

PR7-10 Analyzing Expressions and Equations

REMINDER: An equation contains an equal sign, while an expression does not. An expression represents a numerical value. An equation represents a statement of equality.

- 1. Circle the equations. Underline the expressions.**

$$n + 6 > 7$$

$$7 + 3n = 5 + 2n$$

$$a + b = 4(b + a)$$

$$a \times b = b \times a$$

$$4 + 6n = 5m$$

- ## 2. What is the same about expressions and equations?

- ### 3. How are expressions different from equations?

4. Write an equation that contains the expression $5n + 3$. _____

- 5.** Substitute the given values for the variables and evaluate the expression.

c) $10d - g, g = -11, d = 7$

- 6.** Substitute the value for the variable. Is the equation true or false?

c) $210 = 90 + 6p, p = 20$

In an expression or equation, a quantity with a variable is called a **variable term** while a quantity without a variable is called a **constant term**.

7. Complete the table.

	Expression or Equation	Variable Terms	Constant Terms
a)	$-15 + 1y = -3x + 0$	$+1y, -3x$	$-15, 0$
b)	$19m + 18 - 3m$		
c)	$27y - 5 = 16 - 1x$		

Bonus ►

$342x - 158T + 140 - 3y = 2x + 356y - 52$		
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A variable term has two parts: the variable and the coefficient.

the coefficient of x is -5

$$\underbrace{-5x + 13}$$

the coefficient of n is $+3$

$$\underbrace{27y + 3n} - 5 = 16 - 1x$$

8. Complete the table.

Expression	Variable Term	Variable	Coefficient	Constant Term
$-35x - 6$	$-35x$	x	-35	-6
$108 - 37M$				
$-23 + t$				
$1x$				

You can use variables, coefficients, and constant terms to represent real-world situations.

Use a variable for an unknown quantity, a coefficient with the variable for a quantity that changes as the variable changes, and a constant term for a quantity that does not change.

9. It costs \$10 per hour to use a ski hill and \$40 to rent skis.

- Write an expression for the cost of renting skis and skiing for h hours. _____
- What is the coefficient in your expression? _____
- What is the constant term in your expression? _____
- How much does it cost to rent skis and go skiing for 5 hours? _____

10. A truck is travelling at a speed of 50 km per hour.

- Write an expression for the distance the truck travels in h hours. _____
- What is the constant term? _____
- What is the coefficient? _____
- How far will the truck travel in 7 hours? _____
- What does the variable in your expression represent? Circle the correct answer.

speed

number of hours

distance

11. A company charges a flat fee and an hourly rate to rent a scooter. Draw lines to match the coefficient, the constant term, and the variable with the correct quantities.

coefficient

the flat fee

constant term

the hourly rate

variable

the number of hours rented

PR7-11 Linear Relations in Four Quadrants

REMINDER: The x -coordinate of a point is negative if the point is to the left of the y -axis.
The y -coordinate of a point is negative if the point is below the x -axis.

1. a) Write the coordinates of the points.

$A (\quad , \quad)$ $B (\quad , \quad)$

$C (\quad , \quad)$ $D (\quad , \quad)$

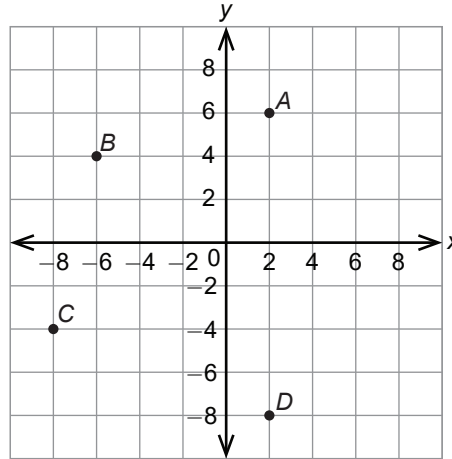
- b) Plot and label the points on the grid.

$E (-4, -8)$

$F (6, 3)$

$G (6, -6)$

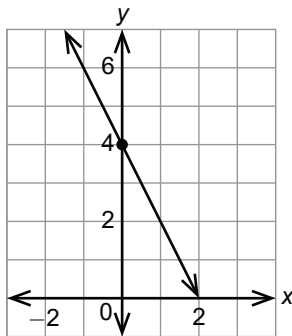
$H (-4, 6)$



The **y -intercept** is the value of y where a line crosses the y -axis.

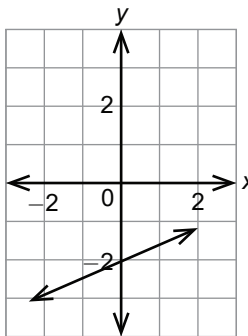
2. a) Write the y -intercept of the line. Mark a point for the y -intercept on the grid.

i)



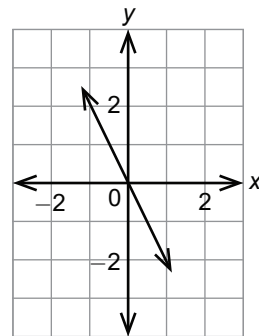
y -intercept: 4

ii)



y -intercept:

iii)



y -intercept:

- b) Write the coordinates of the point you marked in part a) where the line crosses the y -axis.

i) (,)

ii)

iii)

- c) Look at your answers to part b). What can you say about the x -coordinate of each point?
What can you say about the y -coordinate of each point?

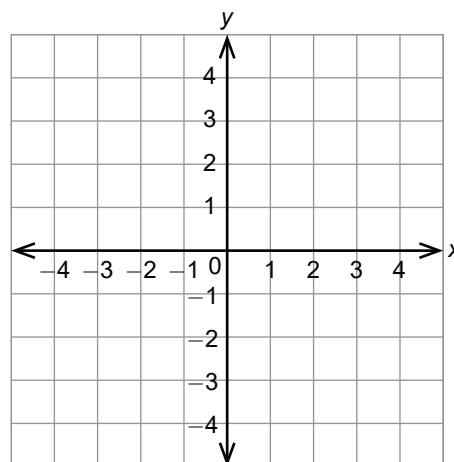
Bonus ►

- a) A line crosses the y -axis at the point $(0, -907)$. What is the y -intercept of the line?
b) The y -intercept of a line is 437. Write the coordinates of the point where the line crosses the y -axis.

3. a) Complete the table of values for the linear relation.

$$y = 3x - 2$$

x	y
-1	
0	
1	
2	



- b) Graph the relation. Mark a point for the y-intercept.

- c) Where does the y-intercept show up in the table?

The row where $x = \underline{\hspace{2cm}}$. The y-intercept is $\underline{\hspace{2cm}}$.

All points on the y-axis have x-coordinate 0. To find the y-intercept of a linear relation using its formula, substitute 0 for x .

4. a) Substitute 0 for x to find the y-intercept of the linear relation.

i) $y = 13x - 5$

ii) $y = 27 - 15x$

iii) $y = -11 - 12x$

$$y = 13(0) - 5$$

$$y = 0 - 5$$

$$y = -5$$

y-intercept is -5

- b) What is the constant term of the formula in part a)?

i) $\underline{\hspace{2cm}}$

ii) $\underline{\hspace{2cm}}$

iii) $\underline{\hspace{2cm}}$

- c) How does the constant term compare to the y-intercept? $\underline{\hspace{5cm}}$

You can read the y-intercept and the change in y as x increases by 1 from the formula of a linear relation. Example:

coefficient (gap: change in y as x increases by 1) is -5

$$y = -5x + 3$$

constant term (y-intercept) is $+3$

5. Write the y-intercept and the coefficient of x for the linear relation.

a) $y = 8x + 13$

y-intercept: $\underline{\hspace{2cm}}$

coefficient of x : $\underline{\hspace{2cm}}$

b) $y = -39x + (-28)$

y-intercept: $\underline{\hspace{2cm}}$

coefficient of x : $\underline{\hspace{2cm}}$

c) $y = -25x - 43$

y-intercept: $\underline{\hspace{2cm}}$

coefficient of x : $\underline{\hspace{2cm}}$

Bonus ► $-983 + 1 - x = y$

y-intercept: $\underline{\hspace{2cm}}$

coefficient of x : $\underline{\hspace{2cm}}$

6. Find the y-intercept and the gap between the y-values in the table. Then write a formula for the linear relation.

a)

x	y
-2	10
-1	6
0	2
1	-2

y-intercept: _____
gap: _____
formula: y =

b)

x	y
-1	8
0	15
1	22
2	29

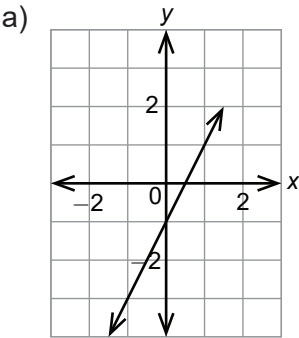
y-intercept: _____
gap: _____
formula: _____

c)

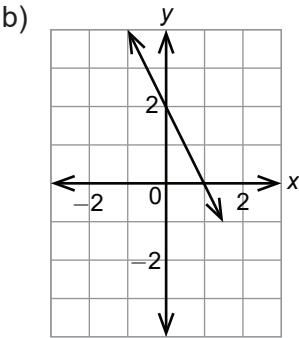
x	y
0	-1
1	-4
2	-7
3	-10

y-intercept: _____
gap: _____
formula: _____

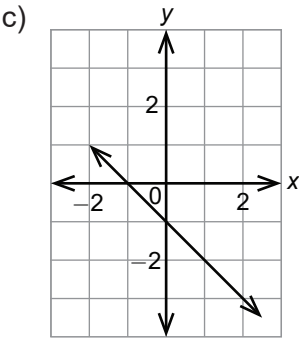
7. Find the y-intercept and the coefficient of x (the change in y as x increases by 1) for the linear relation. Then write the formula.



y-intercept: _____
coefficient of x: _____
formula: y =



y-intercept: _____
coefficient of x: _____
formula: _____

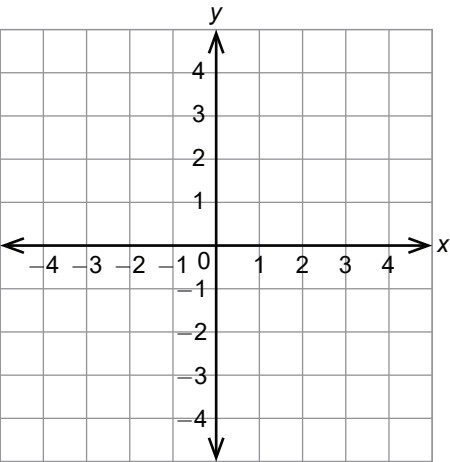


y-intercept: _____
coefficient of x: _____
formula: _____

8. Write the y-intercept and the coefficient of x (the change in y as x increases by 1) for the linear relation. Then sketch the graph.

$y = -2x + 3$

y-intercept: _____
coefficient of x: _____



PR7-12 Solving Equations by Testing and Revising

A value for a variable that makes an equation true is called a **solution** to the equation.

Ezra writes an equation with one variable: $15x - 9 = 51$

He thinks that 4 might be the solution, so he substitutes it for x : $15(4) - 9$

Since $15(4) - 9 = 51$, the value 4 for x is the solution.

1. Use substitution to verify the solution to the equation.

a) $25 + 14s = 53, s = 2$ b) $-40 + 3x = 50, x = 30$ c) $-18 - 5n + 4 = -1, n = 0$

$$\begin{aligned}LS &= 25 + 14(2) & RS &= 53 \\&= 25 + 28 \\&= 53 \\LS &= RS, \\&\text{so } s = 2 \text{ is the solution}\end{aligned}$$

2. Is the given value for the variable a solution to the equation? Check by substitution.

a) $30y - 10 = 120, y = 4$ b) $-28 + b = -33, b = -5$ c) $42 - n = 5n + 10, n = 7$

$$\begin{aligned}LS &= 30(4) - 10 & RS &= 120 \\&= 120 - 10 \\&= 110 \\LS &\neq RS, \\&\text{so } 4 \text{ is not the solution}\end{aligned}$$

Bonus ► $7x - 300 + 4(8) = -690 + 20x + (54 \div 2), x = 30$

3. Marta and Raj worked on different math problems. Fill in the blanks with “Marta,” “Raj,” or “Marta and Raj.”

Marta:	Raj:
$5h + 21$	$5h + 21 = 61$
when $h = 8$,	try $h = 8$
$5(8) + 21$	$LS = 5(8) + 21$ $RS = 61$
$= 40 + 21$	$= 40 + 21$
$= 61$	$= 61$
	$LS = RS$, so $h = 8$ is the solution

- a) _____ used substitution.
- b) _____ tested a possible solution to an equation.
- c) _____ only evaluated an expression for a value of the variable.
- d) _____ simplified an expression after using substitution.

Solving an equation with one variable means finding the solution: the value for the variable that makes the equation true.

4. Solve for x by guessing and checking. Use the table.

a) $6x + 19 = 43$

x	$6x + 19$	True?
1		
2		
3		
4		
5		

so $x =$ _____

b) $20x - 35 = 65$

x	$20x - 35$	True?
1		
2		
3		
4		
5		

so $x =$ _____

c) $11x - 40 = -18$

x	$11x - 40$	True?
0		
1		
2		
3		
4		

so $x =$ _____

5. Substitute 5 for n and say whether 5 is too high or too low. Then try a higher or lower number.

a) $15 + 5n = 35$

n	$15 + 5n$	Answer
5	$15 + 5(5)$	40

5 is _____

b) $12n - 7 = 65$

n	$12n - 7$	Answer
5		

5 is _____

c) $8n + 37 = 93$

n	$8n + 37$	Answer
5		

5 is _____

d) $6n - 100 = -82$

n	$6n - 100$	Answer
5		

5 is _____

e) $6n + 100 = 136$

n	$6n + 100$	Answer
5		

5 is _____

f) $-80 + 10n = 0$

n	$-80 + 10n$	Answer
5		

5 is _____

6. Solve for x by guessing, checking, and revising. Use test values between 0 and 10.

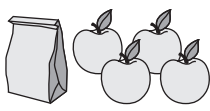
a) $24x + 17 = 137$

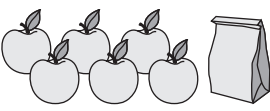
b) $-18 + 7x = -4$

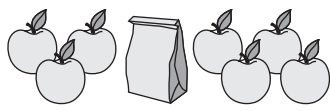
c) $13x - 19 = 98$

PR7-13 Solving One-Step Equations Using Models


1. The bag has an unknown number of apples. Let x represent the number of apples in the bag. Write an expression to represent the total number of apples.


a) 

b) 

c) 

2. The scales are balanced. Let m represent the number of apples in the bag. Write an equation to represent the total number of apples on each side of the balance.

a) 

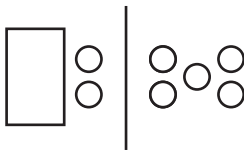
b) 

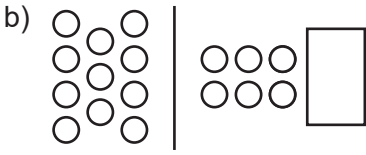
3. You start with balanced scales. If you perform the action, what action must you perform on the other side to maintain the balance?

- a) add 8 apples to the right side _____
- b) remove 5 apples from the left side _____
- c) subtract 13 apples from the right side _____
- d) add 20 apples to the left side _____

Bonus ► remove a bag with n apples from the right side _____

4. In this model circles represent apples, a rectangle represents a bag with an unknown number of apples, and a line divides two sides of a balance. Write the equation represented by the model.

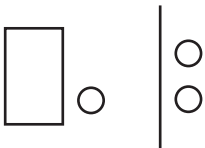
a) 


b) 

5. a) Draw more circles so that the model represents the equation $x + 3 = 8$.

b) Cross out circles from both sides of the model to get the bag by itself on one side. Write a new equation to show removing circles from both sides. _____

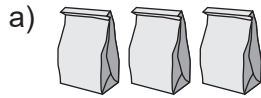
c) Draw a final picture with the crossed-out circles removed. Write an equation to represent your final picture.



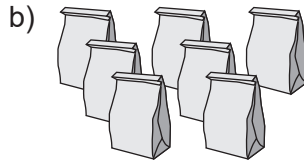


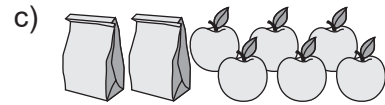
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6. Each bag has the same unknown number of apples. Let y represent the number of apples in one bag. Write an expression to represent the total number of apples.

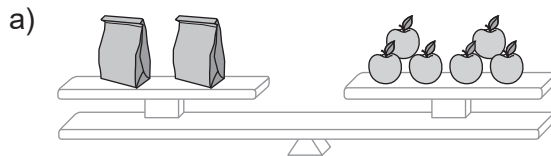


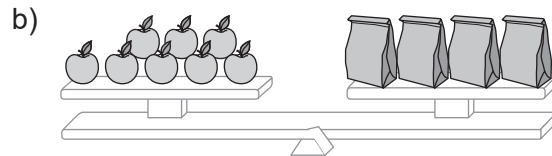
3y





7. The scales are balanced. Let m represent the number of apples in one bag. Write an equation to represent the total number of apples on each side of the balance.





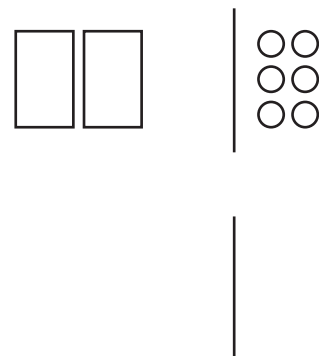
An equation is like balanced scales. If you add, subtract, multiply, or divide on one side, you must do the same on the other side to preserve the balance, or equality.

8. If you perform the action on one side of an equation, what must you do on the other side to make sure the two sides are equal?

- a) You multiply the left side by 5. _____
- b) You divide the right side by 14. _____

9. In this model circles represent apples, rectangles represent bags with the same unknown number of apples, and the line divides two sides of a balance.

- a) Add to the model to represent the equation $3m = 12$.
- b) To get one bag by itself on one side, first show how to divide both sides of the model into equal groups. Write a new equation to show your division on both sides. _____
- c) Draw a final picture after the division, showing just one of the equal groups on each side. Write an equation. _____
- d) Verify your solution works by substituting the value for m into the equation from part a).



PR7-14 Solving One-Step Equations Using Opposite Operations

1. Write the number that makes the equation true.

a) $8 + 10 - \underline{\hspace{1cm}} = 8$

b) $58 - 26 + \underline{\hspace{1cm}} = 58$

c) $35 \times 20 \div \underline{\hspace{1cm}} = 35$

Bonus ►

d) $n + 1 - \underline{\hspace{1cm}} = n$

e) $250 + 306 - \underline{\hspace{1cm}} = 306$

f) $987 + m - \underline{\hspace{1cm}} = m$

2. Write the operation that makes the equation true.

a) $86 + 33 \bigcirc 33 = 86$

b) $77 \div 7 \bigcirc 7 = 77$

c) $h \times 333 \bigcirc 333 = h$

d) $d - 274 \bigcirc 274 = d$

e) $(45 \times p) \bigcirc 45 = p$

f) $25x \bigcirc 25 = x$

3. Write the operation and number that make the equation true.

a) $37 + 9 \underline{\hspace{1cm}} = 37$

b) $60 \div 15 \underline{\hspace{1cm}} = 60$

c) $38 - 75 \underline{\hspace{1cm}} = 38$

d) $m \times 7 \underline{\hspace{1cm}} = m$

e) $(9 \times g) \underline{\hspace{1cm}} = g$

f) $10w \underline{\hspace{1cm}} = w$

Bonus ► $(16 + 45x - 26y) \times 25 \underline{\hspace{1cm}} = 16 + 45x - 26y$

4. The operation is applied to a starting number. How could you undo the operation and get back to the number you started with?

a) add 24 subtract 24

b) multiply by 7 divide by 7

c) subtract x add x

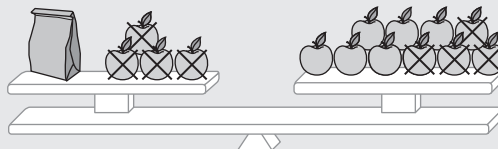
d) divide by K multiply by K

e) add t subtract t

f) multiply by n divide by n

To solve $x + 4 = 10$, subtract 4 from both sides of the equation.

$$\begin{aligned} x + 4 &= 10 \\ x + 4 - 4 &= 10 - 4 \\ x &= 6 \end{aligned}$$

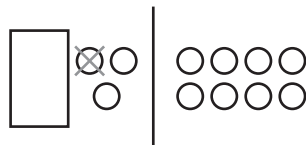


The variable x has been **isolated** since it is by itself on one side of the equation.

5. Isolate the variable by applying the same operation on both sides of the equation.

Adjust the picture to show the first step. Then draw a new picture to isolate the variable.

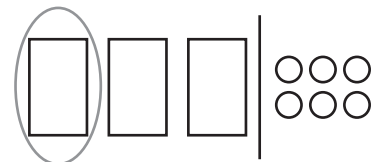
a) $s + 3 = 8$



$$s + 3 - 3 = 8 - 3$$

$$\underline{\hspace{1cm}} = \underline{\hspace{1cm}}$$

b) $3x = 6$



$$3x \div 3 = 6 \div 3$$

$$\underline{\hspace{1cm}} = \underline{\hspace{1cm}}$$

Addition and subtraction are **opposite operations**, as are multiplication and division. Even without a model, you can use opposite operations to isolate a variable in an equation.

6. Isolate the variable by applying the opposite operation. Remember to apply the same operation on both sides of the equation.

a) $17 + x = 35$

b) $64 = 14 + x$

c) $z - 48 = 152$

$$17 + x - 17 = 35 - 17$$

$$x = 18$$

d) $v \times 20 = 220$

e) $150 = 6b$

f) $r \div 25 = 13$

7. Check your solutions to Question 6 by substituting your solution into the original equation.

a) $LS = 17 + x$ $RS = 35$

b) $LS = 64$ $RS = 14 + x$

c) $LS =$

$$LS = 17 + 18$$

$$LS = 35$$

$$LS = RS,$$

so $x = 18$ is the solution

d)

e)

f)

REMINDER: Division is often written in fractional form.

Examples: $27 \div 9 = \frac{27}{9}$

$$7 \div 10 = \frac{7}{10}$$

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

$$19 \div w = \frac{19}{w}$$

8. Solve for the variable by applying the opposite operation. Use fraction notation for division.

a) $7x = 91$

b) $14y = 42$

c) $50q = 450$

$$\frac{7x}{7} = \frac{91}{7}$$

$$x = 13$$

Sometimes the solution to an equation is a fraction or decimal number.

9. Solve for the variable by applying opposite operations to both sides of the equation. Use fraction notation for division. Leave the solution in fraction form.

a) $80w = 20$

b) $26x = 13$

c) $9n = 7$

$$\frac{80w}{80} = \frac{20}{80}$$

$$w = \frac{20}{80} = \frac{1}{4}$$

PR7-15 Undoing Two or More Operations

1. Each bag contains the same unknown number of apples. Write the equation shown by the balanced scale. Use *b* for the unknown number of apples in a bag.

a)

=

b)

=

2. The circles represent apples, the rectangles represent bags with the same unknown number of apples, and the line divides two sides of a balance. Write the equation shown by the picture. Use *n* for the unknown number of apples in each bag.

a)

$2n + 3 = 9$

b)

c)

3. Draw a model to represent the equation.

a) $2x + 5 = 11$

b) $3x + 4 = 13$

c) $13 = 4x + 5$

4. Solve the equation by using a model. Draw the new model and equation for each step of your solution.

a) $2x + 3 = 7$

$2x + 3 - 3 = 7 - 3$

$2x = 4$

$\frac{2x}{2} = \frac{4}{2}$

$x = 2$

b) $2x + 4 = 10$

5. Write the operations in words, in the correct order. Start with the variable.

a) $13 + 8p$

Start with p . Multiply by 8. Add 13.

b) $(x - 35) \div 27$

6. Write an expression to match the description in words. Use brackets only when you need to.

a) Start with x . Multiply by 9. Then add 3.

b) Start with q . Divide by 15. Then subtract 12.

c) Start with w . Subtract 23.
Then divide by 100.

Bonus ▶ Start with v . Divide by 14. Subtract 201.
Multiply by 49.

To undo two or more operations, undo the operations in reverse order. Example:

Start at 20. 20 $\xrightarrow{\quad}$ 20 Get back to 20.
Multiply by 3. 60 $\xrightarrow{\quad}$ 60 Divide by 3.
Add 7. 67 $\xrightarrow{\quad}$ 67 Subtract 7.

7. Do the operations and then undo them in reverse.

Start at 11.	<u>11</u>	\downarrow	<u> </u>	\downarrow	<u> </u>
Add 4.	<u>15</u>	\downarrow	<u> </u>	\downarrow	<u> </u>
Divide by 3.	<u> </u>	\downarrow	<u> </u>	\downarrow	<u> </u>
Subtract 1.	<u> </u>	\downarrow	<u> </u>	\downarrow	<u> </u>
Multiply by 6.	<u> </u>	\downarrow	<u> </u>	\downarrow	<u> </u>
		\rightarrow			<u>Divide by 6.</u>

8. Find the result. Then write the operations to get back to the starting number.

a) Start at 25. Multiply by 3. Add 12.

$$25 \times 3 + 12$$

$$= 75 + 12$$

$$= 87$$

Subtract 12. Divide by 3.

b) Start at 46. Subtract 10. Divide by 3.

9. Write the result as an expression. Then write the operations to get back to the variable.

a) Start with x . Multiply by 4. Add 9.

$$4x + 9$$

Subtract 9. Divide by 4.

b) Start with m . Divide by 14. Subtract 20.

c) Start with r . Multiply by 4. Divide by 9.

d) Start with z . Multiply by 34. Subtract 85.

Bonus ▶ Start with y . Multiply by 14. Divide by 11. Add 23. Subtract 8.

PR7-16 Solving Equations with Two or More Operations

1. Aki performs operations starting with a secret number. Her result is 43. Write an equation and then work backwards to find the secret number.

a) **Aki's operations**

Work backwards to find n

Start with n .	n	Write the equation again.	$4n - 5 = 43$
Multiply by 4.	$4n$	Undo subtracting 5 by adding 5.	$4n - 5 + 5 = 43 + 5$
Subtract 5.	$4n - 5$	Write the new equation (simplify).	$4n = 48$
The result is 43.	$4n - 5 = 43$	Undo multiplying by 4 by dividing by 4.	$4n \div 4 = 48 \div 4$
		Simplify. You solved for n !	$n = 12$

Check your solution by doing the operations in order, the way Aki did them.

Start with your solution: 12 Multiply by 4: 48 Subtract 5: 43 Did you get 43? yes

b) **Aki's operations**

Work backwards to find q

Start with q .		Write the equation again.	
Divide by 5.		Undo adding 24 by subtracting 24.	
Add 24.		Write the new equation (simplify).	
The result is 43.		Undo dividing by 5 by multiplying by 5.	
		Simplify. You solved for q !	

Check your solution by doing the operations in order, the way Aki did them.

Start with your solution: _____ Divide by 5: _____ Add 24. _____ Did you get 43? _____

2. Solve the equation by applying opposite operations. Show each step.

a) $11x - 10 = 78$

b) $30w + 11 = 221$

c) $\frac{t}{6} + 38 = 47$

$$\begin{aligned}
 11x - 10 + 10 &= 78 + 10 \\
 11x &= 88 \\
 11x \div 11 &= 88 \div 11 \\
 x &= 8
 \end{aligned}$$

3. Check your solutions to Question 2 by substituting them into the original equations.

a) $LS = 11(8) - 10$ $RS = 78$ b)

$$\begin{aligned}
 &= 88 - 10 \\
 &= 78 \\
 LS &= RS, \\
 \text{so } x = 8 \text{ is the solution}
 \end{aligned}$$

c)

4. Solve the equation by applying opposite operations. Show each step.

a) $8x \div 12 = 6$

b) $\frac{10m}{7} = 30$

c) $\frac{7w}{2} = 49$

$$\begin{aligned} 8x \div 12 \times 12 &= 6 \times 12 \\ 8x &= 72 \\ 8x \div 8 &= 72 \div 8 \\ x &= 9 \end{aligned}$$

5. Check your solutions to Question 5 by substituting them into the original equations.

a) $LS = 8(9) \div 12$ $RS = 6$

b)

c)

=

=

When solving an equation with two or more operations, isolate the variable by undoing the operations in reverse order.

Example: In the equation $\frac{5x}{6} + 9 = 19$, three things happen to x : multiply x by 5, divide by 6, and then add 9.

To isolate x , work backwards: subtract 9, multiply by 6, and then divide by 5 on both sides of the equation.

6. Solve the equation by applying opposite operations. Describe each step in words.

a) $\frac{5x}{6} + 9 = 19$

b) $\frac{10n}{14} - 4 = 1$

$\frac{5x}{6} + 9 - 9 = 19 - 9$ subtract 9

$\frac{5x}{6} = 10$ simplify

$\frac{5x}{6} \times 6 = 10 \times 6$ multiply by 6

$5x = 60$ simplify

$5x \div 5 = 60 \div 5$ divide by 5

$x = 12$ simplify

c) $3y \div 2 + 28 = 40$

d) $4n \div 5 - 13 = 7$

7. Nahid has 3 bags of apples and 2 extra apples. Each bag of apples has the same number of apples. In total, Nahid has 17 apples. Answer the questions to find out how many apples Nahid has in each bag.
- Let b stand for the number of apples in each bag. Write an expression for the total number of apples inside the bags.
 - Write an expression using the variable b for the total number of apples Nahid has.
 - Use your expression from part b) and the total number of apples to write an equation.
 - Solve the equation for b by using a picture model. Use rectangles for bags with the unknown number of apples, and circles for apples. The first picture has been started for you. Write the equations that match each step of the solution.



- How many apples are in each of Nahid's bags? Write your answer as a complete sentence.
8. At an amusement park, admission costs \$20 and each ride costs \$3. Amo spent \$95 in total.
- How many rides did Amo go on? Write an equation to solve the problem. Show each step of your work. Write a concluding statement.



Bonus ► If Amo had gone on double the number of rides, how much would he have spent?

PR7-17 Solving Equations with Integers

1. Solve the equation by applying opposite operations. Show your work.

a) $y + 9 = 3$

$$y + 9 - 9 = 3 - 9$$

$$y = -6$$

b) $g - 23 = -11$

c) $x + 39 = -86$

2. Check your solutions to Question 1 by substituting them into the original equations.

a) $LS = (-6) + 9$ $RS = 3$

$$LS = 3$$

$$LS = RS,$$

so $y = -6$ is the solution

b)

c)

REMINDER: You can rewrite integer addition or subtraction without brackets.

Rules:

$$+ (+) = +$$

$$+ (-) = -$$

$$- (+) = -$$

$$- (-) = +$$

Examples:

$$(-3) + (+7) = -3 + 7$$

$$(-3) + (-7) = -3 - 7$$

$$(-3) - (+7) = -3 - 7$$

$$(-3) - (-7) = -3 + 7$$

3. Solve the equation. Show your work.

a) $m + (-17) = -45$

$$m - 17 = -45$$

$$m - 17 + 17 = -45 + 17$$

$$m = -28$$

b) $p - (-25) = -55$

c) $-3 + q + (+8) = -62 - (+2)$



Bonus $\blacktriangleright (-75) + w - (-13) - (-12) = -200 - (+30) - (-40)$


4. Talia uses a model to solve the equation. The rectangle represents the variable x , white counters represent negative numbers, and black counters represent positive numbers. A pair of negative and positive counters on the same side cancel each other out.

Write the equations that match each step of Talia's work.

a) $x + (-4) = -2$  b) $x - (-2) = -1$

$x + (-4) + (+4)$
 $= -2 + (+4)$  $x + 2 = -1$

$x + \cancel{(-4)} + \cancel{(+4)}$
 $= -2$  

$x = +2$  


5. Solve the equation using pictures. Write an equation to match each picture in your solution. Remember, opposite integers add to 0 and cancel each other out.

a) $m - (-3) = -1$

$m + (+3) = -1$

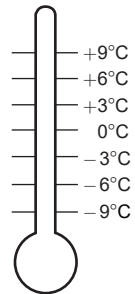


b) $n + (-2) = -3$

6. The coldest temperature on Thursday was -9 degrees Celsius. This was 4 degrees colder than Wednesday's coldest temperature.

- a) Complete the statement: Let W be the _____.
- b) Write an expression with W for the coldest temperature on Wednesday.
Hint: Since Thursday is colder than Wednesday, do you need to add or subtract?

- c) Use your expression from part b) and the actual coldest temperature on Thursday to write an equation. _____



- d) Solve your equation from part c) using pictures. Write equations to match each picture.
- e) What was the coldest temperature on Wednesday? Write your answer as a complete sentence.

7. Cleopatra was born before the common era (BCE). Julius Caesar died 25 years after Cleopatra was born, in the year 44 BCE. Answer the questions to find out when Cleopatra was born.

- a) Complete the statement: Let x stand for _____.
- b) Write and solve an equation using the variable x . Show each step of your work.

- c) In what year was Cleopatra born? Write a concluding statement.



Bonus ► Three biologists are climbing a ladder out of an underground bat cave. Salma is 25 metres below Ross, while Jin is 34 metres above Ross. Jin is at an altitude of -35 metres. At what altitude is Salma? Use an equation to solve the problem. Show each step of your work.

PR7-18 Problems and Puzzles: Equations

To solve word problems, it can be helpful to translate words into mathematical expressions. Key words give clues about the operations needed. Examples:

Add	Subtract	Multiply	Divide
increased by	decreased by	double	divided by
sum	difference	product	quotient
more than	less than	twice as many	divided into
total	reduced by	times	shared equally

1. Match the description with the correct algebraic expression.

a) 2 more than a number	$4x$	b) 2 divided into a number	$3n$
a number divided by 3	$x - 2$	a number reduced by 4	$n \div 2$
2 less than a number	$x + 2$	a number times 3	$n + 3$
the product of a number and 4	$x - 3$	twice as many as a number	$n - 4$
a number decreased by 3	$x \div 3$	a number increased by 3	$2n$

2. Write an algebraic expression for the description.

a) four more than a number	_____	b) a number decreased by 10	_____
c) the product of 7 and a number	_____	d) the sum of a number and 7	_____
e) a number divided by 8	_____	f) two less than a number	_____
g) five times a number	_____	h) 6 divided into a number	_____

When solving word problems, the word “is” means “equal” and it translates to the equal sign, $=$.

Example: “Two more than a number is seven” can be written as $x + 2 = 7$.

3. Translate the sentence into an equation.

a) Four more than a number is eighteen.	b) Five less than a number is twelve.
$x + 4 = 18$	
c) Five times a number is thirty.	d) Six divided into a number is four.
e) A number multiplied by 2 then increased by 5 is 35.	f) A number multiplied by three then decreased by four is seventeen.

g) 3 times a number is 4 less than 28.

Bonus ► Two more than half of a number is five more than three.

4. Translate the sentence into an equation. Solve the equation to find the number.
- a) A number multiplied by 3 then increased by 7 is 31.
- b) A number multiplied by four then decreased by twenty is forty-four.

Bonus ►

- c) 5 more than 4 times a number is 6 less than the product of 13 and 3.
- d) Seven more than a number divided by twenty is two less than the product of three and six.

5. Keegan goes on a road trip with his uncle. They drive at a speed of 80 km per hour. They make two stops, the first for 20 minutes and the second for 40 minutes. The trip takes a total of 7 hours. What distance do they travel?

6. Ava is 4 times as old as her son. Ava's younger brother is 39. The difference between Ava's and her brother's age is 5 years. How old is Ava's son?



Bonus ► Ed's sister is 3 years younger than Ed. Ed's mother is 3 times Ed's age. Ed's father is 4 years older than Ed's mother. The sum of all four ages is 89. How old is Ed's mother?