SUMMIT MATH

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GEOMETRY

second edition

1 INTRODUCTION TO POINTS, LINES ANGLES & SHAPES

CONTENTS

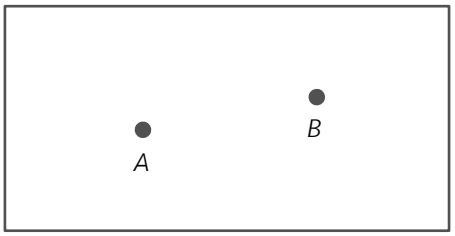
Section 1

POINTS & LINES

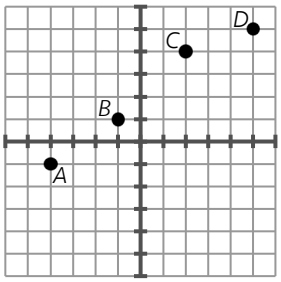
1. If you want to draw a line, you need to start with a point. This is the foundation of geometry. A point is shown below. A true point in geometry is infinitely small, without any actual size.

A point is named with a letter. This is point *P*: •*P*

In the box, points A and B are shown. Draw a third point, *C*, such that a straight line can be drawn through *A*, *B*, and *C*.

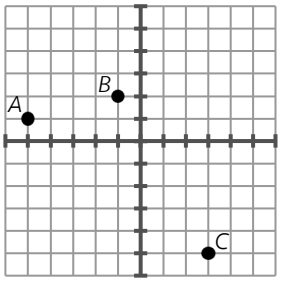


2. The points in the previous scenario are called collinear (pronounced "co-linear") because they can be connected to form a line. In the figure shown, identify 3 points that are collinear.



3. After graphing 3 points for a linear equation, you notice a mistake.

a. Looking at the points you have drawn in the graph shown, how do you know you made a mistake?



b. Your linear equation has a negative slope and a negative *y*-intercept. Which point is in the wrong place?

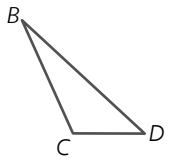
c. Where should the misplaced point be located to fix the mistake?

4. Points can be used to form a segment. A line segment is a part of a line between 2 endpoints. Segment *AB* is shown below. It gets its name from its two endpoints.

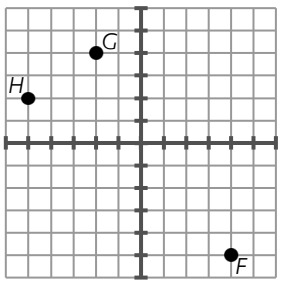
segment *AB*: 

In the box, draw 3 points that are not collinear. Connect all pairs of dots with segments. What have you drawn?

5. The segment in the previous scenario, segment AB, can be shown by the symbol $\overline{AB}$. Use that symbol notation to name the 3 segments that form triangle *BCD* shown.



6. Draw triangle *FGH*. Is *FGH* a right triangle? How do you know?

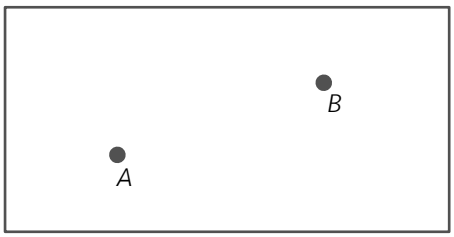


7. Do the symbols $\overline{AB}$ and $\overline{BA}$ represent the same figure? Explain your answer.

8. A ray is formed by starting at a point and then drawing infinitely many connected points that extend in only one direction. You cannot actually draw a ray (it's infinitely long), so an arrow is used to show that a ray keeps going. Ray *AB* is shown below. It gets it name from its starting point and another point that it passes through. Using symbols, ray *AB* is called $\overrightarrow{AB}$.

ray *AB*:

In the box, use the points shown to draw $\overrightarrow{BA}$.

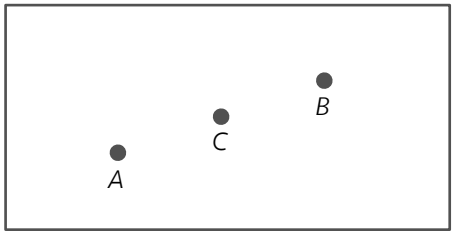


9. Do the symbols $\overrightarrow{AB}$ and $\overrightarrow{BA}$ represent the same figure? Explain your answer.

10. Opposite rays share the same endpoint and extend in opposite directions without ending.

Opposite rays:

Draw opposite rays that share *C* as a common endpoint. Make one ray pass through point *A* and the other ray contain point B.



11. Use symbol notation to name the 2 opposite rays you drew in the previous scenario.

12. Opposite rays form a line. A line extends in both directions without ending, so it is not possible to actually draw a line. Instead, arrows are drawn at the ends to show that the line keeps going. The line below is shown by the symbol $\overleftrightarrow{AB}$. Do the symbols $\overleftrightarrow{AB}$ and $\overleftrightarrow{BA}$ represent the same figure? Explain your answer.

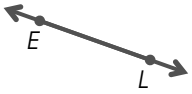
line AB: 

13. What is the name of each figure shown?

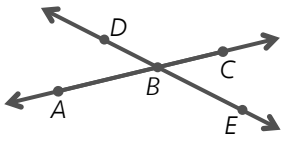
a. 

b. 

c. 

d. 

14. Consider the figure shown.



a. How many different names can you use to identify the lines in the figure? Assume that $\overleftrightarrow{AB}$ and $\overleftrightarrow{BA}$ are the same name.

b. How many rays are in the figure? Name them.

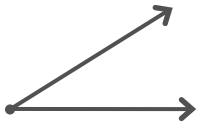
c. Name all of the segments in the figure. Assume that $\overline{AB}$ and $\overline{BA}$ are the same name.

Section 2

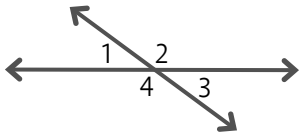
ANGLES

15. When 2 rays share the same endpoint, they form an angle. When 2 lines intersect they form 4 angles.

Rays with a common endpoint

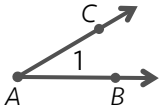


Intersecting lines (4 angles are marked)



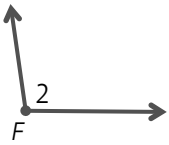
How many angles are formed when you connect 3 points that are not collinear? Draw a figure to show this.

16. An angle can be named using either letters or numbers. The angle shown can be identified in 4 ways. Name each angle shown below using as many names as you can.

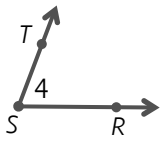


4 names:
$\angle 1$
$\angle A$
$\angle CAB$
$\angle BAC$

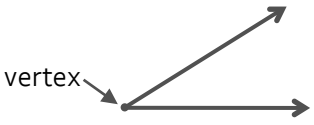
a.



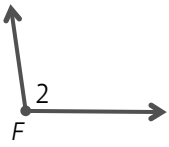
b.



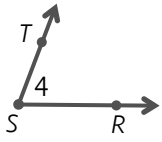
17. When you draw an angle, the point at which it bends is called the vertex. The vertex of an angle is a single point. What is the vertex of each angle shown?



a.



b.



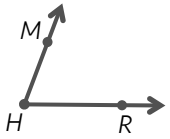
18. What is the vertex of each angle named below?

a. $\angle ABC$ b. $\angle PTB$ c. $\angle BPT$

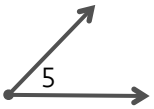
Angles can be sorted into groups by their size. There are acute, right, obtuse, and straight angles.

19. Acute angles are between 0° and 90°. Several acute angles are shown below. Try to accurately redraw each angle under its corresponding figure.

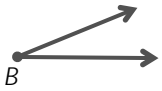
a. $\angle MHR$



b. $\angle 5$



c. $\angle B$



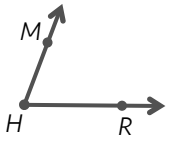
20. The size of an angle is called its measure. The symbol $m\angle ABC$ can be written or spoken as "the measure of angle ABC." Write out in words the meaning of each symbol below.

a. $m\angle 1$

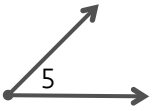
b. $m\angle DEF$

21. Estimate the size of each angle shown.

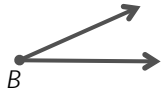
a. $m\angle MHR \approx$ _____



b. $m\angle 5 \approx$ _____



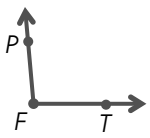
c. $m\angle B \approx$ _____



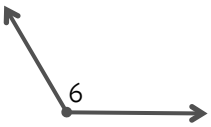
22. Right angles are exactly 90°. Draw a right angle by connecting a second ray to the one already shown.

23. Obtuse angles are between 90° and 180°. Estimate the size of each angle shown.

a. $m\angle PFT \approx$ _____



b. $m\angle 6 \approx$ _____



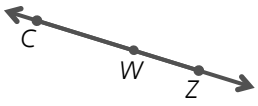
c. $m\angle C \approx$ _____

24. Try to draw an obtuse angle that is exactly 135°. How can you use acute angles you are familiar with to draw this angle? Draw the angle by connecting a second ray to the one drawn.

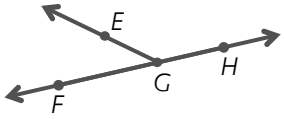
25. Straight angles are exactly 180°. Draw a straight angle. Draw the angle by connecting a second ray to the one drawn. What is another name for a straight angle?

26. Name the straight angle in each figure.

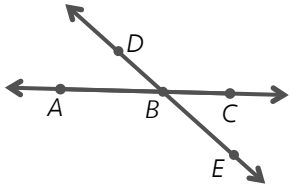
a.



b.



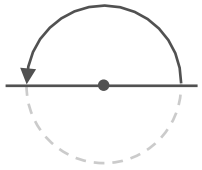
c.



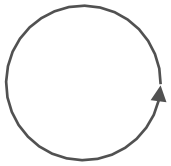
27. An angle can be described by an amount of rotation around a circle. Three rotations are shown below. How many degrees of rotation are represented in each diagram below?

a.

b.



c.



Section 3

COMPLIMENTARY AND SUPPLEMENTARY ANGLES

28. In the previous scenario, an angle is shown to be 90° by drawing a square in the corner of the angle. Consider the figure shown. The dashed line splits a right angle into 2 acute angles.

a. If angle 1 measures 40°, how large is angle 2?

b. Angle 1 measures $35°$. If angle 2 measures $(x+5)^\circ$, what is the value of x?

c. If angle 1 measures $(x+3)^\circ$, and angle 2 measures $(3x-13)^\circ$, what is the value of x?

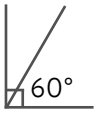
If the sum of two angles is 90°, the angles are called complementary. If you glue two complementary angles together, joining them at their vertex, the pair would fit perfectly into a corner. Complementary angles form a corner.

29. Angles 1 and 2 are complementary. Angle 1 has a measure of 5°. What is the measure of angle 2?

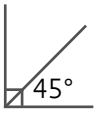
30. An angle measures 37°. What is the measure of its complement?

31. What is the measure of the unmarked angle in each figure?

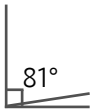
a.



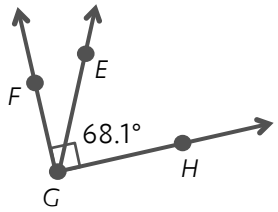
b.



c.



32. Consider the figure shown.

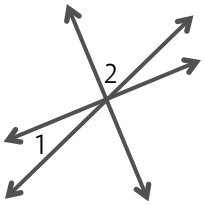


a. What is the name of the smallest angle?

b. What is $m\angle EGF$?

c. What is $m\angle HGF$?

33. Consider the diagram shown. Angles 1 and 2 are complementary. Suppose angle 2 is four times larger than angle 1. How large is each angle?

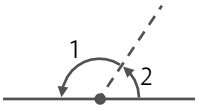


34. How large is each angle shown?

a.

b.

35. Consider the figure shown.



a. If angle 1 measures 120°, how large is angle 2?

b. The measure of angle 2 is $65°$. If angle 1 measures $(x-20)^\circ$, what is the value of x?

c. If angle 1 measures $(3x+11)^\circ$, and angle 2 measures $(2x-1)^\circ$, what is the value of x?

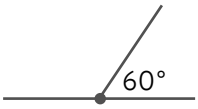
36. How large is the angle shown? 

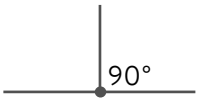
If the sum of two or more angles is 180°, the angles are called supplementary. If you glue supplementary angles together, joining them at their vertex, the unconnected ends will lay flat along a straight line. Supplementary angles form a straight line.

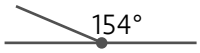
37. Angles 1 and 2 are supplementary. Angle 1 has a measure of 20°. What is the measure of angle 2?

38. An angle measures 112°. What is the measure of its supplement?

39. What is the measure of the unmarked angle in each figure?

a. 

b. 

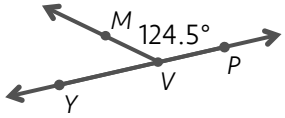
c. 

40. Consider the figure shown.

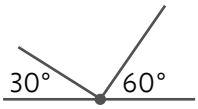
a. What is the name of the obtuse angle?

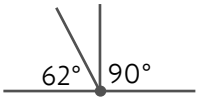
b. What is $m\angle MVY$?

c. What is $m\angle YVP$?



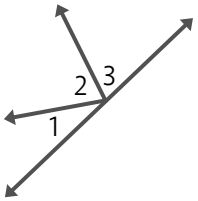
41. What is the measure of the unmarked angle in each figure?

a. 

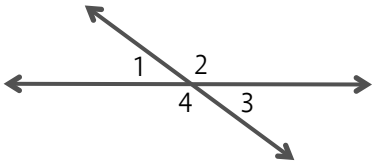
b. 

c. 

42. Consider the diagram shown. Angles 1, 2, and 3 are supplementary. Angle 1 is one-half of the measure of angle 2. Angle 3 is 75°. What is the measure of angle 1?



43. Consider the figure shown. Suppose angle 1 has a measure of 40°.



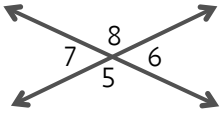
a. How large is angle 2?

b. How large is angle 3?

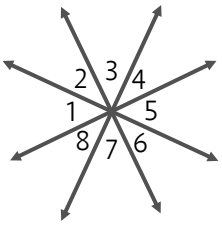
c. How large is angle 4?

d. What can you conclude about the relationships between angles in the figure?

44. In the figure shown, identify all pairs of angles that are the same size.

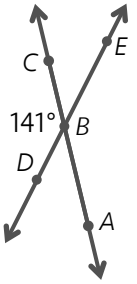


45. In the previous scenario, angles 2 and 4 are called vertical angles. To see why they are called vertical angles, imagine drawing a vertical line that passes through the 2. It will also pass through the 4. This makes the angles vertically aligned. Angles 1 and 3 are also called vertical angles, although you would need to rotate the diagram 90° to make them vertically aligned. If lines intersect, any pair of angles that are on opposite sides of an intersection point are called vertical angles. In the figure shown, identify all pairs of vertical angles.



46. Find the measure of the unmarked angles in each diagram.

a.



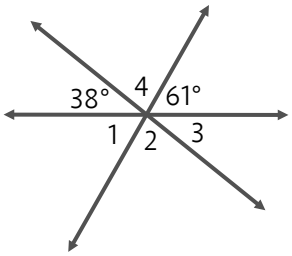
$m\angle CBE =$ _____

$m\angle ABE =$ _____

$m\angle DBA =$ _____

$m\angle DBE =$ _____

b.



$m\angle 1 =$ _____

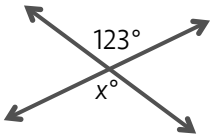
$m\angle 2 =$ _____

$m\angle 3 =$ _____

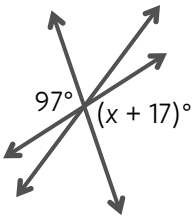
$m\angle 4 =$ _____

47. In each diagram shown, what is the value of x?

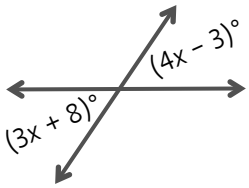
a.



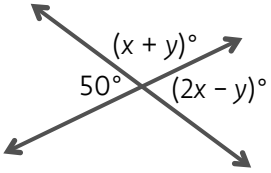
b.



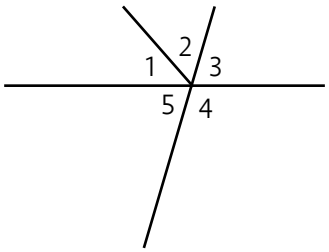
48. In the diagram shown, what is the value of x? How large is each angle in the figure?



49. In the diagram shown, determine the values of x and y.



50. Consider the figure shown.

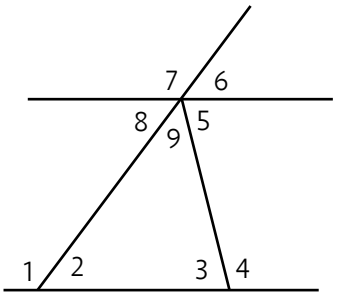


a. Identify all pairs of vertical angles.

b. A linear pair is a pair of angles that have a sum of 180°. Identify all linear pairs in the figure.

c. Identify all obtuse angles in the figure.

51. Consider the figure shown.



a. Identify all pairs of vertical angles.

b. Identify all linear pairs in the figure.

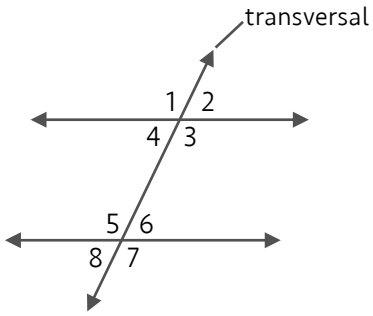
c. Identify all obtuse angles in the figure.

Section 4

PARALLEL LINES AND A TRANSVERSAL

52. Consider the diagram shown. It shows two lines that are parallel and a third line that is called a transversal. The transversal passes through both of the parallel lines. This diagram creates 8 angles, but there are only 2 different sizes shown in the diagram because it creates pairs of angles that are either equal or supplementary.

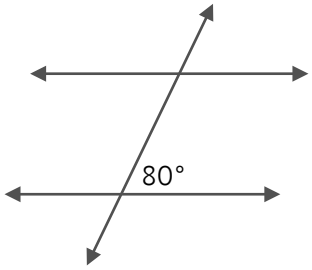
a. Given: $m\angle 6 = 70°$. Fill in the remaining angles in the diagram.



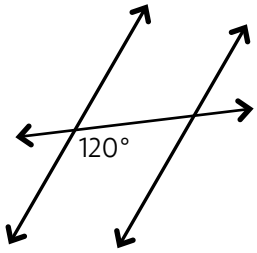
b. If all even numbered angles are 68°, what is the measure of the odd numbered angles?

53. Each diagram shows parallel lines and a transversal. Fill in the unlabeled angles in the diagram.

a.

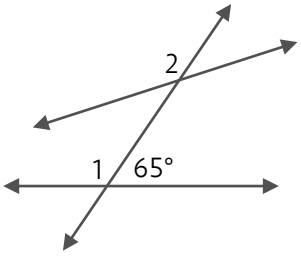


b.

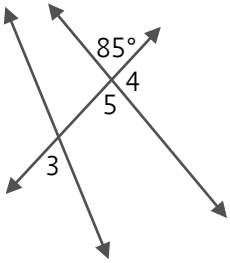


54. Find the measure of each numbered angle.

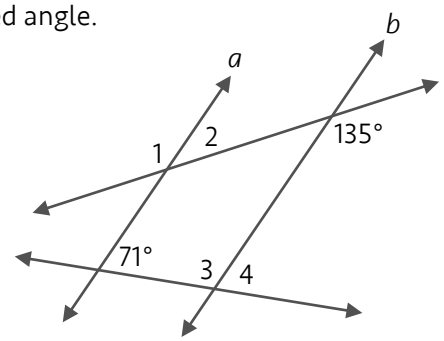
a.



b.

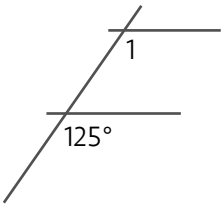


55. Lines a and b are parallel. Find the measure of each numbered angle.

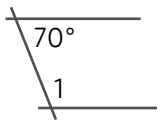


56. Each figure shows two parallel lines and a transversal. What is the measure of angle 1 in each figure?

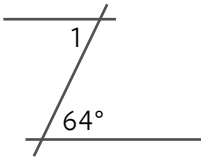
a.



b.



c.

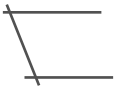


57. When two parallel lines are intersected by a transversal, 8 angles are formed, but there are only 2 possible relationships that exist between any pair of angles. Any 2 angles in the figure are either equal or supplementary. One way to help you find the relationship between any 2 angles is to find letters in the figure. Consider the figures in the previous scenario. Each figure looks like a letter of the alphabet.

a.

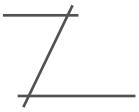
looks like the letter ___

b.



looks like the letter ___

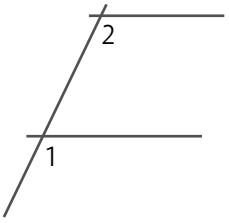
c.



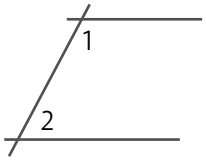
looks like the letter ___

58. In each figure, are the numbered angles equal or supplementary?

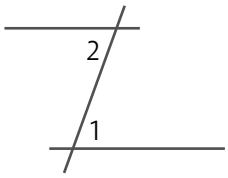
a.



b.

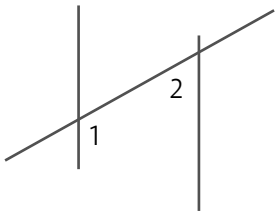


c.

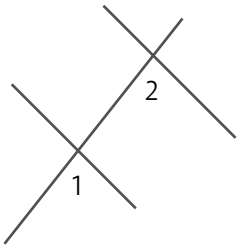


59. Are the numbered angles part of an F, C, or Z? Are they equal or supplementary?

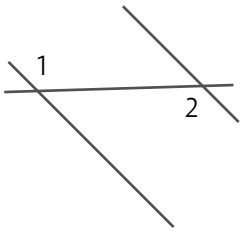
a.



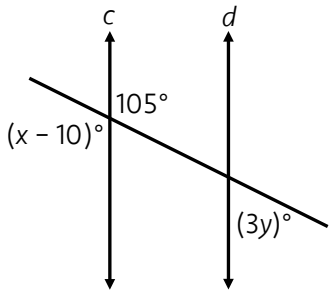
b.



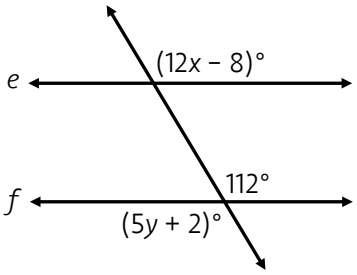
c.



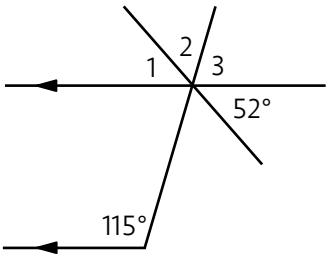
60. Lines *c* and *d* are parallel. This can be shown by writing $c \| d$. Use what you have learned about angle relationships in the previous scenarios to solve for *x* and *y*.



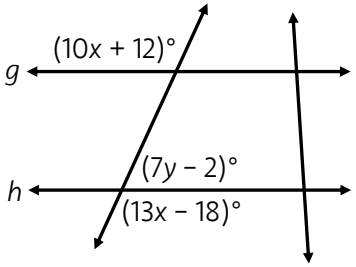
61. In the diagram, $e \| f$. Solve for *x* and *y*.



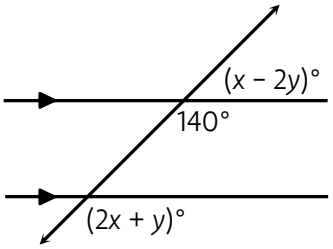
62. Find the measure of each numbered angle.



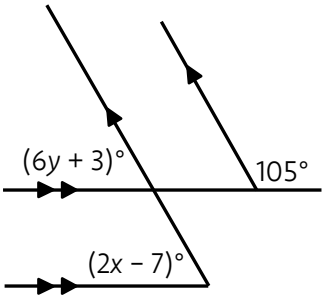
63. In the diagram, $g \| h$. Solve for x and y.



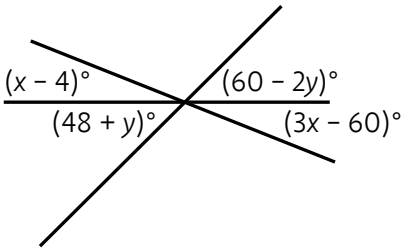
64. There is another way to show that lines are parallel. If there are matching arrow markings on lines, those markings indicate lines are parallel. Use the figure shown to find the values of x and y.



65. Fill in the unlabeled angles. Two of the lines are parallel.



66. Find the measure of each of the 6 angles shown in the figure.



Section 5

TRIANGLES

If you connect two segments, they form an angle. If you connect 3 segments, they form a triangle. As its name indicates, a triangle has 3 angles. Triangles can be classified by their angles.

67. Part of each triangle is missing. Carefully extend the incomplete sides to finish drawing each triangle.

right

acute

obtuse

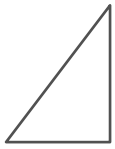
equiangular

68. Define the term below:

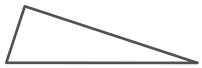
right triangle –

69. Circle the triangle that does not look like a right triangle.

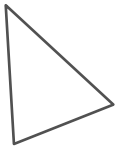
a.



b.



c.

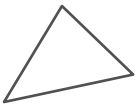


70. Define the term below:

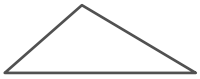
acute triangle –

71. Circle the triangle that is not an acute triangle.

a.



b.

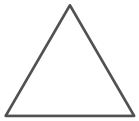


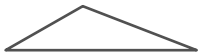
c.

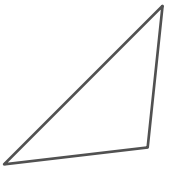
72. Define the term below:

obtuse triangle –

73. Circle the triangle that is not an obtuse triangle.

a. 

b. 

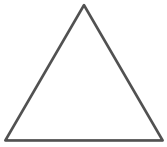
c. 

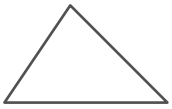
74. Define the term below:

equiangular –

75. Circle the triangle that is not equiangular.

a. 

b. 

c. 

76. Can a right triangle also be an acute triangle? Try to draw one.

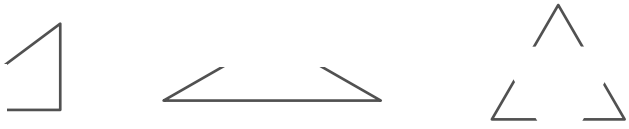
77. Try to draw a triangle that has the following classification

a. obtuse equiangular b. right obtuse c. acute equiangular

Triangles can also be classified by their side lengths.

78. Part of each triangle is missing. Carefully extend the incomplete sides to finish drawing each triangle.

scalene isosceles equilateral



79. Define each term:

a. scalene triangle –

b. isosceles triangle –

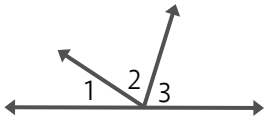
c. equilateral triangle –

80. Can a scalene triangle be isosceles? Try to draw one.

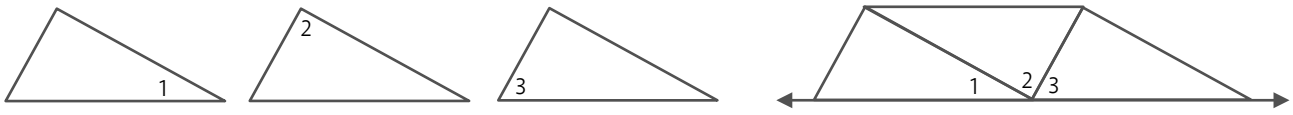
81. Try to draw a triangle that has the following classification

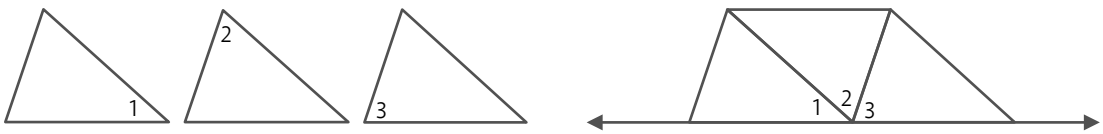
a. acute isosceles b. right scalene c. isosceles right

82. Consider the diagram shown. If $m\angle 1 = 31°$ and $m\angle 3 = 79°$, what is the measure of angle 2?



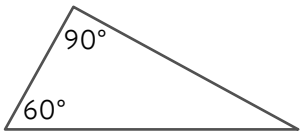
83. Three copies of the same triangle are shown. They are then joined together. This diagram is repeated, with a different triangle. What do the images below show about the 3 angles of a triangle?



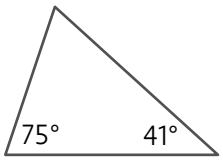


84. What is the measure of the unmarked angle?

a.



b.



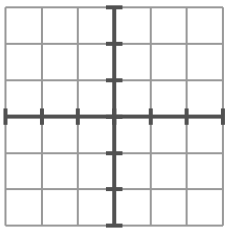
85. Two angles of a triangle are 40° and 50°. What is the measure of the third angle?

86. Two angles of a triangle are 23.5° and 61.8°. Is this triangle acute, obtuse, right or isosceles?

87. Two angles of a triangle are 45° and 90°. Is this triangle acute, obtuse, right or isosceles?

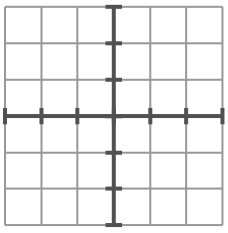
88. Plot the points shown and connect them to form a triangle. Classify each triangle by its angles.

a.



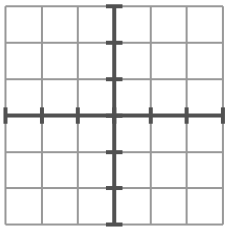
points: (−2, 3), (1, 2), (2, −2)

b.



points: (−2, 1), (2, 2), (3, −2)

c.

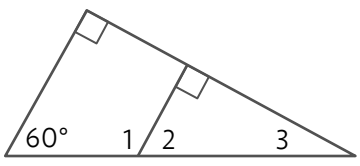


points: (3, 1), (−1, −1), (−1, 3)

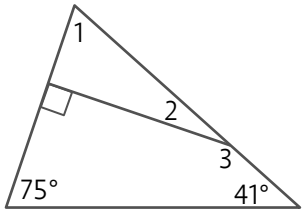
89. Classify each triangle in the previous scenario by its side lengths.

90. Find the measures of angles 1, 2 and 3?

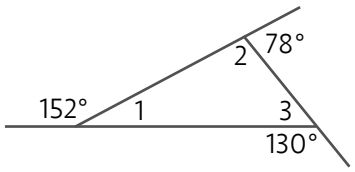
a.



b.



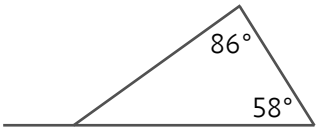
91. The figure shown is a triangle with its sides extended to create angles that are outside the triangle. These angles are called exterior angles. Find the measure of each angle inside the triangle.



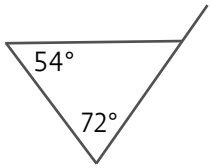
$m\angle 1 =$ _____ $m\angle 2 =$ _____ $m\angle 3 =$ _____

92. Each figure has one exterior angle. Find the measure of the exterior angle.

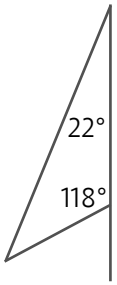
a.



b.

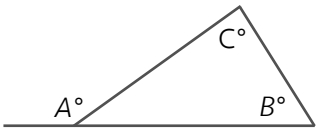


c.

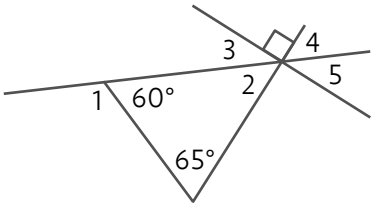


93. In the previous scenario, what do you notice about the measure of the exterior angle in each figure?

94. In the diagram shown, what is the relationship between angles *A*, *B*, and *C*?



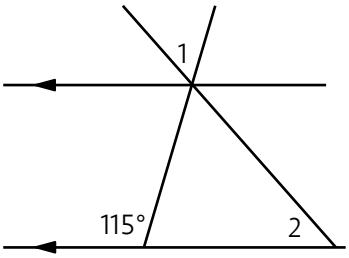
95. Find the measure of each numbered angle.



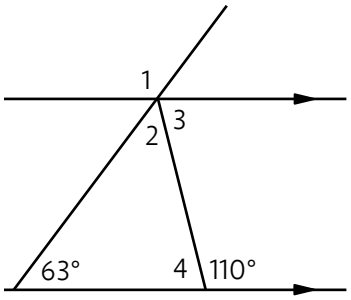
96. Consider the diagram shown.

Given: $m\angle 1 = x + 7$ and $m\angle 2 = 2x - 12$

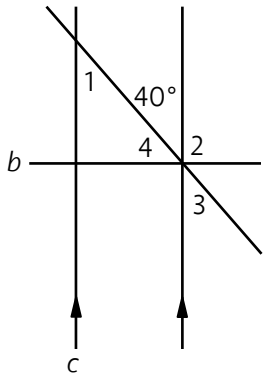
Find the measure of angle 1 and angle 2.



97. Arrows can be placed on lines and line segments to show they are parallel. In the figure shown, two line segments are shown to be parallel. Find the measure of each numbered angle in the figure.

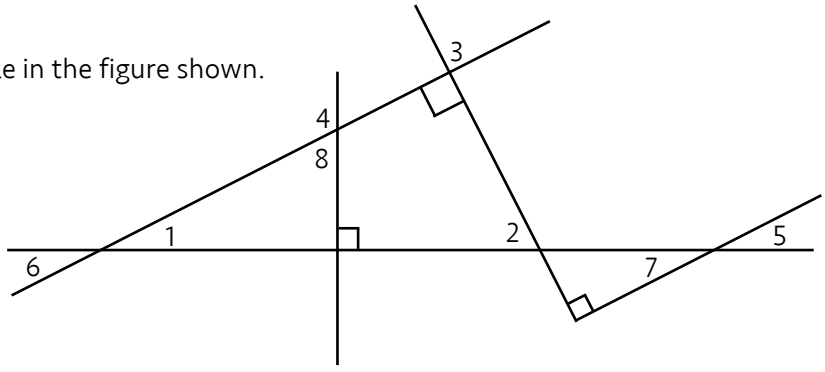


98. Find the measure of each numbered angle in the figure shown. Lines b and c are perpendicular.



99. Find the measure of each numbered angle in the figure shown.

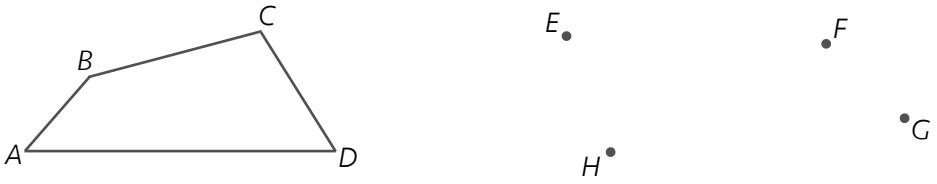
Given: $m\angle 4 = 125°$



Section 6

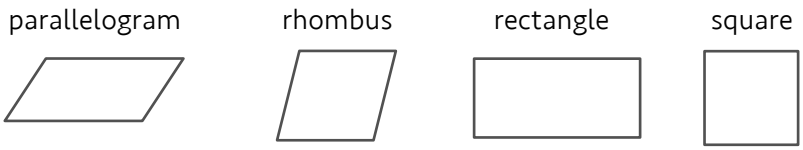
QUADRILATERALS

100. If you connect three segments, they form a triangle. If you connect 4 segments, they form a quadrilateral. A quadrilateral is shown below. It is called quadrilateral *ABCD*. Connect the dots to form a second quadrilateral. Using its points, what is the name of this second quadrilateral?



101. Identify the 4 angles in quadrilateral *ABCD* in the previous scenario.

Some common quadrilaterals are listed below.



102. Define a parallelogram.

103. Define a rhombus by comparing it to a parallelogram.

104. Define a rectangle by comparing it to a parallelogram.

105. Define a square by comparing it to a rhombus.

106. Answer each question with yes or no.

a. Is every square a rectangle?

b. Is every rectangle a square?

c. Is every parallelogram a rectangle?

d. Is every rectangle a parallelogram?

107. Identify the quadrilateral that has the property described. There may be more than one answer and the possible quadrilaterals are listed below.

parallelogram rhombus rectangle square

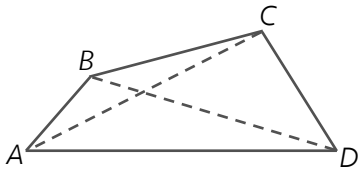
a. both pairs of opposite sides are congruent

b. both pairs of opposite sides are parallel

c. four right angles

d. four congruent sides

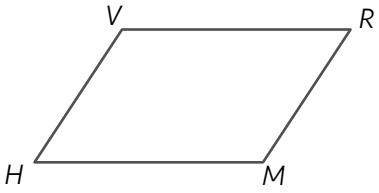
108. A segment that connects opposite corners of a quadrilateral is called a diagonal. Two diagonals are shown in the figure using dashed line segments. Use symbol notation to identify each diagonal.



109. In the parallelogram shown, draw one diagonal that splits the figure into 2 obtuse triangles.

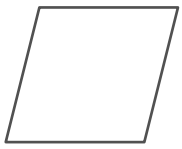
a. What is the name of the diagonal?

b. What do you notice about the 2 obtuse triangles?

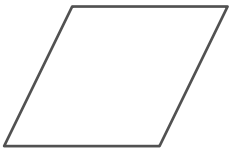


110. In each rhombus shown, carefully draw both of the diagonals. What do you notice about the diagonals?

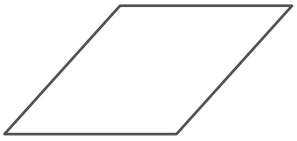
a.



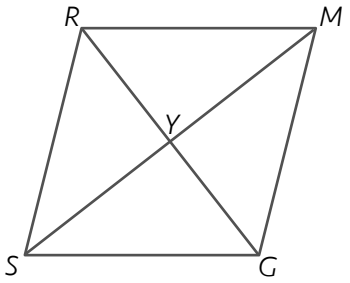
b.



c.



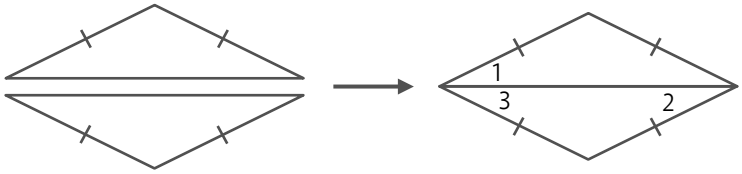
111. Rhombus *GMRS* is shown. Use what you found in the previous scenario to identify the length of each segment listed below.



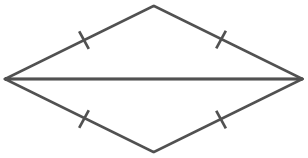
a. If $RG = 30$, then $RY =$ _____ and $YG =$ _____.

b. If $SY = 34$, then $MY =$ _____ and $MS =$ _____.

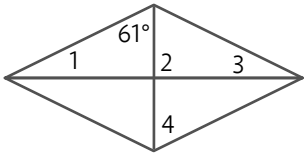
112. One way to form a rhombus is to start with an isosceles triangle, make a congruent copy, and stick the two pieces together as shown. The glued edge is now one diagonal of the rhombus. If $m\angle 1 = 36°$, what are the measures of angle 2 and angle 3, respectively?



113. Draw two segments to represent the height of each of the isosceles triangles in the figure shown. Together, what do these segments form in the rhombus?



114. Consider the two diagonals of the rhombus shown.



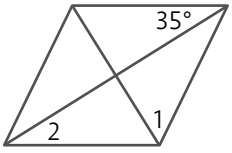
a. What do you notice about how they intersect?

b. What are the measures of angles 1, 2, 3 and 4, respectively?

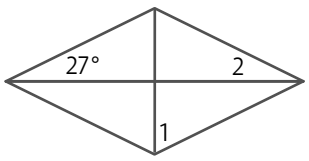
115. The diagonals of a rhombus form 4 right triangles. What do you notice about these 4 triangles?

116. Both diagonals are shown in each rhombus. Use the given measures to find $m\angle 1$ and $m\angle 2$.

a.

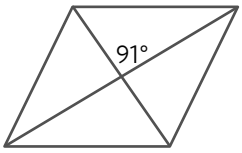


b.

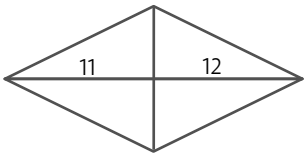


117. How do you know that each figure shown is not a rhombus?

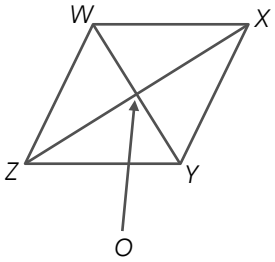
a.



b.



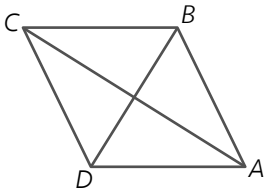
118. Consider the rhombus shown. The length of *WY* is 12 and the length of *XZ* is 16. The diagonals intersect at point *O*.



a. How can you use these measurements to find the length of *WX*?

b. What is the length of *WX*?

119. The length of *AC* is 8 and the length of *BD* is 6.



a. What is the area of the rhombus?

b. What is the perimeter of the rhombus?

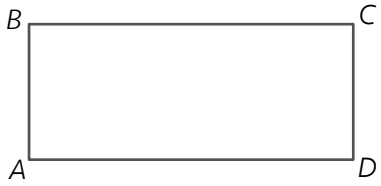
120. In each rectangle shown, draw both diagonals. Measure their lengths. What do you notice?

a.

b.

c.

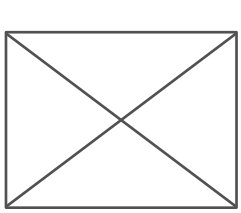
121. In the rectangle shown, $AC = 7x - 9$ and $BD = 4x + 6$.

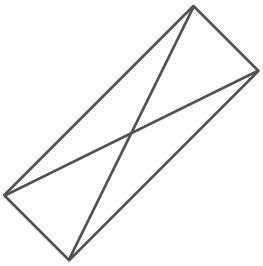


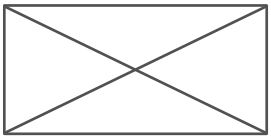
a. How long is diagonal *AC*?

b. If *AB* = 10, what is the perimeter of rectangle *ABCD*?

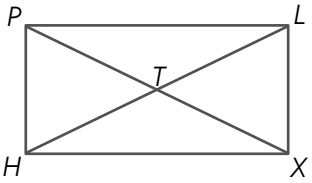
122. Both diagonals are drawn in each rectangle. What do you notice about the triangles formed inside each rectangle?







123. Rectangle *HPLX* is shown. Use what you found in the previous scenario to identify the length of each segment listed below.



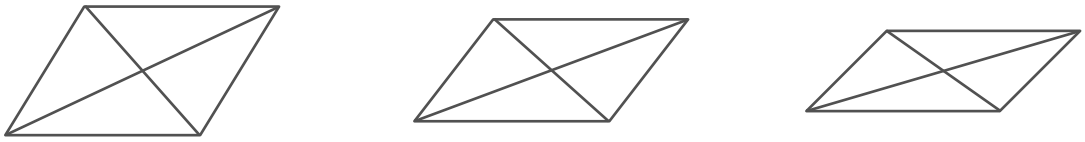
a. If *PT* = 12, then *TH* = _____ , *LT* = _____ and *PX* = _____.

b. If *HL* = 44, then *TL* = _____ and *PX* = _____.

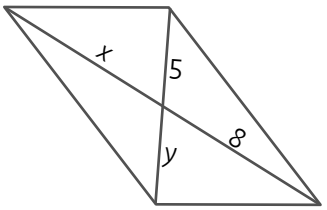
124. If it takes one can of paint to cover triangle *TLX*, how many cans of paint do you need to cover rectangle *LXHP*?

125. Describe what you have learned about the lengths of segments and the measures of angles that are formed when two diagonals are drawn in a rhombus.

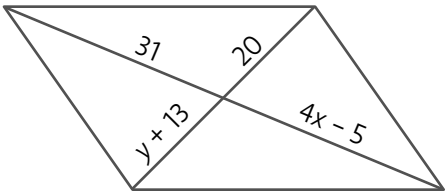
126. Consider the diagonals in a parallelogram. What do you notice about the lengths of the diagonals and how they intersect each other?



127. In the parallelogram shown, what are the values of x and y?



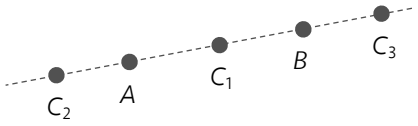
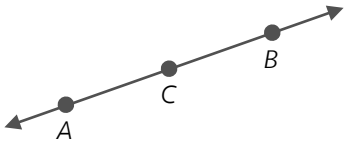
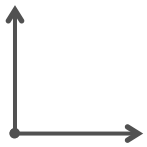
128. Given the parallelogram shown, solve for x and y.

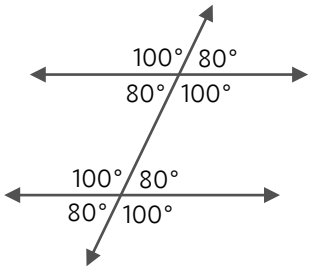


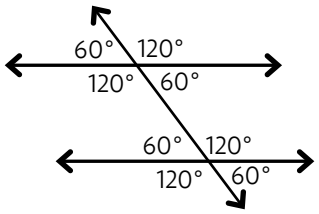
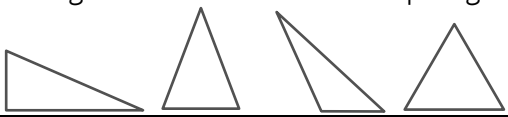
129. If the diagonals in a parallelogram are perpendicular, what type of parallelogram is it?

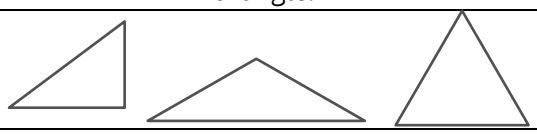
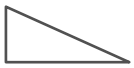
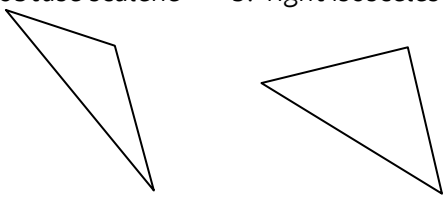
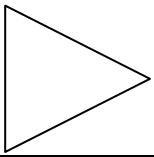
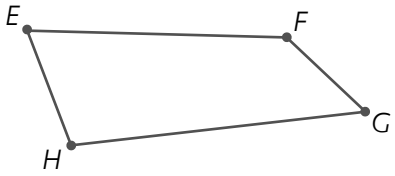
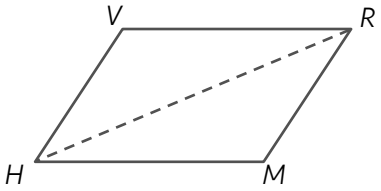
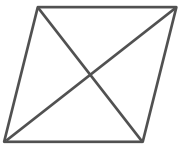
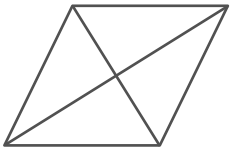
130. If a parallelogram has congruent diagonals, what type of parallelogram is it?

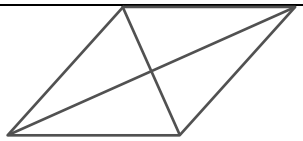
Section 7
ANSWER KEY

1.	You should be able to draw a line through A, B and C. Three possible locations for C are shown below. 
2.	Points A, B and D are collinear.
3.	a. The 3 points are not collinear b. Point B c. $(-1, -2)$ is one option, but there are infinitely many options.
4.	If you connect 3 points that are not collinear, they will form a triangle.
5.	The 3 segments are $\overline{BC}$, $\overline{BD}$, and $\overline{CD}$.
6.	The slope of $\overline{GH}$ is $\frac{2}{3}$ and the slope of $\overline{FG}$ is $-\frac{3}{2}$. The segments are perpendicular because their slopes are opposite reciprocals. Since $\angle G$ is a right angle, it follows that FGH is a right triangle.
7.	Yes, both symbols represent the segment with endpoints of A and B.
8.	
9.	No, the first letter in the symbol is the endpoint of the ray. The second letter indicates the point that the ray passes through. The symbols represent rays with different endpoints and opposite directions.
10.	
11.	$\overrightarrow{CA}$ and $\overrightarrow{CB}$
12.	Yes, both symbols represent the line that passes through points A and B.
13.	a. F, or point F b. $\overline{RW}$ or segment RW
	c. $\overrightarrow{CN}$ or ray CN d. $\overleftrightarrow{EL}$ or line EL
14.	a. 6 names: $\overleftrightarrow{AB}$, $\overleftrightarrow{BC}$, $\overleftrightarrow{AC}$, $\overleftrightarrow{DB}$, $\overleftrightarrow{BE}$, $\overleftrightarrow{DE}$ b. 8: $\overrightarrow{AB}, \overrightarrow{BC}, \overrightarrow{BA}, \overrightarrow{CA}, \overrightarrow{DE}, \overrightarrow{BE}, \overrightarrow{BD}, \overrightarrow{ED}$ c. $\overline{AB}$, $\overline{BC}$, $\overline{AC}$, $\overline{DB}$, $\overline{DE}$, $\overline{BE}$
15.	Three angles are formed because a triangle is formed when you connect 3 points that are not collinear.
16.	a. $\angle F$ or $\angle 2$ b. $\angle S$ or $\angle 4$ or $\angle TSR$
17.	a. point F b. point S
18.	a. point B b. point T c. point P
19.	–
20.	a. the measure of angle 1 b. the measure of angle DEF
21.	a. 70° b. 45° c. 25°
22.	
23.	a. 95° b. 120° c. 170°
24.	 One way to picture a 135° angle is to combine a 90° angle with a 45° angle.
25.	 a straight angle is a line
26.	a. $\angle CWZ$ b. $\angle FGH$ c. 2 angles: $\angle ABC$ and $\angle DBE$
27.	a. 90° b. 180° c. 360°
28.	a. $90 - 40 = 50°$ b. $90 - 35 = 55°$; solve $x+5=55 \rightarrow x=50$ c. solve $(x+3)+(3x-13)=90 \rightarrow x=25$
29.	$90 - 5 = 85°$
30.	$90 - 37 = 53°$
31.	a. $90 - 60 = 30°$ b. $90 - 45 = 45°$ c. 9°
32.	a. $\angle FGE$ b. $90 - 68.1 = 21.9°$ c. 90°
33.	$\angle 1+\angle 2=90 \rightarrow x+4x=90 \rightarrow x=18$ $m\angle 1=18°$ and $m\angle 2=72°$
34.	a. It looks like 90°, but it needs a square in

	the corner to assume it is exactly 90°. b. 90°
35.	a. 180 − 120 = 60° b. 180−65 = 115°; solve $x-20=115 \rightarrow x=135$ c. solve $(3x+11)+(2x-1)=180 \rightarrow x=34$
36.	180°
37.	180 − 20 = 160°
38.	180 − 112 = 68°
39.	a. 180 − 60 = 120° b. 180 − 90 = 90° c. 180 − 154 = 26°
40.	a. $\angle MVP$ b. 180 − 124.5 = 55.5° c. 180°
41.	a. $180-(60+30)=90°$ b. $180-(90+62)=28°$ c. $180-(20+20)=140°$
42.	$\angle 1+\angle 2+\angle 3=180 \rightarrow 0.5x+x+75=180$ $\rightarrow x=70 \rightarrow m\angle 1=35°$
43.	a. $m\angle 2=140°$ b. $m\angle 3=40°$ c. $m\angle 4=140°$ d. $m\angle 1=m\angle 3$ and $m\angle 2=m\angle 4$
44.	$m\angle 6=m\angle 7$ and $m\angle 5=m\angle 8$
45.	$\angle 1$ & $\angle 5$, $\angle 2$ & $\angle 6$, $\angle 3$ & $\angle 7$, $\angle 4$ & $\angle 8$
46.	a. $m\angle CBE = 39°$, $m\angle ABE = 141°$, $m\angle DBA = 39°$, $m\angle DBE = 180°$ b. $m\angle 1 = 61°$, $m\angle 2 = 81°$, $m\angle 3 = 38°$, $m\angle 4 = 180 - (61° + 38°) = 81°$
47.	a. 123° b. solve: $x + 17 = 97 \rightarrow x = 80$
48.	solve: $3x + 8 = 4x - 3 \rightarrow x = 11$ The two acute angles measure 41°. The two obtuse angles measure 139°.
49.	$x + y = 130$ and $2x - y = 50$ solve a system of equations using either substitution or elimination $x = 60, y = 70$
50.	a. $\angle 3$ & $\angle 5$ b. $\angle 4$ & $\angle 5$ and $\angle 3$ & $\angle 4$ c. $\angle 4$
51.	a. $\angle 6$ & $\angle 8$ b. $\angle 6$ & $\angle 7$; $\angle 7$ & $\angle 8$; $\angle 1$ & $\angle 2$; $\angle 3$ & $\angle 4$ c. $\angle 7$; $\angle 1$; $\angle 4$
52.	a. $m\angle 2=m\angle 4=m\angle 8=m\angle 6=70°$ $m\angle 1=m\angle 3=m\angle 5=m\angle 7=110°$ b. 112°
53.	 a.

	 b.
54.	a. $m\angle 1=115°$. There is not enough information to find $m\angle 2$ because the figure does not show parallel lines. b. $m\angle 5=85°$; $m\angle 4=180-85°=95°$. There is not enough information to find $m\angle 3$ because the lines are not parallel.
55.	$m\angle 1=135°$; $m\angle 2=45°$ $m\angle 3=109°$; $m\angle 4=71°$
56.	a. 125° b. 110° c. 64°
57.	a. F b. C c. Z
58.	a. equal b. supplementary c. equal
59.	a. C: supplementary b. F: equal c. Z: equal
60.	solve: $x - 10 = 105 \rightarrow x = 115$ solve: $3y = 75 \rightarrow y = 25$
61.	solve: $12x - 8 = 112 \rightarrow x = 10$ solve: $5y + 2 = 112 \rightarrow y = 22$
62.	$m\angle 1=52°$; $m\angle 3=65°$; $m\angle 2=63°$ angles 1, 2, and 3 are supplementary
63.	solve: $10x + 12 = 13x - 18 \rightarrow x = 10$ Since $x = 10$, then $13x - 18$ is 112. solve: $7y - 2 = 68 \rightarrow y = 10$
64.	solve a system of equations using either substitution or elimination $x - 2y = 40$ and $2x + y = 140$ $x = 64, y = 12$
65.	solve: $6y + 3 = 75 \rightarrow y = 12$ solve: $2x - 7 = 75 \rightarrow x = 41$
66.	There are 3 pairs of vertical angles. solve: $x - 4 = 3x - 60 \rightarrow x = 28$ The 2 smallest angles are 24°. solve: $48 + y = 60 - 2y \rightarrow y = 4$ The angles $(48 + y)°$ and $(60 - 2y)°$ are 52°. The 2 obtuse angles are both 104°.
67.	right acute obtuse equiangular 
68.	a triangle with one right angle
69.	circle c.
70.	a triangle with 3 acute angles
71.	circle b.
72.	a triangle with one obtuse angle
73.	circle a.
74.	a triangle with 3 equal angles

75.	circle c.
76.	No. Each angle in an acute triangle is less than 90 degrees.
77.	a. Not possible. An equiangular triangle has three 60° angles, so it cannot have an obtuse angle. b. Not possible. Obtuse triangles cannot have a 90° angle. c.  Every equiangular triangle has three 60° angles so it must be an acute triangle.
78.	
79.	a. 3 different side lengths and 3 different angle measures b. 2 equal sides and 2 equal angle measures c. 3 equal sides and 3 equal angle measures
80.	No. If all 3 sides are different lengths, 2 sides cannot be equal.
81.	a.  b.  c. 
82.	The 3 angles have a sum of 180°. $m\angle 2 = 70°$
83.	The 3 angles of a triangle have a sum of 180°.
84.	a. 30° b. 64°
85.	90°
86.	The triangle is obtuse because the third angle is 94.7°.
87.	The triangle is right because one angle is 90°. It is isosceles because the third angle is 45°, which makes it have 2 equal angles.
88.	a. obtuse scalene b. right isosceles  c. acute isosceles 
89.	a. scalene b. isosceles c. isosceles
90.	a. $m\angle 3 = 30°$; $m\angle 2 = 60°$; $m\angle 1 = 120°$ b. $m\angle 1 = 64°$; $m\angle 2 = 26°$; $m\angle 3 = 154°$
91.	$m\angle 1 = 180 - 152 \rightarrow 28°$ $m\angle 2 = 180 - 78 \rightarrow 102°$ $m\angle 3 = 180 - 130 \rightarrow 50°$
92.	a. The missing interior angle is 36°. The exterior angle is 148°. b. The missing interior angle is 54°. The exterior angle is 126°. c. The missing interior angle is 40°. The exterior angle is 140°.
93.	The exterior angle is equal to the sum of the two interior angles.
94.	$A = B + C$
95.	$m\angle 1 = 120°$; $m\angle 2 = 55°$; $m\angle 4 = 55°$ $m\angle 5 = 35°$; $m\angle 3 = 35°$
96.	$m\angle 1 + m\angle 2 = 115° \rightarrow x + 7 + 2x - 12 = 115$ $3x - 5 = 115 \rightarrow x = 40 \rightarrow m\angle 1 = 47°$; $m\angle 2 = 68°$
97.	$m\angle 4 = 70°; m\angle 2 = 47°; m\angle 3 = 70°; m\angle 1 = 117°$ Hints: $m\angle 3 + 110° = 180°$; $m\angle 2 + m\angle 3 = m\angle 1$
98.	$m\angle 3 = 40°; m\angle 2 = 90°; m\angle 4 = 50°; m\angle 1 = 40°$
99.	$m\angle 8 = 55°; m\angle 1 = 35°; m\angle 6 = 35°; m\angle 3 = 90°$ $m\angle 2 = 55°; m\angle 7 = 35°; m\angle 5 = 35°$
100.	 quadrilateral *EFGH*
101.	$\angle A$, $\angle B$, $\angle C$, $\angle D$
102.	a quadrilateral with 2 pairs of parallel sides
103.	a parallelogram with 4 congruent sides
104.	a parallelogram with 4 right angles
105.	a rhombus with 4 right angles
106.	a. yes b. no c. no d. yes
107.	a. p-gram, rhombus, rectangle, square b. p-gram, rhombus, rectangle, square c. rectangle, square d. rhombus, square
108.	diagonals *AC* and *BD*
109.	 a. diagonal *HR* b. they are congruent
110.	Three observations can be made: 1. the diagonals form 4 congruent triangles 2. the diagonals intersect at right angles 3. the diagonals bisect each other a.  b. 

	c. 
111.	a. $RY = 15$ and $YG = 15$ b. $MY = 34$ and $MS = 68$
112.	$m\angle 2 = m\angle 3 = 36°$
113.	The segments connect to form the other diagonal of the rhombus.
114.	the diagonals intersect at right angles $m\angle 1 = 29°; m\angle 2 = 90°; m\angle 3 = 29°; m\angle 4 = 61°$
115.	They are all the same size.
116.	a. $m\angle 1 = 55°$; $m\angle 2 = 35°$ b. $m\angle 2 = 27°$; $m\angle 1 = 63°$
117.	a. the diagonals do not form 90° angles b. the longer diagonal is not split into 2 congruent segments by the shorter diagonal
118.	a. Rhombus diagonals bisect each other. If $WY = 12$, then $WO = 6$. If $XZ = 16$, then $XO = 8$. WOX is a right triangle because rhombus diagonals intersect at right angles. You can use the Pythagorean Theorem to find the length of WX. $6^2 + 8^2 = (WX)^2$ b. $WX = 10$
119.	a. The diagonals bisect each other and split the rhombus into 4 congruent right triangles. The longer leg of each right triangle is 4 and the shorter leg of each right triangle is 3. The area of each right triangle is $\frac{1}{2}(3)(4) \rightarrow 6$. Since the rhombus is split into 4 of these right triangles, the area of the rhombus is $4 \cdot 6$ or 24 square units. b. To find the perimeter, find the hypotenuse of each right triangle using the Pythagorean Theorem. $3^2 + 4^2 = h^2 \rightarrow h = 5$ The perimeter is $4 \cdot 5$ or 20 units.
120.	The diagonals have the same lengths.
121.	a. Solve: $7x - 9 = 4x + 6 \rightarrow x = 5$ $AC = 7x - 9 = 7(5) - 9 \rightarrow AC = 26$ units b. To find the perimeter, find the length of BC using the Pythagorean Theorem. $10^2 + (BC)^2 = 26^2 \rightarrow BC = 24$ The perimeter is $2 \cdot 10 + 2 \cdot 24$ or 68 units.
122.	Two pairs of congruent isosceles triangles are formed. Unless the rectangle is a square, 2 of the triangles are acute isosceles and 2 are obtuse isosceles.
123.	a. $TH = 12$, $LT = 12$ and $PX = 24$. b. $TL = 22$ and $PX = 44$.
124.	4 cans. Each triangle has the same area.
125.	The diagonals bisect each other and the diagonals are perpendicular. The diagonals form 4 congruent right triangles.
126.	The diagonals bisect each other. The diagonals are different lengths.
127.	$x = 8$ and $y = 5$
128.	Solve: $4x - 5 = 31 \rightarrow x = 9$ Solve: $y + 13 = 20 \rightarrow y = 7$
129.	It is either a rhombus or a square.
130.	It is either a rectangle or a square.

