-2x=8$$

"How can we use decomposition to get x by itself?" [show $-2=-1\bullet 2$ and $8=2\bullet 4$]

$$-1\bullet 2\bullet x=2\bullet 4$$

"What do we have on both sides we can remove?" [a product of 2]

$$-1\bullet x=4$$

"If the opposite of x is 4, what is x?" [-4]

$$x=-4$$

Example 2: Method 3 Decomposing & Factoring

"We are going to take another look at the problem. This time using factoring, which will be similar to using the distributive property."

$$\frac{2}{5}-\frac{2}{15}x=\frac{14}{15}$$

"Let's decompose the numerators and denominators for $\frac{2}{15}$ and $\frac{14}{15}$."

$$\frac{2}{5}-\frac{2\bullet 1}{5\bullet 3}x=\frac{2\bullet 7}{5\bullet 3}$$

"Let's rewrite that as…"

$$\frac{2}{5}-\frac{2}{5}\bullet\frac{1}{3}x=\frac{2}{5}\bullet\frac{7}{3}$$

"What is a common factor of all the terms?" $\left[\frac{2}{5}\right]$

"On the left, we are going to factor out the common factor of $\frac{2}{5}$ …. Think Distributive Property"

$$\frac{2}{5}\left(1-\frac{1}{3}x\right)=\frac{2}{5}\bullet\frac{7}{3}$$

"What factor can we remove from both sides?" $\left[\frac{2}{5}\right]$

$$1-\frac{1}{3}x=\frac{7}{3}$$

"Decompose $\frac{7}{3}$ into $\frac{3}{3}+\frac{4}{3}$"

$$1-\frac{1}{3}x=\frac{3}{3}+\frac{4}{3}$$

$$1-\frac{1}{3}x=1+\frac{4}{3}$$

"We have an addend of 1 on both sides of the equation, let's remove it."

$$-\frac{1}{3}x=\frac{4}{3}$$

"If the denominators are the same, the numerators are equal."

$$-1x=4$$

"If the opposite of x is 4, what is x?" [-4]

$$x=-4$$

You Try 2a (Think-Pair-Share)

"Now I would like you to try a problem with your partner. Solve at least using 2 of the 3 methods"

$$\frac{3}{4}+\frac{15}{4}x=\frac{9}{2}$$

Have students work on You Try 2a**.** Students should work with their partner, but they each should be writing the solution in their notes.

When pairs have finished, have students come to the board and show their work for each of the 3 methods.

Debrief the You Try.

<u>**Solution**</u>:

<u>Method 1: Traditional + Decomposition</u>

$$\begin{aligned}
\frac{3}{4}+\frac{15}{4}x&=\frac{9}{2}\\
\frac{3}{4}-\frac{3}{4}+\frac{15}{4}x&=\frac{9}{2}-\frac{3}{4}\\
\frac{15}{4}x&=\frac{9}{2}\left(\frac{2}{2}\right)-\frac{3}{4}\\
\frac{15}{4}x&=\frac{18}{4}-\frac{3}{4}\\
\frac{15}{4}x&=\frac{15}{4}\\
x&=1
\end{aligned}$$

<u>Method 2: Clear Fractions</u>

$$\begin{aligned}
\frac{3}{4}+\frac{15}{4}x&=\frac{9}{2}\\
\frac{3}{4}+\frac{15}{4}x&=\frac{9}{2}\left(\frac{2}{2}\right)\\
\frac{3}{4}+\frac{15}{4}x&=\frac{18}{4}\\
\frac{3}{4}(4)+\frac{15}{4}(4)x&=\frac{18}{4}(4)\\
3+15x&=18\\
\cancel{3}+15x&=\cancel{3}+15\\
15x&=15\\
x&=1
\end{aligned}$$

<u>Method 3: Decomposition + Factoring</u>

$$\begin{aligned}
\frac{3}{4}+\frac{15}{4}x&=\frac{9}{2}\\
\frac{3}{4}+\frac{15}{4}x&=\frac{9}{2}\left(\frac{2}{2}\right)\\
\frac{3}{4}+\frac{15}{4}x&=\frac{18}{4}\\
\frac{3}{4}+\frac{3\bullet 5}{4}x&=\frac{3\bullet 6}{4}\\
\frac{3}{4}+\frac{3}{4}\bullet 5x&=\frac{3}{4}\bullet 6\\
\cancel{\frac{3}{4}}(1+5x)&=\cancel{\frac{3}{4}}\bullet 6\\
1+5x&=6\\
\cancel{1}+5x&=\cancel{1}+5\\
5x&=5\\
x&=1
\end{aligned}$$

You Try 2b (Think-Pair-Share)

"Now I would like you to try a problem with your partner. Solve using at least 2 of the 3 methods"

$$\frac{35}{4}x - \frac{15}{4} = 15$$

Have students work on You Try 2b**.** Students should work with their partner, but they each should be writing the solution in their notes.

When pairs have finished, have students come to the board and show their work for each of the 3 methods.

Debrief the You Try.

<u>**Solution**</u>:

<u>Method 1: Traditional + Decomposition</u>

$$\frac{35}{4}x - \frac{15}{4} = 15$$
$$\frac{35}{4}x - \frac{15}{4} + \frac{15}{4} = \frac{60}{4} + \frac{15}{4}$$
$$\frac{35}{4}x = \frac{75}{4}$$
$$35x = 75$$
$$\cancel{5} \bullet 7 \bullet x = \cancel{5} \bullet 15$$
$$7x = 15$$
$$\frac{7x}{7} = \frac{15}{7}$$
$$x = \frac{15}{7}$$

<u>Method 2: Clear Fractions</u>

$$\frac{35}{4}x - \frac{15}{4} = 15$$
$$\frac{35}{4}x - \frac{15}{4} = 15\left(\frac{4}{4}\right)$$
$$\frac{35}{4}x - \frac{15}{4} = \frac{60}{4}$$
$$\frac{5 \bullet 7}{4}x - \frac{5 \bullet 3}{4} = \frac{5 \bullet 12}{4}$$
$$\frac{5}{4} \bullet 7x - \frac{5}{4} \bullet 3 = \frac{5}{4} \bullet 12$$
$$\cancel{\frac{5}{4}}(7x - 3) = \cancel{\frac{5}{4}} \bullet 12$$
$$7x - 3 = 12$$
$$7x - \cancel{3} = 12 + 3 - \cancel{3}$$
$$7x = 15$$
$$x = \frac{15}{7}$$

<u>Method 3: Decomposition + Factoring</u>

$$\frac{35}{4}x - \frac{15}{4} = 15$$
$$\frac{35}{4}x - \frac{15}{4} = 15\left(\frac{4}{4}\right)$$
$$\frac{35}{4}x - \frac{15}{4} = \frac{60}{4}$$
$$\frac{35}{4}(4)x - \frac{15}{4}(4) = \frac{60}{4}(4)$$
$$35x - 15 = 60$$
$$35x - \cancel{15} = 60 + 15 - \cancel{15}$$
$$35x = 75$$
$$\frac{35x}{35} = \frac{75}{35}$$
$$x = \frac{75}{35}$$
$$x = \frac{5 \bullet 15}{5 \bullet 7}$$
$$x = \frac{15}{7}$$

Example 3: Method 1 Traditional + Decomposition

"Let's look at another example. Fractions are a part of Rational Numbers, but so are Decimals. In this example, we will have a 2-step equation with decimals."

$$0.5x + 0.2 = 0.25$$

"One way to solve this equation would be to keep the numbers as decimals."

"How can I decompose 0.25?" [0.2+0.05]

$$0.5x + 0.2 = 0.2 + 0.05$$

"We have an addend of 0.2, *two-tenths,* on both sides we can remove."

$$0.5x = 0.05$$

"The inverse of multiplication is division, so let's divide both sides by 0.5, *five-tenths.*"

$$\frac{0.5x}{0.5} = \frac{0.05}{0.5}$$
$$x = 0.1$$

Division with decimals:

Here are a couple ways to simplify:

$$\frac{0.05}{0.5} = \frac{0.05}{0.5}\left(\frac{100}{100}\right) = \frac{5}{50} = \frac{5 \bullet 1}{5 \bullet 10} = \frac{1}{10}$$

or

$$\frac{0.05}{0.5} = \frac{5 \bullet 0.01}{5 \bullet 0.1} = \frac{0.01}{0.1} = \frac{0.1 \bullet 0.1}{0.1} = 0.1 = \frac{1}{10}$$

Example 3: Method 2 Clear Decimals

"Let's look at another example. In an equation with fractions, one method we used was to clear the fractions. We can do a similar thing with decimals. This method we will clear the decimals – making all the numbers integers."

$$0.5x + 0.2 = 0.25$$

"To clear the decimals, we will multiply by the power of ten (10, 100, 1000 …) that will result in each product being an integer. Here we will multiply by 100."

$$0.5(100)x + 0.2(100) = 0.25(100)$$
$$50x + 20 = 25$$

"Now we have an equation with integers. You have many options for continuing to solve. Let's use decomposition. "

'what sum should we decompose 25 into?" [20+5]

$$50x + 20 = 20 + 5$$

"Now we are adding a 20 on both sides of the equation, so let's remove it."

$$50x = 5$$

"What should we do next?" [divide]

$$\frac{50x}{50} = \frac{5}{50}$$
$$x = \frac{1}{10}$$

Example 3: Method 3 Change to Fractions

"For our 3rd method, we are going to change the decimals to fractions."

$0.5x + 0.2 = 0.25$

"How would we write 0.5 *five-tenths* as a fraction? $\left[\frac{5}{10}\right]$

"How would we write 0.2 *two-tenths* as a fraction? $\left[\frac{2}{10}\right]$

"How would we write 0.25 *twenty-five hundredths* as a fraction? $\left[\frac{25}{100}\right]$

"Let's rewrite the equation with fractions."

$$\frac{5}{10}x + \frac{2}{10} = \frac{25}{100}$$

"From what we learned about fractions, let's get common denominators."

"What is the common denominator of 10 and 100?" [100]

"What equivalent form of 1 should we multiply $\frac{5}{10}$?" $\left[\frac{10}{10}\right]$

"What equivalent form of 1 should we multiply $\frac{2}{10}$?" $\left[\frac{10}{10}\right]$

$$\frac{5}{10}\left(\frac{10}{10}\right)x + \frac{2}{10}\left(\frac{10}{10}\right) = \frac{25}{100}$$

$$\frac{50}{100}x + \frac{20}{100} = \frac{25}{100}$$

"From what we've learned in the fraction examples, when all the denominators are the same, then the numerators are the same." (we could also show this by multiplying everything by 100).

$50x + 20 = 25$

"Now we have an equation with integers. You have many options for continuing to solve. Let's use decomposition. "

'what sum should we decompose 25 into?" [20+5]

$50x + 20 = 20 + 5$

"Now we have an addend of 20 on both sides of the equation, so let's remove it."

$50x = 5$

"What should we do next?" [divide]

$$\frac{50x}{50} = \frac{5}{50}$$

$$x = \frac{1}{10}$$

You Try 3:

"Now I would like you to try a problem with your partner. Solve this one using 2 of the 3 methods"

$0.28x + 0.7 = 0.56$

Have students work on You Try 3**.** Students should work with their partner, but they each should be writing the solution in their notes.

When pairs have finished, have students come to the board and show their work for each of the 3 methods.

Debrief the You Try.

Solution:

Method 1: Traditional

$$0.28x + 0.7 = 0.56$$
$$0.28x + 0.7 - 0.7 = 0.56 - 0.7$$
$$0.28x = -0.14$$
$$\frac{0.28x}{0.28} = \frac{-0.14}{0.28}$$
$$x = -0.5$$

Method 2: Clear Decimals

$$0.28x + 0.7 = 0.56$$
$$100(0.28x + 0.7) = 100(0.56)$$
$$28x + 70 = 56$$
$$28x + \cancel{5}0 + 14 + \cancel{6} = \cancel{5}0 + \cancel{6}$$
$$28x + 14 = 0$$
$$28x = -14$$
$$\frac{28x}{28} = \frac{-14}{28}$$
$$x = -\frac{1 \bullet \cancel{14}}{2 \bullet \cancel{14}}$$
$$x = -\frac{1}{2}$$

Method 3: Change to Fractions Factoring

$$0.28x + 0.7 = 0.56$$
$$\frac{28}{100}x + \frac{70}{100} = \frac{56}{100}$$
$$100\left(\frac{28}{100}x + \frac{70}{100}\right) = 100\left(\frac{56}{100}\right)$$
$$28x + 70 = 56$$
$$14 \bullet 2 \bullet x + 14 \bullet 5 = 14 \bullet 4$$
$$14(2x + 5) = 14 \bullet 4$$
$$2x + 5 = 4$$
$$2x + \cancel{5} = 4 + \cancel{5} - 5$$
$$2x = -1$$
$$x = -\frac{1}{2}$$

Solving 2-Step Equations with Rational Numbers

Example 1: $\frac{1}{2}x + \frac{1}{5} = \frac{1}{4}$

Method 1: Traditional

$$\frac{1}{2}x + \frac{1}{5} = \frac{1}{4}$$
$$\frac{1}{2}x + \frac{1}{5} - \frac{1}{5} = \frac{1}{4} - \frac{1}{5}$$
$$\frac{1}{2}x = \frac{1}{4}\left(\frac{5}{5}\right) - \frac{1}{5}\left(\frac{4}{4}\right)$$
$$\frac{1}{2}x = \frac{5}{20} - \frac{4}{20}$$
$$\frac{1}{2}x = \frac{1}{20}$$
$$2 \bullet \frac{1}{2}x = \frac{1}{20} \bullet 2$$
$$x = \frac{1 \bullet 2}{10 \bullet 2}$$
$$x = \frac{1}{10}$$

Method 2: Common Denominators

$$\frac{1}{2}x + \frac{1}{5} = \frac{1}{4}$$
$$\frac{1}{2}\left(\frac{10}{10}\right)x + \frac{1}{5}\left(\frac{4}{4}\right) = \frac{1}{4}\left(\frac{5}{5}\right)$$
$$\frac{10}{20}x + \frac{4}{20} = \frac{5}{20}$$
$$\frac{10}{20}(20)x + \frac{4}{20}(20) = \frac{5}{20}(20)$$
$$10x + 4 = 5$$
$$10x + 4 = 1 + 4$$
$$10x = 1$$
$$\frac{10x}{10} = \frac{1}{10}$$
$$x = \frac{1}{10}$$

Method 3: Clear Denominators

$$\frac{1}{2}x + \frac{1}{5} = \frac{1}{4}$$
$$\frac{1}{2}(20)x + \frac{1}{5}(20) = \frac{1}{4}(20)$$
$$10x + 4 = 5$$
$$10x + 4 = 1 + 4$$
$$10x = 1$$
$$\frac{10x}{10} = \frac{1}{10}$$
$$x = \frac{1}{10}$$

Check:

$$\frac{1}{2}x + \frac{1}{5} = \frac{1}{4}$$
$$\frac{1}{2}\left(\frac{1}{10}\right) + \frac{1}{5} = \frac{1}{4}$$
$$\frac{1}{20} + \frac{1}{5} = \frac{1}{4}$$
$$\frac{1}{20} + \frac{4}{20} = \frac{1}{4}$$
$$\frac{5}{20} = \frac{1}{4}$$
$$\frac{1}{4} = \frac{1}{4}$$

You Try 1: $\frac{2}{3}x - \frac{1}{5} = \frac{2}{5}$

Method 1: Traditional

$$\frac{2}{3}x - \frac{1}{5} = \frac{2}{5}$$
$$\frac{2}{3}x - \frac{1}{5} + \frac{1}{5} = \frac{2}{3} + \frac{1}{5}$$
$$\frac{2}{3}x = \frac{2}{5} + \frac{1}{5}$$
$$\frac{2}{3}x = \frac{3}{5}$$
$$\frac{2}{3} \bullet \frac{3}{2}x = \frac{3}{5} \bullet \frac{3}{2}$$
$$x = \frac{3 \bullet 3}{5 \bullet 2}$$
$$x = \frac{9}{10}$$

Method 2: Common Denominators

$$\frac{2}{3}x - \frac{1}{5} = \frac{2}{5}$$
$$\frac{2}{3} \bullet \left(\frac{5}{5}\right)x - \frac{1}{5} \bullet \left(\frac{3}{3}\right) = \frac{2}{5} \bullet \left(\frac{3}{3}\right)$$
$$\frac{10}{15}x - \frac{3}{15} = \frac{6}{15}$$
$$\frac{10}{15}x - \frac{3}{15} + \frac{3}{15} = \frac{6}{15} + \frac{3}{15}$$
$$\frac{10}{15}x = \frac{9}{15}$$
$$\frac{15}{10} \bullet \frac{10}{15}x = \frac{9}{15} \bullet \frac{15}{10}$$
$$x = \frac{9}{10}$$

Method 3: Clear Denominators

$$\frac{2}{3}x - \frac{1}{5} = \frac{2}{5}$$
$$(15) \bullet \frac{2}{3}x - \frac{1}{5} \bullet (15) = \frac{2}{5} \bullet (15)$$
$$\frac{3 \bullet 5 \bullet 2}{3}x - \frac{1 \bullet 3 \bullet 5}{5} = \frac{2 \bullet 3 \bullet 5}{5}$$
$$10x - 3 = 6$$
$$10x - 3 = 6 + 3 - 3$$
$$10x = 9$$
$$\frac{10x}{10} = \frac{9}{10}$$
$$x = \frac{9}{10}$$

Check:

$$\frac{2}{3}x - \frac{1}{5} = \frac{2}{5}$$
$$\frac{2}{3}\left(\frac{9}{10}\right) - \frac{1}{5} = \frac{2}{5}$$
$$\frac{18}{30} - \frac{1}{5} = \frac{2}{5}$$
$$\frac{18}{30} - \frac{6}{30} = \frac{2}{5}$$
$$\frac{12}{30} = \frac{2}{5}$$
$$\frac{2}{5} = \frac{2}{5}$$

Example 2: $\frac{2}{5}-\frac{2}{15}x=\frac{14}{15}$

Method 1: Traditional/Decomposition

$$\frac{2}{5}-\frac{2}{15}x=\frac{14}{15}$$
$$\left(\frac{3}{3}\right)\frac{2}{5}-\frac{2}{15}x=\frac{14}{15}$$
$$\frac{6}{15}-\frac{2}{15}x=\frac{14}{15}$$
$$\frac{6}{15}-\frac{2}{15}x=\frac{8+6}{15}$$
$$\cancel{\frac{6}{15}}-\frac{2}{15}x=\frac{8}{15}+\cancel{\frac{6}{15}}$$
$$-\frac{2}{15}x=\frac{8}{15}$$
$$-2x=8$$
$$-1\bullet\cancel{2}\bullet x=\cancel{2}\bullet 4$$
$$-\cancel{1}\bullet x=4\bullet-\cancel{1}\bullet-1$$
$$x=-4$$

Method 2: Clear Denominators

$$\frac{2}{5}-\frac{2}{15}x=\frac{14}{15}$$
$$\left(\frac{3}{3}\right)\frac{2}{5}-\frac{2}{15}x=\frac{14}{15}$$
$$\frac{6}{15}-\frac{2}{15}x=\frac{14}{15}$$
$$\frac{6}{15}(15)-\frac{2}{15}(15)x=\frac{14}{15}(15)$$
$$6-2x=14$$
$$\cancel{6}-2x=8+\cancel{6}$$
$$-2x=8$$
$$-1\bullet\cancel{2}\bullet x=4\bullet\cancel{2}$$
$$-x=4$$
$$x=-4$$

Method 3: Decomposition/Factoring

$$\frac{2}{5}-\frac{2}{15}x=\frac{14}{15}$$
$$\frac{2}{5}-\frac{2\bullet 1}{5\bullet 3}x=\frac{2\bullet 7}{5\bullet 3}$$
$$\frac{2}{5}-\frac{2}{5}\bullet\frac{1}{3}x=\frac{2}{5}\bullet\frac{7}{3}$$
$$\cancel{\frac{2}{5}}\left(1-\frac{1}{3}x\right)=\cancel{\frac{2}{5}}\bullet\frac{7}{3}$$
$$1-\frac{1}{3}x=\frac{7}{3}$$
$$\frac{3}{3}-\frac{1}{3}x=\frac{7}{3}$$
$$3\bullet\frac{3}{3}-3\bullet\frac{1}{3}x=3\bullet\frac{7}{3}$$
$$3-x=7$$
$$3-x=3+4$$
$$-x=4$$
$$x=-4$$

Check:

$$\frac{2}{5}-\frac{2}{15}x=\frac{14}{15}$$
$$\frac{2}{5}-\frac{2}{15}(-4)=\frac{14}{15}$$
$$\frac{2}{5}+\frac{8}{15}=\frac{14}{15}$$
$$\frac{6}{15}+\frac{8}{15}=\frac{14}{15}$$
$$\frac{14}{15}=\frac{14}{15}$$

You Try 2a: $\frac{3}{4}+\frac{15}{4}x=\frac{9}{2}$

Method 1: Traditional/Decomposition

$$\frac{3}{4}+\frac{15}{4}x=\frac{9}{2}$$
$$\frac{3}{4}-\frac{3}{4}+\frac{15}{4}x=\frac{9}{2}-\frac{3}{4}$$
$$\frac{15}{4}x=\frac{9}{2}\left(\frac{2}{2}\right)-\frac{3}{4}$$
$$\frac{15}{4}x=\frac{18}{4}-\frac{3}{4}$$
$$\frac{15}{4}x=\frac{15}{4}$$
$$x=1$$

Method 2: Clear Denominators

$$\frac{3}{4}+\frac{15}{4}x=\frac{9}{2}$$
$$\frac{3}{4}+\frac{15}{4}x=\frac{9}{2}\left(\frac{2}{2}\right)$$
$$\frac{3}{4}+\frac{15}{4}x=\frac{18}{4}$$
$$\frac{3}{4}(4)+\frac{15}{4}(4)x=\frac{18}{4}(4)$$
$$3+15x=18$$
$$\cancel{3}+15x=\cancel{3}+15$$
$$15x=15$$
$$x=1$$

Method 3: Decomposition/Factoring

$$\frac{3}{4}+\frac{15}{4}x=\frac{9}{2}$$
$$\frac{3}{4}+\frac{15}{4}x=\frac{9}{2}\left(\frac{2}{2}\right)$$
$$\frac{3}{4}+\frac{15}{4}x=\frac{18}{4}$$
$$\frac{3}{4}+\frac{3\bullet 5}{4}x=\frac{3\bullet 6}{4}$$
$$\frac{3}{4}(1+5x)=\frac{3}{4}\bullet 6$$
$$1+5x=6$$
$$\cancel{1}+5x=\cancel{1}+5$$
$$5x=5$$
$$x=1$$

Check:

$$\frac{3}{4}+\frac{15}{4}x=\frac{9}{2}$$
$$\frac{3}{4}+\frac{15}{4}(1)=\frac{9}{2}$$
$$\frac{3}{4}+\frac{15}{4}=\frac{9}{2}$$
$$\frac{18}{4}=\frac{9}{2}$$
$$\frac{9}{2}=\frac{9}{2}$$

You Try 2b: $\frac{35}{4}x-\frac{15}{4}=15$

Method 1: Traditional/Decomposition

$$\frac{35}{4}x-\frac{15}{4}=15$$
$$\frac{35}{4}x-\frac{15}{4}+\frac{15}{4}=\frac{60}{4}+\frac{15}{4}$$
$$\frac{35}{4}x=\frac{75}{4}$$
$$35x=75$$
$$\cancel{5}\bullet 7\bullet x=\cancel{5}\bullet 15$$
$$7x=15$$
$$\frac{7x}{7}=\frac{15}{7}$$
$$x=\frac{15}{7}$$

Method 2: Clear Denominators

$$\frac{35}{4}x-\frac{15}{4}=15$$
$$\frac{35}{4}x-\frac{15}{4}=15\left(\frac{4}{4}\right)$$
$$\frac{35}{4}x-\frac{15}{4}=\frac{60}{4}$$
$$\frac{35}{4}(4)x-\frac{15}{4}(4)=\frac{60}{4}(4)$$
$$35x-15=60$$
$$35x-\cancel{15}=60+15-\cancel{15}$$
$$35x=75$$
$$\frac{35x}{35}=\frac{75}{35}$$
$$x=\frac{75}{35}$$
$$x=\frac{\cancel{5}\bullet 15}{\cancel{5}\bullet 7}$$
$$x=\frac{15}{7}$$

Method 3: Decomposition/Factoring

$$\frac{35}{4}x-\frac{15}{4}=15$$
$$\frac{35}{4}x-\frac{15}{4}=15\left(\frac{4}{4}\right)$$
$$\frac{35}{4}x-\frac{15}{4}=\frac{60}{4}$$
$$\frac{5\bullet 7}{4}x-\frac{5\bullet 3}{4}=\frac{5\bullet 12}{4}$$
$$\frac{5}{4}\bullet 7x-\frac{5}{4}\bullet 3=\frac{5}{4}\bullet 12$$
$$\frac{5}{4}(7x-3)=\frac{5}{4}\bullet 12$$
$$7x-3=12$$
$$7x-\cancel{3}=12+3-\cancel{3}$$
$$7x=15$$
$$x=\frac{15}{7}$$

Check:

$$\frac{35}{4}x-\frac{15}{4}=15$$
$$\frac{35}{4}\left(\frac{15}{7}\right)-\frac{15}{4}=15$$
$$\frac{75}{4}-\frac{15}{4}=15$$
$$\frac{60}{4}=15$$
$$15=15$$

Example 3: $0,5x + 0,2 = 0.25$

Method 1: Traditional

$$0.5x + 0.2 = 0.25$$
$$0.5x + 0.2 - 0.2 = 0.25 - 0.2$$
$$0.5x = 0.05$$
$$\frac{0.5x}{0.5} = \frac{0.05}{0.5}$$
$$x = 0.1$$

Another way to simplify:

$$\frac{0.5x}{0.5} = \frac{0.05}{0.5}$$
$$x = \frac{0.05}{0.5}\left(\frac{100}{100}\right)$$
$$x = \frac{5}{50}$$
$$x = \frac{5 \bullet 1}{5 \bullet 10}$$

Method 2: Clear Decimals

$$0.5x + 0.2 = 0.25$$
$$100(0.5x + 0.2) = 100(0.25)$$
$$50x + 20 = 25$$
$$50x + 20 = 20 + 5$$
$$50x = 5$$
$$\frac{50x}{50} = \frac{5}{50}$$
$$x = \frac{1}{10}$$

Method 3: Change to Fractions

$$0.5x + 0.2 = 0.25$$
$$\frac{5}{10}x + \frac{2}{10} = \frac{25}{100}$$
$$\frac{50}{100}x + \frac{20}{100} = \frac{25}{100}$$
$$50x + 20 = 25$$
$$50x + 20 = 20 + 5$$
$$50x = 5$$
$$\frac{50x}{50} = \frac{5}{50}$$
$$x = \frac{1}{10}$$

Check:

$$0.5x + 0.2 = 0.25$$
$$0.5(0.1) + 0.2 = 0.25$$
$$0.05 + 0.2 = 0.25$$
$$0.25 = 0.25$$

You Try 3: $0.28x + 0.7 = 0.56$

Method 1: Traditional

$$0.28x + 0.7 = 0.56$$
$$0.28x + 0.7 - 0.7 = 0.56 - 0.7$$
$$0.28x = -0.14$$
$$\frac{0.28x}{0.28} = \frac{-0.14}{0.28}$$
$$x = -0.5$$

Method 2: Clear Decimals

$$0.28x + 0.7 = 0.56$$
$$100(0.28x + 0.7) = 100(0.56)$$
$$28x + 70 = 56$$
$$28x + 50 + 14 + 6 = 50 + 6$$
$$28x + 14 = 0$$
$$28x = -14$$
$$\frac{28x}{28} = -\frac{14}{28}$$
$$x = -\frac{1 \bullet 14}{2 \bullet 14}$$
$$x = -\frac{1}{2}$$

Method 3: Change to Fractions

$$0.28x + 0.7 = 0.56$$
$$\frac{28x}{100} + \frac{70}{100} = \frac{56}{100}$$
$$100\left(\frac{28x}{100} + \frac{70}{100}\right) = 100\left(\frac{56}{100}\right)$$
$$28x + 70 = 56$$
$$14 \bullet 2 \bullet x + 14 \bullet 5 = 14 \bullet 4$$
$$14(2x + 5) = 14 \bullet 4$$
$$\frac{14(2x + 5)}{14} = \frac{14 \bullet 4}{14}$$
$$2x + 5 = 4$$
$$2x + 5 = 4 + 5 - 5$$
$$2x = -1$$
$$\frac{2x}{2} = \frac{-1}{2}$$
$$x = -\frac{1}{2}$$

Check:

$$0.28x + 0.7 = 0.56$$
$$0.28(-0.5) + 0.7 = 0.56$$
$$-0.14 + 0.70 = 0.56$$
$$0.56 = 0.56$$