Solution Guide for Chapter 12

Here are the solutions for the “Doing the Math” exercises in *Kiss My Math*!

**DTM from p. 170-1**

2. Start with \( x \). Add 3, then multiply by 4.

So, starting with \( x \), when we add 3, we’ll get: \( x + 3 \). Then we multiply the whole thing by 4, so that’s: \( 4(x + 3) \). To unwrap this, then first we’d have to divide by 4, and then subtract 3. That would give us \( x \) all by itself again!

Answer: \( 4(x + 3) \), **and to unwrap it, divide by 4, then subtract 3.**

3. Start with \( y \). Multiply by 4, then add 3.

Starting with \( y \), multiplying by 4 would give us \( 4y \). Then adding 3, we’d get \( 4y + 3 \). Then to unwrap it, we’d have to subtract 3, then divide by 4.

Answer: \( 4y + 3 \), **and to unwrap it, subtract 3, then divide by 4.**
4. Start with $z$. Add 3, then divide by 4.

Starting with $z$, when we add 3, we’d get: $z + 3$. Then, dividing “$z + 3$” by 4, we’d get:

$$\frac{z + 3}{4}.$$ To unwrap this, first we’d have to multiply by 4, and then subtract 3.

Answer: $\frac{z + 3}{4}$, and to unwrap this, first we’d have to multiply by 4, and then subtract 3.

5. Start with $w$. Divide by 2, then subtract 1, then multiply by 5.

Starting with $w$, when we first divide by 2, we’ll get: $\frac{w}{2}$. Then if we subtract 1, we’ll get:

$$\frac{w}{2} - 1$$. Then if we multiply this expression by 5, we’ll get: $5\left(\frac{w}{2} - 1\right)$.

To unwrap this, doing the inverse of the steps, we’d first divide by 5, then add 1, and finally we’d multiply by 2 in order to get back to plain ‘ol $w$!

Answer: $5\left(\frac{w}{2} - 1\right)$, and to unwrap this, divide by 5, then add 1, then multiply by 2.

6. Start with $n$. Multiply by 6, then subtract 5, then divide by 7.

Starting with $n$, when we first multiply by 6, we’d get $6n$. Then subtracting 5, we’d get $6n - 5$, right? Then dividing the whole thing by 7, we’d get: $\frac{6n - 5}{7}$. And doing the inverse, to unwrap it, we’d first multiply by 7, then add 5, and finally divide by 6.

Answer: $\frac{6n - 5}{7}$. To unwrap it, we’d first multiply by 7, then add 5, and then divide by 6.
2. $2(x - 6) = -18$

To isolate $x$, let’s first divide both sides by 2, so that we can get $x$ out of the parentheses:

\[
\frac{2(x - 6)}{2} = \frac{-18}{2}
\]

\[
(x - 6) = -9
\]

\[
x - 6 = -9
\]

And now, we just need to add 6 to both sides:

\[
x - 6 + 6 = -9 + 6
\]

\[
x = -3
\]

Now, let’s check our answer by sticking in the value $x = -3$ into our original equation:

\[
2(x - 6) = -18
\]

\[
2(-3 - 6) = -18 \ ?
\]

\[
3(-9) = -18 \ ?
\]

\[
-18 = -18
\]

yep! We got a true statement, which means that we found the value of $x$ that makes the original equation true statement.

Answer: $x = -3$

3. \[
\frac{(x - 4)}{2} = 1
\]

To isolate $x$, let’s start by multiplying both sides by 2:

\[
\frac{(x - 4)}{2} = 1
\]
\[
\Rightarrow \frac{2(x - 4)}{2} = (2)1
\]

Notice that the 2’s cancel on the fraction, just like we intended them to!

\[
\Rightarrow (x - 4) = 2
\]

\[
\Rightarrow x - 4 = 2
\]

and now we just need to add 4 to both sides:

\[
\Rightarrow x - 4 + 4 = 2 + 4
\]

\[
\Rightarrow x = 6
\]

Now, let’s check out answer by plugging in the value \(x = 6\) into the original equation:

\[
\frac{(x - 4)}{2} = 1
\]

\[
\Rightarrow \frac{(6 - 4)}{2} = 1 \ ?
\]

\[
\Rightarrow \frac{2}{2} = 1 \ ?
\]

\[
\Rightarrow 1 = 1, \text{ yep! We found the right value of } x \text{ to make the equation true!}
\]

Answer: \(x = 6\)

4. \(3(x - 5) - 2 = 7\)

To unwrap \(x\), remembering reverse PEMDAS, we should add 2 to both sides, so we get:

\[
3(x - 5) - 2 = 7
\]

\[
\Rightarrow 3(x - 5) - 2 + 2 = 7 + 2
\]

\[
\Rightarrow 3(x - 5) = 9
\]

Now, let’s divide both sides by 3:
\[ \Rightarrow \frac{3(x - 5)}{3} = \frac{9}{3} \]

notice that the 3’s cancel on the fraction, and 9 divided by 3 equals 3, so:

\[ \Rightarrow (x - 5) = 3 \]
\[ \Rightarrow x - 5 = 3 \]

and now we can just add 5 to both sides:

\[ x - 5 + 5 = 3 + 5 \]
\[ \Rightarrow x = 8 \]

Let’s check our answer by plugging in \( x = 8 \) into our original equation:

\[ 3(x - 5) - 2 = 7 \]
\[ \Rightarrow 3(8 - 5) - 2 = 7 \, ? \]
\[ \Rightarrow 3(3) - 2 = 7 \, ? \]
\[ \Rightarrow 9 - 2 = 7 \, ? \]
\[ \Rightarrow 7 = 7, \text{ yep, we must have found the right value of } x \text{ for this equation.} \]

Answer: \( x = 8 \)

5. \( \frac{(x + 1)}{3} + 2 = 3 \)

Again, undoing PEMDAS, we should subtract 2 from both sides to begin isolating \( x \):

\[ \frac{(x + 1)}{3} + 2 = 3 \]
\[ \Rightarrow \frac{(x + 1)}{3} + 2 - 2 = 3 - 2 \]
\[ \Rightarrow \frac{(x + 1)}{3} = 1 \]
Now we should multiply both sides by 3, so that the 3 will cancel from the bottom of the fraction:

\[
\frac{3(x + 1)}{3} = 3 \times 1
\]

\[\Rightarrow (x + 1) = 3\]

\[\Rightarrow x + 1 = 3\]

finally, we can just subtract 1 from both sides:

\[x + 1 - 1 = 3 - 1\]

\[\Rightarrow x = 2\]

Now let’s check our answer by plugging in \(x = 2\) into the original equation:

\[
\frac{x + 1}{3} + 2 = 3
\]

\[\Rightarrow \frac{(2 + 1)}{3} + 2 = 3\]

\[\Rightarrow \frac{3}{3} + 2 = 3\]

\[\Rightarrow 1 + 2 = 3\]

\[\Rightarrow 3 = 3, \text{ yep, we found the right value of } x!\]

Answer: \(x = 2\)

**DTM from p.188**

2. \(6x + 10 = 4(x + 3)\)

Okay, in order to collect all the “\(x\)” stuff to one side, and the numbers to the other, we’ll have to first distribute that 4:
\[6x + 10 = 4(x + 3)\]
\[\Rightarrow 6x + 10 = 4x + 12\]

Now, let’s subtract 10 from both sides, so that only constants are on the right side:

\[\Rightarrow 6x + 10 - 10 = 4x + 12 - 10\]
\[\Rightarrow 6x = 4x + 2\]

now let’s subtract 4x from both sides:

\[\Rightarrow 6x - 4x = 4x - 4x + 2\]
\[\Rightarrow 2x = 2\]

Finally, we just divide both sides by 2:

\[\frac{2x}{2} = \frac{2}{2}\]
\[\Rightarrow x = 1\]

Let’s check our answer by plugging \(x = 1\) into the original equation:

\[6x + 10 = 4(x + 3)\]
\[\Rightarrow 6(1) + 10 = 4(1 + 3)\ ?\]
\[\Rightarrow 6 + 10 = 4(4)\ ?\]
\[\Rightarrow 16 = 16\ yep!\ We\ found\ the\ right\ value\ of\ x.\]

Answer: \(x = 1\)

3. \(-2x - 5 = -x + 1\)

Hm, lots of negative signs on this one. Let’s multiply both sides by \(-1\) to get rid of them, just to make thing nicer to deal with:

\[-2x - 5 = -x + 1\]
\[\Rightarrow (-1)(-2x - 5) = (-1)(-x + 1)\]
\[ 2x + 5 = x - 1 \]

That’s better. Okay, moving forward, let’s subtract \( x \) from both sides:

\[ 2x - x + 5 = x - x - 1 \]

\[ x + 5 = -1 \]

and now let’s subtract 5 from both sides:

\[ x + 5 - 5 = -1 - 5 \]

On the left, the 5’s disappear, and you can rewrite that subtraction as “adding a negative on the right, if it helps:

\[ x = -1 + (-5) \]

\[ x = -6 \]

Let’s check our answer by plugging the value “\( x = -6 \)” back into the original equation:

\[ -2x - 5 = -x + 1 \]

\[ -2(-6) - 5 = -(-6) + 1 \]

Remembering how to multiply negatives, we see that the negative signs cancel twice here!

\[ 2(6) - 5 = 6 + 1 \]

\[ 12 - 5 = 7 \]

\[ 7 = 7, \text{ yep!} \]

Answer: \( x = -6 \)

4. \( 3x + 2 - x = -6 + 2x + 8 \)

Let’s first rewrite the subtraction as “adding a negative”:

\[ 3x + 2 + (-x) = -6 + 2x + 8 \]
Before we do things to both sides, notice that we can combine some like terms! on the left, the $3x$ and $(-x)$ will combine to give us $2x$, and on the right, the $-6$ and the $8$ will combine to make $2$:

$$3x + 2 + (-x) = -6 + 2x + 8$$

$$\rightarrow 2x + 2 = 2x + 2$$

Hey, wait a minute – we have the same thing on both sides! We could subtract $2x$ from both sides, and get:

$$\rightarrow 2 = 2$$

So, now that we have gotten a true statement without $x$ in it, we know that this is true for all values of $x$. Try plugging in $x = 0, x = 1,$ or $x =$ anything else, and you’ll see that you get true statements each time!

Answer: This equation is true for all values of $x$.

5. $\frac{2x}{3} + 1 = x$ (Hint: multiply both entire sides by 3.)

Let’s take the hint, and see what happens when we multiply both sides by 3. See, our goal is to get $x$ off of that fraction:

$$\frac{2x}{3} + 1 = x$$

$$\rightarrow 3\left(\frac{2x}{3} + 1\right) = 3x$$

Distributing the 3 inside the parentheses, and writing $3$ as $\frac{3}{1}$ to multiply it times the fraction, we get:
\[
\Rightarrow \frac{3}{1} \left( \frac{2x}{3} \right) + 3(1) = 3x \\
\Rightarrow \frac{6x}{3} + 3 = 3x \\
\]

We can cancel a factor of “3” from the top and bottom of the fraction, and get:

\[
\Rightarrow 2x + 3 = 3x \\
\]

Phew! The \(x\) is finally off that fraction.

Okay, in order to get all the “stuff with \(x\)” on one side, let’s subtract \(2x\) from both sides:

\[
2x - 2x + 3 = 3x - 2x \\
\Rightarrow 3 = 1x \\
\Rightarrow 3 = x \\
\Rightarrow x = 3 \\
\]

To check our answer, let’s plug the value \(x = 3\) wherever we see \(x\) in the original equation:

\[
\Rightarrow \frac{2x}{3} + 1 = x \\
\Rightarrow \frac{2(3)}{3} + 1 = 3 \quad ? \\
\Rightarrow \frac{6}{3} + 1 = 3 \quad ? \\
\Rightarrow 2 + 1 = 3 \quad ? \\
\Rightarrow 3 = 3, \text{ yep! We found the right value for } x. \\
\]

Answer: \(x = 3\)
6. \(x + 2xy + 1 - xy = 2x - 7 + xy\) (Hint: notice what happens to the “xy” term when you collect variables together and combine like terms correctly!)

Well, this looks like a big mess. Let’s deal with it a step at a time. First, let’s rewrite the subtraction as “adding negatives” and go ahead and write in the “1” coefficients, just to make this problem easier to look at:

\[
1x + 2xy + 1 + (-1xy) = 2x + (-7) + 1xy
\]

We have \(x\) terms, \(xy\) terms, and constants. The hint says we should pay attention to the \(xy\) terms – so let’s do that. On the left side of the equation, we have \(2xy\) and also \((-1xy)\), so they will combine to give us \(-xy\). Let’s rewrite the problem:

\[
1x + 1xy + 1 = 2x + (-7) + 1xy
\]

Notice that we can subtract \(-xy\) from both sides, and the terms disappear completely!

\[
\Rightarrow 1x + 1xy - 1xy + 1 = 2x + (-7) + 1xy - 1xy
\]

\[
\Rightarrow 1x + 1 = 2x + (-7)
\]

Ah, much nicer. Now let’s subtract \(1x\) from both sides:

\[
\Rightarrow 1x - 1x + 1 = 2x - 1x + (-7)
\]

\[
\Rightarrow 1 = x + (-7)
\]

Now let’s add 7 to both sides, and we’ll get:

\[
\Rightarrow 1 + 7 = x + (-7) + 7
\]

\[
\Rightarrow 8 = x
\]

\[
\Rightarrow x = 8
\]

Let’s check our answer by plugging the value \(x = 8\) into the original equation, remembering that the \(xy\) terms will all disappear completely:
\[ 8 + 2(8)y + 1 - 8y = 2(8) - 7 + (8)y \; \]
\[ \rightarrow 8 + 16y + 1 - 8y = 16 - 7 + 8y \; \]

at this point, we can combine the “y” terms and see that they disappear completely, just like we knew they would (these used to be the xy terms)

\[ \rightarrow 8 + 1 + 8y = 16 - 7 + 8y \; \]

(subtract 8y from both sides, and get)

\[ \rightarrow 8 + 1 = 16 - 7 \; \]

\[ \rightarrow 9 = 9 \; \text{yep! We got the right value of x.} \]

Answer: \( x = 8 \)