

Table of Contents

Table of Contents	1
Letter to Students and Teachers	3
Table of Contents with Benchmarks for Grade 8	5
Number Sense and Operations	10
Define Irrational Numbers.....	11
Compare Rational and Irrational Numbers.....	16
Evaluate Rational Numbers with Exponents.....	21
Express Numbers in Scientific Notation.....	28
Algebraic Operations with Numbers in Scientific Notation.....	34
Real-World problems with Numbers in Scientific Notation.....	38
Solve Multi-Step Problems with Rational Numbers	42
Algebraic Reasoning	45
Generate Equivalent Algebraic Expressions.....	46
Multiply Two Linear Expressions	50
Rewrite Expressions with Common Monomial Factor	53
Solve Multi-Step Linear Equations	56
Solve Two-Step Linear Inequalities	66
Determine the solutions to $x^2 = p$ and $x^3 = q$	71
Proportional Relationship	77
Determine the Slope.....	81
Write an Equation in Slope-Intercept Form	87
Graph a Linear Equation.....	92
Interpret the Slope and y -Intercept	97
Determine if an Ordered Pair is a Solution to a System	103
Determine the Number of Solutions to a System.....	106
Solve Systems of Two Linear Equations by Graphing.....	110



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Functions	114
Determine whether the Relationship is a Function	115
Determine whether the Function is a Linear Function.....	121
Increasing, Decreasing, and Constant Functions	126
Geometric Reasoning	136
Find Unknown Side Lengths in Right Triangles	137
Find Distances Between Ordered Pairs	144
Use the Triangle Inequality Theorem.....	150
Supplementary, Complementary, Vertical, and Adjacent Angles	155
Interior and Exterior Angles of a Triangle.....	161
Sum of the Interior Angles of Regular Polygons.....	168
Identify Transformations	173
Identify the Scale Factor in Dilation.....	184
Transformations on the Coordinate Plane	194
Proportional Relationships between Similar Triangles	202
Data Analysis and Probability	208
Create Scatter Plots or Line Graphs	209
Describe Patterns of Association in a Scatter Plot.....	215
Fit a Straight Line on a Scatter Plot	222
Sample Space for a Repeated Experiment.....	227
Find the Probability of an Event.....	231
Real-World Problems Involving Probabilities	237
Glossary	242
Item Type Reference Sheet	246



Table of Contents with Standards

Number Sense and Operations	10
Solve problems involving rational numbers, including numbers in scientific notation, and extend the understanding of rational numbers to irrational numbers.	
MA.8.NSO.1.1	11
Extend previous understanding of rational numbers to define irrational numbers within the real number system. Locate an approximate value of a numerical expression involving irrational numbers on a number line.	
MA.8.NSO.1.2	16
Plot, order and compare rational and irrational numbers, represented in various forms.	
MA.8.NSO.1.3	21
Extend previous understanding of the Laws of Exponents to include integer exponents. Apply the Laws of Exponents to evaluate numerical expressions and generate equivalent numerical expressions, limited to integer exponents and rational number bases, with procedural fluency.	
MA.8.NSO.1.4	28
Express numbers in scientific notation to represent and approximate very large or very small quantities. Determine how many times larger or smaller one number is compared to a second number.	
MA.8.NSO.1.5	34
Add, subtract, multiply and divide numbers expressed in scientific notation with procedural fluency.	
MA.8.NSO.1.6	38
Solve real-world problems involving operations with numbers expressed in scientific notation.	
MA.8.NSO.1.7	42
Solve multi-step mathematical and real-world problems involving the order of operations with rational numbers including exponents and radicals.	



Algebraic Reasoning	45
Generate equivalent algebraic expressions.	
MA.8.AR.1.1	46
Apply the Laws of Exponents to generate equivalent algebraic expressions, limited to integer exponents and monomial bases.	
MA.8.AR.1.2	50
Apply properties of operations to multiply two linear expressions with rational coefficients.	
MA.8.AR.1.3	53
Rewrite the sum of two algebraic expressions having a common monomial factor as a common factor multiplied by the sum of two algebraic expressions.	
Solve multi-step one-variable equations and inequalities.	
MA.8.AR.2.1	56
Solve multi-step linear equations in one variable, with rational number coefficients. Include equations with variables on both sides.	
MA.8.AR.2.2	66
Solve two-step linear inequalities in one variable and represent solutions algebraically and graphically.	
MA.8.AR.2.3	71
Given an equation in the form of $x^2 = p$ and $x^3 = q$, where p is a whole number and q is an integer, determine the real solutions.	
Extend understanding of proportional relationships to two-variable linear equations.	
MA.8.AR.3.1	77
Determine if a linear relationship is also a proportional relationship.	
MA.8.AR.3.2	81
Given a table, graph, or written description of a linear relationship, determine the slope.	
MA.8.AR.3.3	87
Given a table, graph, or written description of a linear relationship, write an equation in slope-intercept form.	
MA.8.AR.3.4	92
Given a mathematical or real-world context, graph a two-variable linear equation from a written description, a table, or an equation in slope-intercept form.	



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MA.8.AR.3.5 97
Given a real-world context, determine and interpret the slope and y -intercept of a two-variable linear equation from a written description, a table, a graph, or an equation in slope-intercept form.

Develop an understanding of two-variable systems of equations.

MA.8.AR.4.1 103
Given a system of two linear equations and a specified set of possible solutions, determine which ordered pairs satisfy the system of linear equations.

MA.8.AR.4.2 106
Given a system of two linear equations represented graphically on the same coordinate plane, determine whether there is one solution, no solution or infinitely many solutions.

MA.8.AR.4.3 110
Given a mathematical or real-world context, solve systems of two linear equations by graphing.

Functions 114

Define, evaluate, and compare functions.

MA.8.F.1.1 115
Given a set of ordered pairs, a table, a graph or mapping diagram, determine whether the relationship is a function. Identify the domain and range of the relation.

MA.8.F.1.2 121
Given a function defined by a graph or an equation, determine whether the function is a linear function. Given an input-output table, determine whether it could represent a linear function.

MA.8.F.1.3 126
Analyze a real-world written description or graphical representation of a functional relationship between two quantities and identify where the function is increasing, decreasing or constant.



Geometric Reasoning..... 136

Develop an understanding of the Pythagorean Theorem and angle relationships involving triangles.

MA.8.GR.1.1 137

Apply the Pythagorean Theorem to solve mathematical and real-world problems involving unknown side lengths in right triangles.

MA.8.GR.1.2 144

Apply the Pythagorean Theorem to solve mathematical and real-world problems involving the distance between two points in a coordinate plane.

MA.8.GR.1.3 150

Use the Triangle Inequality Theorem to determine if a triangle can be formed from a given set of sides. Use the converse of the Pythagorean Theorem to determine if a right triangle can be formed from a given set of sides.

MA.8.GR.1.4 155

Solve mathematical problems involving the relationships between supplementary, complementary, vertical, or adjacent angles.

MA.8.GR.1.5 161

Solve problems involving the relationships of interior and exterior angles of a triangle.

MA.8.GR.1.6 168

Develop and use formulas for the sums of the interior angles of regular polygons by decomposing them into triangles.

Understand similarity and congruence using models and transformations.

MA.8.GR.2.1 173

Given a preimage and image generated by a single transformation, identify the transformation that describes the relationship.

MA.8.GR.2.2 184

Given a preimage and image generated by a single dilation, identify the scale factor that describes the relationship.

MA.8.GR.2.3 194

Describe and apply the effect of a single transformation on two-dimensional figures using coordinates and the coordinate plane.

MA.8.GR.2.4 202

Solve mathematical and real-world problems involving proportional relationships between similar triangles.



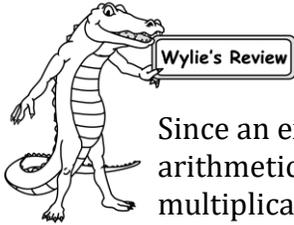
Data Analysis and Probability	208
Represent and investigate numerical bivariate data	
MA.8.DP.1.1	209
Given a set of real-world bivariate numerical data, construct a scatter plot or a line graph as appropriate for the context.	
MA.8.DP.1.2	215
Given a scatter plot within a real-world context, describe patterns of association.	
MA.8.DP.1.3	222
Given a scatter plot with a linear association, informally fit a straight line.	
Represent and find probabilities of repeated experiments.	
MA.8.DP.2.1	227
Determine the sample space for a repeated experiment.	
MA.8.DP.2.2	231
Find the theoretical probability of an event related to a repeated experiment.	
MA.8.DP.2.3	237
Solve real-world problems involving probabilities related to single or repeated experiments, including making predictions based on theoretical probability.	



Multiply Two Linear Expressions

Generate equivalent algebraic expressions.

Apply properties of operations to multiply two linear expressions with rational coefficients.



Since an expression represents a calculation with numbers, we use the same rules of arithmetic. Recall the reordering and regrouping rules for addition and multiplication respectively:

$$\begin{aligned} a + b &= b + a & \text{and} & & ab &= ba \\ a + (b + c) &= (a + b) + c & \text{and} & & a(bc) &= (ab)c \end{aligned}$$

We can also write subtraction as addition:

$$a - b = a + (-b)$$

The **distributive property** shows how multiplication by the number a distributes over the sum $b + c$:

$$a(b + c) = ab + ac.$$

Example 1: Simplify the following expressions. The solutions are provided with problem statement:

(a) $4(2x + 5) = 4 \cdot 2x + 4 \cdot 5 = 8x + 20$

(b) $-2.1(4a + 3b - 6) = (-2.1) \cdot 4a + (-2.1) \cdot 3b - (-2.1) \cdot 6 = -8.4a - 6.3b + 12.6$

(c) $(1.6x - 2.8) \cdot (0.9x) = (1.6x) \cdot (0.9x) - (2.8) \cdot (0.9x) = 1.44x^2 - 2.52x$

One purpose for reordering terms in an expression is to put like terms next to each other so that they can be combined.

Example 2: Simplify the following expressions.

(a) $3(x + 3) - x - 12$

(b) $\frac{x}{4}(8x - 4) + x^2$

Solution:

(a) We first distribute 3: $3(x + 3) = 3x + 3 \cdot 3 = 3x + 9$. Then, by reordering and combining like terms, we obtain

$$3(x + 3) - x - 12 = 3x + 9 - x - 12 = 3x - x + 9 - 12 = 2x - 3.$$

(b) We begin by multiplying $\frac{x}{4}$ by $(8x - 4)$ and then combining similar terms:

$$\frac{x}{4}(8x - 4) + x^2 = \frac{x}{4} \cdot 8x - \frac{x}{4} \cdot 4 + x^2 = \frac{8}{4} \cdot x \cdot x - \frac{4}{4}x + x^2 = 2x^2 - x + x^2 = 3x^2 - x.$$



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Algebraic Reasoning – MA.8.AR.1.2

Now Try These:

For 1-7, **Hot Text:** Are the expressions equivalent?

YES

NO

1. $5 + \frac{x}{2}$ and $5 + 0.5x$

2. $3(z + w)$ and $3z + 3w$

3. $-a + 2$ and $-(a + 2)$

4. $bc - cd$ and $c(b - d)$

5. $(a - b)^2$ and $a^2 - b^2$

6. $3h^2 + 2h^2$ and $5h^2$

7. $3b + 2b^2$ and $5b^3$

For 8-13, **Equation Editor:** Simplify each expression.

8. $-0.5(8.6x - 1.2)$

9. $(-1.3)^2(1 + x)$

10. $3.8(-2x + 5)$

11. $(3x + 7.5)(1.2x)$

12. $(-4.9x)(7.3 - 3.8x)$

13. $(-100)(2.5x + \frac{1}{5})$

14. **Multiselect:** Which of the following are equivalent to $4x(\frac{1}{2}x - 2)$? Choose all that apply.

A. $2x - 2$

B. $2x^2 - 8x$

C. $2(x^2 - 4x)$

D. $2x^2 - 8$

E. $x(2x - 8)$

F. $4x - 4$



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Algebraic Reasoning – MA.8.AR.1.3

Rewrite Expressions with Common Monomial Factor

Generate equivalent algebraic expressions.

Rewrite the sum of two algebraic expressions having a common monomial factor as a common factor multiplied by the sum of two algebraic expressions.



In previous section we learned the **distributive property** where a is distributed over $b + c$:

$$a(b + c) = ab + ac.$$

Other times, we use the distributive property in the reverse way: $ab + ac \rightarrow a(b + c)$.

We call this taking out a common factor a from $ab + ac$.

Example 1: Take out a common factor. The solutions are provided with the problem statement.

(a) $2x + xy = x(2 + y)$

(b) $-wx - 1.2w = -w(x - 1.2)$

(c) $12nm^2 - m^2 = m^2(12n - 1)$

(d) $-4xyz - 8xy = -4xy(z + 2)$

(e) $-ab + a^2b - ab^2 = ab(-1 + a - b) = -ab(1 - a + b)$

Example 2: Mrs. Navetta asked Carla to write the following solutions on the board. How many errors did Carla make? Can you fix her mistakes?

- Carla's work:
- a) $2x + 3y = x(2 + 3y)$
 - b) $3x + 6xy = 3x(1 + 2y)$
 - c) $20xy + 25xm = 15x(2y + 3m)$
 - d) $-5xy + 25ax = 5x(5a - y)$

Solution:

Carla made a mistake in problems a) and c).

In problem a), these two terms have no common factors, so there is nothing to factor out. The problem has to remain $2x + 3y$.

In problem c), the greatest common factor for 20 and 25 is 5 (not 15). We can therefore factor out a 5. We can also factor out x as it is common for both terms. Thus, the correct solution is $20xy + 25xm = 5x(4y + 5m)$.



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Algebraic Reasoning – MA.8.AR.1.3

Now Try These:

For 1-7, Hot Text: Are the two expressions equivalent?

YES

NO

1. $10 + \frac{x}{2}$ and $\frac{1}{2}(20 + x)$

2. $5x + 100$ and $5(x + 500)$

3. $3x^2 + 6x + 3$ and $3(x^2 + 2x)$

4. $a^2b + ab^2$ and $a(a + b)$

5. $a^2b + ab^2 + ab$ and $ab(a + b + 1)$

6. $6x + 8y$ and $2(3x + 4y)$

7. $3b + 2b^2$ and $b(3 + b)$

9. $5x + 100$

10. $22x^2 - 11$

11. $2x^2 - 6x$

12. $\frac{x}{5} + \frac{y}{5}$

13. $-m^2n - 3mn^2$

For 8-17, Equation Editor: Rewrite each expression by taking out the common factors.

8. $2ax - 3bx$

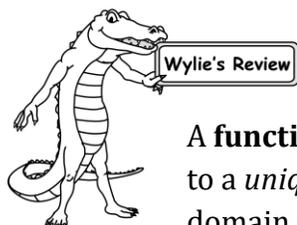
14. $-4a^2b - 6ab^2 - 2ab$



Determine whether the Relationship is a Function

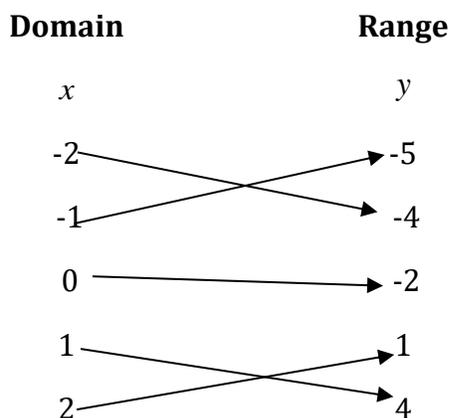
Define, evaluate, and compare functions.

Given a set of ordered pairs, a table, a graph or mapping diagram, determine whether the relationship is a function. Identify the domain and range of the relation.

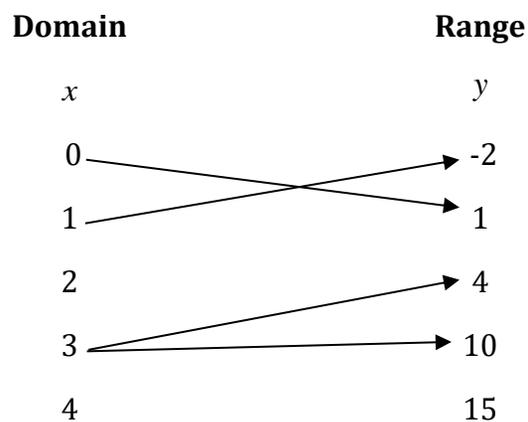


A **function** is a mapping that takes elements of one set, the **domain**, and maps them to a *unique* element in another set, the **range**. That is, for every element in the domain there is EXACTLY ONE element in the range.

The following example is a function because each element in the domain has one arrow pointing to a single element in the range.



The following example is NOT a function because there are two arrows from 4 in the domain pointing to different elements in the range.



As an example, consider the following function called *The Mailbox Function*. The domain of the Mailbox Function is the set of all letters to be delivered by Mailman Fritz. Fritz's job is to place each letter in the proper mailbox. The set of mailboxes is the range. Note that each letter corresponds to **EXACTLY** one mailbox. Each mailbox may receive any number of letters, 0, 1, 30 etc.

The **domain** of a function is the set of objects that can be inputted into the function. Points that make the denominator 0 or cause a negative number under a square root are not in the domain.

The **range** of a function is the set of objects that are outputted from the function, or those things to which items in the domain are mapped.



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Functions – MA.8.F.1.1

The variable that is inputted into the function is called the **independent variable**. The number that is the corresponding output is called the **dependent variable**. If $y = f(x)$, then x is independent and y is dependent.

The **graph of a function** is a graph of the equation $y = f(x)$. Given a graph of a function, the domain of the function is the set of x values that have a point on the graph. **NOTE:** If $y = f(x)$ is a function, then for every x value there must be **ONLY** one y value.

Example 1: Find the domain and range of the function.

x	-2	-1	0	1	2	3	4
y	-8	-4	0	-4	-8	-12	-16

The domain is the set of x values. In this case the domain is $\{-2, -1, 0, 1, 2, 3, 4\}$.

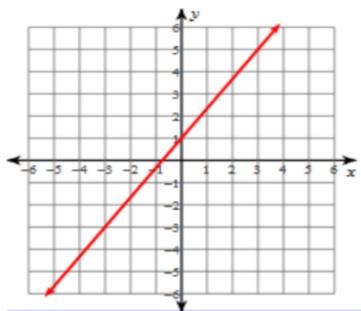
The range is the set of y values. -8 and -4 appear twice but we only list them once.

The range is $\{-16, -12, -8, -4, 0\}$.

Example 2: Find the domain of $f(x) = 2x - 1$.

Solution: If you take any real number, you can multiply it by 2 and still have a real number. Then if you subtract 1 you still get a real number. So in this case, the domain of $f(x) = 2x - 1$ is all real numbers or $(-\infty, \infty)$.

Example 3: The graph below is the graph of $f(x) = \frac{4}{3}x + 1$. Find the domain and range of $f(x)$.



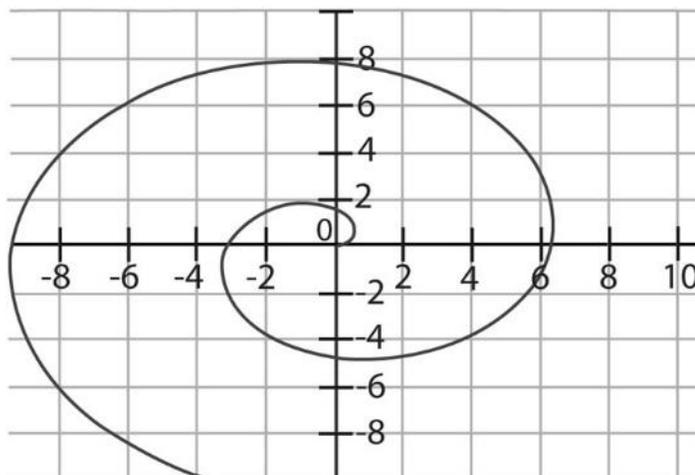
Solution: The domain is the set of x -values that have corresponding points on the graph. In this case, the domain is all real numbers or $(-\infty, \infty)$.

The range is the set of y -values that have corresponding points on the graph. In this case, the range is all real numbers or $(-\infty, \infty)$.



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Functions – MA.8.F.1.1

Example 4: Is the following a graph of a function $y = f(x)$?

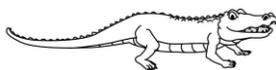


Solution: No. The graph is NOT the graph of a function because for example, when $x = 3$, there are at least 2 corresponding y values. To be a function, for each x value, there must correspond only one y value. Graphically this means that for every vertical line, it must intersect the graph AT MOST ONCE. It can intersect 0 times or 1 time, but no other intersection is allowed.

Vertical Line Test: For a graph, in the xy -plane, the graph represents a function if and only if every vertical line intersects the curve AT MOST ONCE.

Example 5: Determine if the relation is a function:

Solution: No. The graph is NOT a function because when x or the input is -7 , there are two corresponding outputs or y values: 4 and 9 .

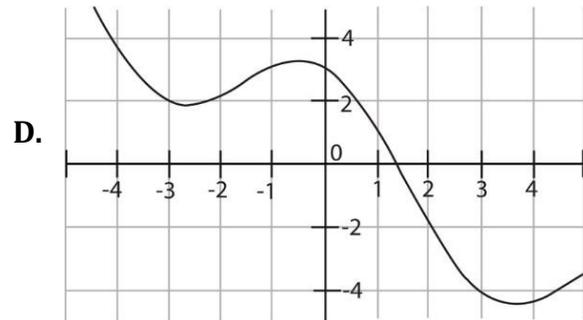
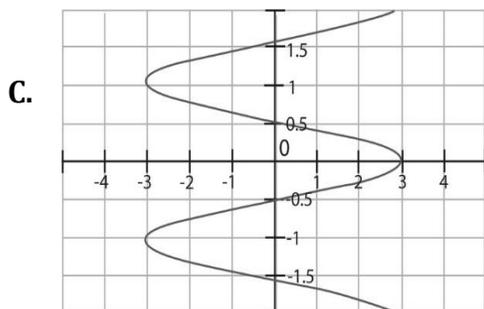
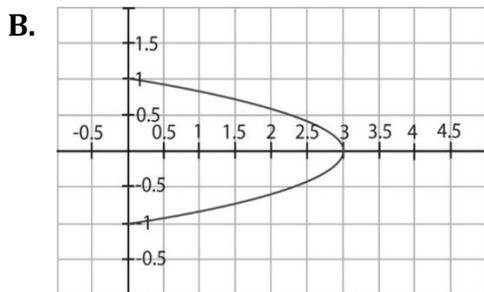
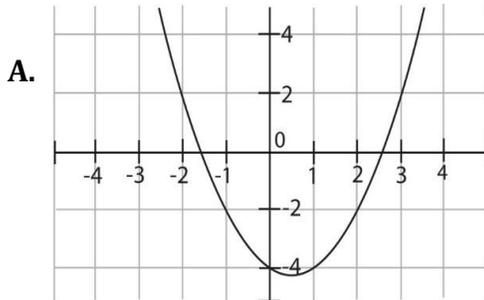


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Functions – MA.8.F.1.1**

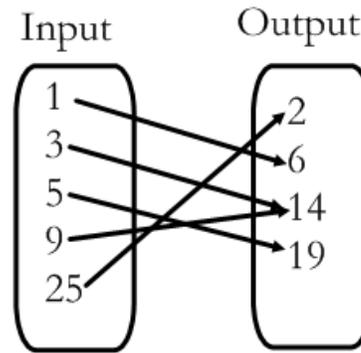
Now Try These:

- 1. Multiselect:** Which of the following sets of ordered pairs represents a function?
- A. $(-1,2), (3,4), (7,8), (-1,0)$
 - B. $(1,2), (1,3), (3,4), (5,6)$
 - C. $(1,2), (2,2), (3,2), (4,2)$
 - D. $(-1, -1), (2, -1), (-1,2), (2,3)$
 - E. $(0, 4), (4, 0), (0, 7), (7, 0)$
 - F. $(5, 3), (5, -3), (6, -3), (7, -3)$

- 2. Multiselect:** Which of the following are graphs of functions $y = f(x)$?



- E. All of them are functions.
 - F. None of them are functions.
- 3. Determine if the following relation is a function. Explain.**



- 4. Multiple Choice:** Given the following table, choose the correct response.

x	-2	-5	0	7
y	3	6	3	6

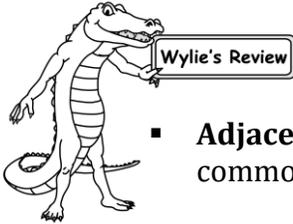
- A. The relation is not a function because 3 is listed twice.
- B. The relation is not a function because 6 is listed twice.
- C. The relation is a function because for every x value, there is only one y value.
- D. It cannot be determined whether or not this is a function.



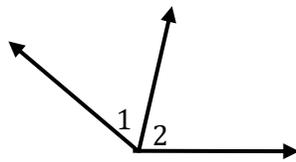
Supplementary, Complementary, Vertical, and Adjacent Angles

Develop an understanding of the Pythagorean Theorem and angle relationships involving triangles.

Solve mathematical problems involving the relationships between supplementary, complementary, vertical or adjacent angles.

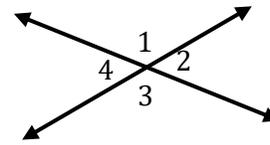


- **Adjacent angles** are two angles with a common side, a common vertex and no common interior points.

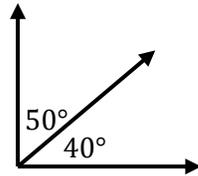


Adjacent angles:

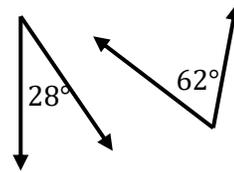
- $\angle 1$ and $\angle 2$
- $\angle 2$ and $\angle 3$
- $\angle 3$ and $\angle 4$
- $\angle 1$ and $\angle 4$



- **Complementary angles** are two angles whose sum is 90° . Complementary angles may, or may not, be adjacent.

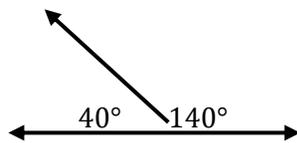


$$50^\circ + 40^\circ = 90^\circ$$

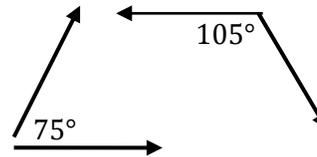


$$28^\circ + 62^\circ = 90^\circ$$

- **Supplementary angles** are two angles whose sum is 180° . Supplementary angles may, or may not, be adjacent.

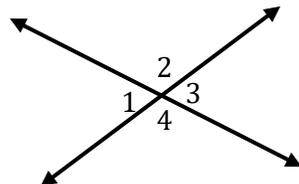


$$40^\circ + 140^\circ = 180^\circ$$



$$75^\circ + 105^\circ = 180^\circ$$

- **Vertical angles** are opposite angles formed when two lines intersect. $\angle 1$ and $\angle 3$ are vertical angles. $\angle 2$ and $\angle 4$ are vertical angles.



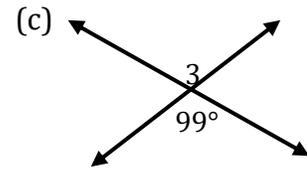
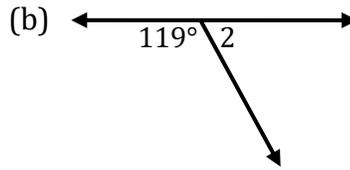
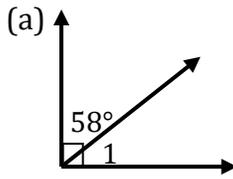
Vertical angles are congruent.

$$\begin{aligned} \angle 1 &\cong \angle 3 \\ \angle 2 &\cong \angle 4 \end{aligned}$$



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Geometric Reasoning – MA.8.GR.1.4**

Example 1: Find the measure of each numbered angle.



Solution:

(a) The two angles are complementary. They have a sum of 90° .

Complementary angles	$m\angle 1 + 58^\circ = 90^\circ$
Subtract 58°	$\underline{\quad -58^\circ \quad -58^\circ}$
Solve	$m\angle 1 = 32^\circ$

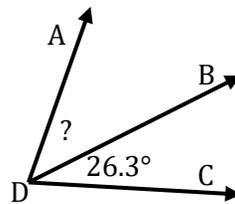
(b) The two angles are supplementary. They have a sum of 180° .

Supplementary angles	$m\angle 2 + 119^\circ = 180^\circ$
Subtract 119°	$\underline{\quad -119^\circ \quad -119^\circ}$
Solve	$m\angle 2 = 61^\circ$

(c) The two angles are vertical. Vertical angles are congruent. Congruent angles have equal measures.

Vertical angles	$m\angle 3 = 99^\circ$
-----------------	------------------------

Example 2: If the $m\angle ADC = 72.4^\circ$, what is the measure of $\angle ADB$?



Solution:

The whole is equal to the sum of its parts

$$m\angle ADB + m\angle BDC = m\angle ADC$$

Substitution

$$m\angle ADB + 26.3^\circ = 72.4^\circ$$

Subtract 26.3°

$$\underline{\quad - 26.3^\circ \quad - 26.3^\circ}$$

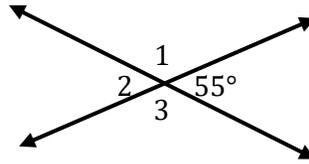
Solve

$$m\angle ADB = 46.1^\circ$$



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Geometric Reasoning – MA.8.GR.1.4**

Example 3: Find the measure of each numbered angle.



Solution:

The 55° angle and $\angle 1$ are supplementary angles. Supplementary angles have a sum of 180° .

Equation	$55^\circ + m\angle 1 = 180^\circ$
Subtract 55°	$\underline{-55^\circ} \qquad \underline{-55^\circ}$
Solution	$m\angle 1 = 125^\circ$

$\angle 1$ and $\angle 3$ are vertical angles. Vertical angles are congruent.

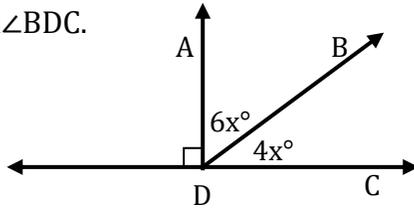
Congruent angles have equal measures $m\angle 1 = m\angle 3$

Substitution $125^\circ = m\angle 3$

The 55° angle and $\angle 2$ are vertical angles. Vertical angles are congruent. Therefore, $m\angle 2$ is 55° .

$m\angle 1 = 125^\circ, m\angle 2 = 55^\circ, m\angle 3 = 125^\circ$.

Example 4: Find the value of x and $m\angle BDC$.



Solution:

$\angle ADB$ and $\angle BDC$ are complementary angles.

Complementary angles have a sum of 90° $m\angle ADB + m\angle BDC = 90^\circ$

Substitution $6x + 4x = 90^\circ$

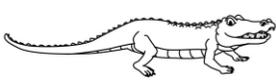
Combine like terms $10x = 90^\circ$

Divide $\frac{10x}{10} = \frac{90^\circ}{10}$

Solve $x = 9^\circ$

Find the $m\angle BDC$	$m\angle BDC = 4x^\circ$
Substitution	$m\angle BDC = 4(9^\circ)$
Multiply	$m\angle BDC = 36^\circ$

$x = 9^\circ$ and $m\angle BDC = 36^\circ$

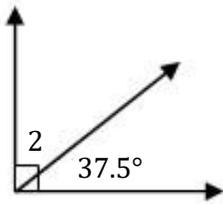


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Geometric Reasoning – MA.8.GR.1.4**

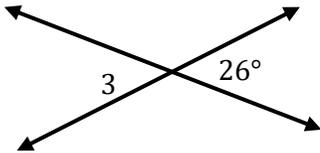
Now Try These

Open Response: For 1-4, write an equation to find the measure of the numbered angle. Solve the equation.

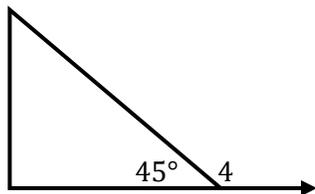
1.



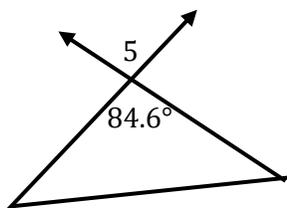
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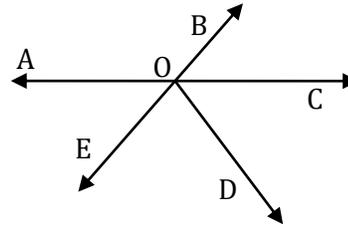
3.



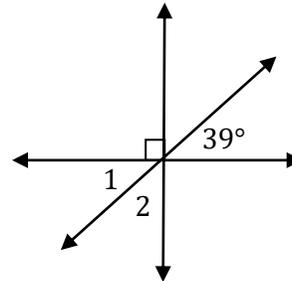
4.



5. **Equation Editor:** Name an angle adjacent and supplementary to $\angle AOB$.



For 6-7: Use the diagram below to find the measures of the indicated angles.



6. **Multiple Choice:** What is the measure of $\angle 1$?

- A. 39°
- B. 90°
- C. 51°
- D. 30°

7. **Multiple Choice:** What is the measure of $\angle 2$?

- A. 39°
- B. 90°
- C. 51°
- D. 30°



Find the Probability of an Event

Represent and find probabilities of repeated experiments.

Find the theoretical probability of an event related to a repeated experiment.



The theoretical probability is defined as the ratio of the number of favorable outcomes to the number of possible outcomes.

$$\text{Probability of an event } (E) = \frac{\text{number of favorable outcomes}}{\text{number of possible outcomes}}$$

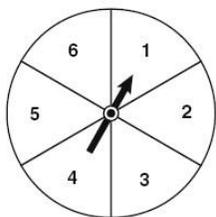
or

$$\text{Probability of an event } (E) = \frac{\text{number of event outcomes}}{\text{number of outcomes in the sample space}}$$

Determine the probability of rolling a 2 when a six-sided fair die is tossed.

We know that there are six possible outcomes: 1, 2, 3, 4, 5, 6. One of those outcomes is a 2. Therefore the probability of rolling a 2 is $\frac{1}{6}$.

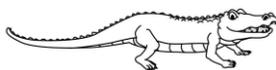
Example 1: Mikeala spins the spinner below. Find the probability of each event.



- (a) P(spinning a 5) (c) P(spinning a number < 3) (e) P(spinning a number < 7)
(b) P(not spinning a 6) (d) P(spinning a number > 2) (f) P(spinning a 7)

Solution:

- (a) $\frac{1}{6}$ (d) $P(\text{spinning } 3, 4, 5, 6) = \frac{4}{6} = \frac{2}{3}$
(b) $\frac{5}{6}$ (e) $\frac{6}{6} = 1$
(c) $P(\text{spinning } 1 \text{ or } 2) = \frac{2}{6} = \frac{1}{3}$ (f) $\frac{0}{6} = 0$



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Data Analysis and Probability – MA.8.DP.2.2**

In Example 1e, it is guaranteed that the numbers 1, 2, 3, 4, 5, or 6 have a chance to be spun. There are 6 favorable outcomes out of 6 total outcomes. The probability of a guaranteed, or certain, event is 100%.

In Example 1f, it was not possible to spin the number 7. This event was impossible. There are 0 favorable outcomes out of 6 total outcomes. The probability of an event that is impossible equals 0

Example 2: Given a standard deck of 52 playing cards, determine the following probabilities. Write your answer as a percent. Round to the tenth place.

(a) P(heart)

(c) P(6)

(b) P(face card)

(d) P(10 of hearts)

Black Cards		Red Cards	
Clubs	Spades	Diamonds	Hearts
Ace	Ace	Ace	Ace
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9
10	10	10	10
Jack	Jack	Jack	Jack
Queen	Queen	Queen	Queen
King	King	King	King

} Face cards

Solution:

(a) $P(\text{heart}) = \frac{13}{52} = 25\%$

(c) $P(6) = \frac{4}{52} = 7.7\%$

(b) $P(\text{face card}) = P(J, Q, K) = \frac{12}{52} = 23.1\%$

(d) $P(10 \text{ of hearts}) = \frac{1}{52} = 1.9\%$



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Data Analysis and Probability – MA.8.DP.2.2

		Outcome of First Die					
		1	2	3	4	5	6
Outcome of Second Die	1	2	3	4	5	6	7
	2	3	4	5	6	7	8
	3	4	5	6	7	8	9
	4	5	6	7	8	9	10
	5	6	7	8	9	10	11
	6	7	8	9	10	11	12

(a) $P(\text{sum of } 7) = \frac{6}{36} = \frac{1}{6}$

(b) $P(\text{sum of } 11) = \frac{2}{36} = \frac{1}{18}$

(c) $P(\text{sum} > 8) = P(9, 10, 11, 12) = \frac{10}{36} = \frac{5}{18}$

(d) $P(\text{sum} < 5) = P(2, 3, 4) = \frac{6}{36} = \frac{1}{6}$



Everglades K-12 Publishing's Mathematics B.E.S.T. Standards Grade 8
Data Analysis and Probability – MA.8.DP.2.2

Now Try These:

1. A fair coin is tossed twice. How many possible outcomes are in the sample space?

2. **Multiple Choice:** A fair coin is tossed three times. What is the probability of at least one head?

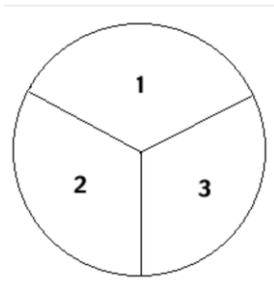
A. $\frac{7}{8}$

B. $\frac{3}{4}$

C. $\frac{3}{8}$

D. $\frac{1}{2}$

For questions 3-5, use the spinner below:



3. **Multiple Choice:** If the spinner is spun two times, what is the probability of getting a sum of 5?

A. $\frac{1}{3}$

B. $\frac{5}{9}$

C. $\frac{1}{2}$

D. $\frac{2}{9}$

4. **Multiple Choice:** If the spinner is spun two times, what is the probability of getting a sum greater than 3?

A. $\frac{1}{3}$

B. $\frac{2}{3}$

C. 0

D. $\frac{2}{9}$

5. **Multiple Choice:** If the spinner is spun two times, what is the probability of getting an even sum?

A. $\frac{1}{3}$

B. $\frac{5}{9}$

C. $\frac{4}{9}$

D. $\frac{2}{9}$

6. **Open Response**

Jennifer and Ronald were playing a game using a six-sided fair die. Each of them rolled the die two times. Jennifer rolled a sum of seven and Ronald rolled a sum of 9. Jennifer stated that the probability of getting the sum of seven was higher than getting a sum of nine. Ronald stated that because nine is a larger number, the probability of the nine must be larger. Who is correct? Justify your answer.

