Reasoning about Solving Equations (Part 2)

Let's use hangers to understand two different ways of solving equations with parentheses.

7.1 Equivalent to $2(x + 3)$

Select **all** the expressions equivalent to $2(x + 3)$.

A. $2 \cdot (x + 3)$

B. $(x + 3)2$

C. $2 \cdot x + 2 \cdot 3$

D. $2 \cdot x + 3$

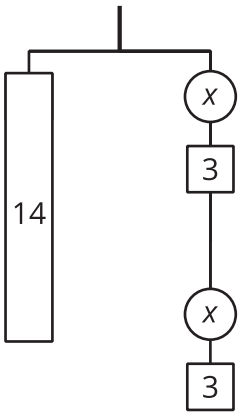
E. $(2 \cdot x) + 3$

F. $(2 + x)3$

7.2 Either Or

1. Explain why either of these equations could represent this hanger:

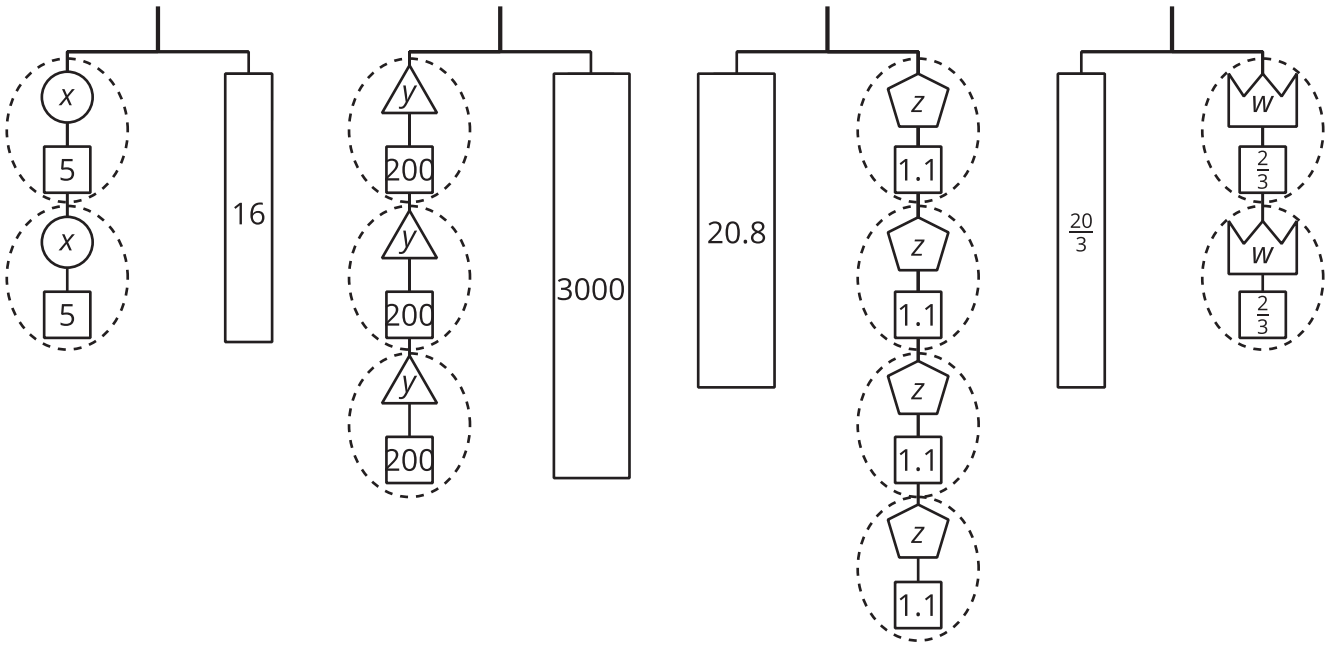
   $14 = 2(x + 3)$ or
   $14 = 2x + 6$



2. Find the weight of one circle. Be prepared to explain your reasoning.

7.3 Use Hangers to Understand Equation Solving, Again

Here are some balanced hanger diagrams. Each piece is labeled with its weight.



For each diagram:

1. Explain how to figure out the weight of a piece labeled with a variable by reasoning about the diagram.

2. Identify which of the following equations matches the diagram. Then explain how to figure out the weight of a piece labeled with a variable by reasoning about the equation.

$2(x + 5) = 16$

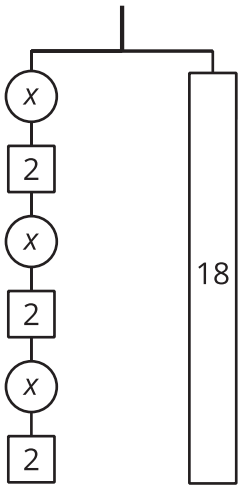
$3(y + 200) = 3{,}000$

$20.8 = 4(z + 1.1)$

$\frac{20}{3} = 2\left(w + \frac{2}{3}\right)$

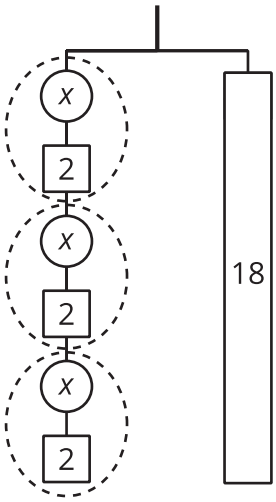
Lesson 7 Summary

The balanced hanger diagram shows the amounts on the left equal the amounts on the right. The left side has 3 pieces that each have unknown weight x and 3 pieces that each weigh 2 units. So, the left side shows 3 x's plus 6 units. The right side shows 18 units. We could represent this diagram with an equation and solve the equation the same way we did before.



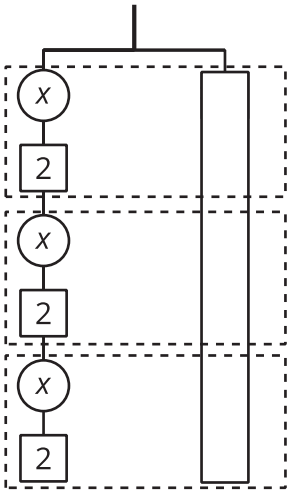
$$\begin{aligned} 3x + 6 &= 18 \\ 3x &= 12 \\ x &= 4 \end{aligned}$$

Since there are 3 groups of $x + 2$ on the left, we could represent this hanger with a different equation: $3(x + 2) = 18$.



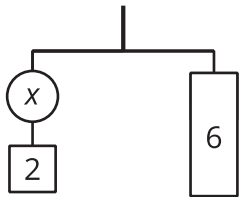
$3(x + 2) = 18$

The two sides of the hanger balance with these weights: 3 groups of $x + 2$ on one side, and 18, or 3 groups of 6, on the other side.



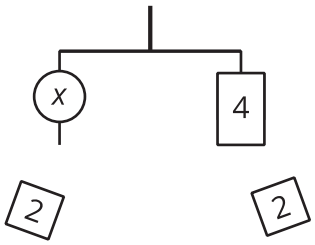
$\frac{1}{3} \cdot 3(x + 2) = \frac{1}{3} \cdot 18$

The two sides of the hanger will balance with $\frac{1}{3}$ of the weight on each side:



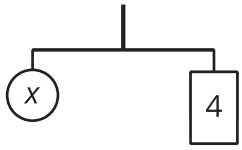
$x + 2 = 6$

We can remove 2 units of weight from each side, and the hanger will stay balanced. This is the same as subtracting 2 from each side of the equation.



$x + 2 - 2 = 6 - 2$

An equation for the new balanced hanger is $x = 4$. This gives the solution to the original equation.



$x = 4$

Here is a concise way to write the steps above:

$$3(x + 2) = 18$$

$x + 2 = 6$ after multiplying each side by $\frac{1}{3}$

$x = 4$ after subtracting 2 from each side