Chapter 1 - Tools of Geometry - Get Ready for Chapter 1

Graph and label each point in the coordinate plane.

1. $W(5, 2)$
2. $X(0, 6)$
3. $Y(-3, -1)$
4. $Z(4, -2)$

5. **GAMES** Carolina is using the diagram to record her chess moves. She moves her knight 2 spaces up and 1 space to the left from f3. What is the location of the knight after Carolina completes her turn?

![Chessboard with knight at f3]

Find each sum or difference.

6. $\frac{2}{3} + \frac{5}{6}$
7. $\frac{2}{18} + \frac{4}{3} - \frac{3}{4}$
8. $\frac{13}{18} - \frac{5}{9}$
9. $\frac{14}{5} - \frac{3}{9} - \frac{7}{15}$

10. **FOOD** Alvin ate $\frac{1}{3}$ of a pizza for dinner and took $\frac{1}{6}$ of it for lunch the next day. How much of the pizza does he have left?

Evaluate each expression.

11. $(-4 - 5)^2$
12. $(6 - 10)^2$
13. \((8 - 5)^2 + [9 - (-3)]^2\)

Solve each equation.

14. \(6x + 5 + 2x - 11 = 90\)

15. \(8x - 7 = 53 - 2x\)
1-1 Points, Lines, and Planes - Check Your Understanding

Use the figure to name each of the following.

1. a line containing point \( X \)
2. a line containing point \( Z \)
3. a plane containing points \( W \) and \( R \)

Name the geometric term modeled by each object.

4. a beam from a laser
5. a floor

Draw and label a figure for each relationship.

6. A line in a coordinate plane contains \( A(0, -5) \) and \( B(3, 1) \) and a point \( C \) that is not collinear with \( \overrightarrow{AB} \).
7. Plane \( Z \) contains lines \( x, y, w \). Lines \( x \) and \( y \) intersect at point \( V \) and lines \( x \) and \( w \) intersect at point \( P \).

Refer to the figure.

8. How many planes are shown in the figure?
9. Name three points that are collinear.
10. Are points \( A, H, J, \) and \( D \) coplanar? Explain.
11. Are points \( B, D, \) and \( F \) coplanar? Explain.
12. ASTRONOMY Ursa Minor, or the Little Dipper, is a constellation made up of seven stars in the northern sky including the star Polaris.
   a. What geometric figures are modeled by the stars?
   b. Are Star 1, Star 2, and Star 3 collinear on the constellation map? Explain.
   c. Are Polaris, Star 2, and Star 6 coplanar on the map?
1-1 Points, Lines, and Planes - Practice and Problem Solving

Refer to the figure.

13. Name the lines that are only in plane $Q$.

14. How many planes are labeled in the figure?

15. Name the plane containing the lines $m$ and $t$.

16. Name the intersection of lines $m$ and $t$.

17. Name a point that is not coplanar with points $A$, $B$, and $C$.


19. Name the points not contained in a line shown.

20. What is another name for line $t$?


Name the geometric term(s) modeled by each object.

22.

23.
24.  

25.  

26. a blanket  
27. a knot in a rope  
28. a telephone pole  
29. the edge of a desk  
30. two connected hallways  
31. a partially opened folder  

**Draw and label a figure for each relationship.**  
32. Line $m$ intersects plane $R$ at a single point.  
33. Two planes do not intersect.  
34. Points $X$ and $Y$ lie on $\overline{CD}$.  
35. Three lines intersect at point $J$ but do not all lie in the same plane.  
36. Points $A(2, 3), B(2, -3), C$ and $D$ are collinear, but $A, B, C, D,$ and $F$ are not.  
37. Lines $\overline{LM}$ and $\overline{NP}$ are coplanar but do not intersect.  
38. $\overline{FG}$ and $\overline{JK}$ intersect at $P(4, 3)$, where point $F$ is at $(-2, 5)$ and point $J$ is at $(7, 9)$.  
39. Lines $s$ and $t$ intersect, and line $v$ does not intersect either one.
Packing When packing breakable objects such as glasses, movers frequently use boxes with inserted dividers like the one shown.

40. How many planes are modeled in the picture?

41. What parts of the box model lines?

42. What parts of the box model points?

Refer to the figure at the right.

43. Name two collinear points.

44. How many planes appear in the figure?

45. Do plane \( A \) and plane \( MNP \) intersect? Explain.

46. In what line do planes \( A \) and \( QRV \) intersect?

47. Are points \( T, S, R, Q \), and \( V \) coplanar? Explain.

48. Are points \( T, S, R, Q \), and \( W \) coplanar? Explain.
49. **FINITE PLANES** A *finite plane* is a plane that has boundaries, or does not extend indefinitely. The street signs shown are finite planes.
   a. If the pole models a line, name the geometric term that describes the intersection between the signs and the pole.
   b. What geometric term(s) describes the intersection between the two finite planes? Explain your answer with a diagram if necessary.

![Diagram of street signs with pole](image)

50. **ONE-POINT PERSPECTIVE** One-point perspective drawings use lines to convey depth. Lines representing horizontal lines in the real object can be extended to meet at a single point called the *vanishing point*. Suppose you want to draw a tiled ceiling in the room below with eight tiles across.
   a. What point represents the vanishing point in the drawing?
   b. Trace the figure. Then draw lines from the vanishing point through each of the eight points between A and B. Extend these lines to the top edge of the drawing.
   c. How could you change the drawing to make the back wall of the room appear farther away?

![Perspective drawing](image)

51. **TWO-POINT PERSPECTIVE** Two-point perspective drawings use two vanishing points to convey depth.
   a. Trace the drawing of the castle shown. Draw five of the vertical lines used to create the drawing.
   b. Draw and extend the horizontal lines to locate the vanishing points and label them.
   c. What do you notice about the vertical lines as they get closer to the vanishing point?
   d. Draw a two-point perspective of a home or a room in a home.

![Perspective drawing of a castle](image)

52. **OPTICAL ILLUSION** Name two points on the same line in the figure. How can you support your assertion?
53. TRANSPORTATION When two cars enter an intersection at the same time on opposing paths, one of the cars must adjust its speed or direction to avoid a collision. Two airplanes, however, can cross paths while traveling in different directions without colliding. Explain how this is possible.

54. MULTIPLE REPRESENTATIONS Another way to describe a group of points is called a locus. A locus is a set of points that satisfy a particular condition. In this problem, you will explore the locus of points that satisfy an equation.
   a. TABULAR Represent the locus of points satisfying the equation $2 + x = y$ using a table of at least five values.
   b. GRAPHICAL Represent this same locus of points using a graph.
   c. VERBAL Describe the geometric figure that the points suggest.

55. PROBABILITY Three of the labeled points are chosen at random.
   a. What is the probability that the points chosen are collinear?
   b. What is the probability that the points chosen are coplanar?

56. MULTIPLE REPRESENTATIONS In this problem, you will explore the locus of points that satisfy an inequality.
   a. TABULAR Represent the locus of points satisfying the inequality $y < -3x - 1$ using a table of at least ten values.
   b. GRAPHICAL Represent this same locus of points using a graph.
   c. VERBAL Describe the geometric figure that the points suggest.

57. OPEN ENDED Sketch three planes that intersect in a line.

58. FIND THE ERROR Camille and Hiroshi are trying to determine how many lines can be drawn between four points. Is either of them correct? Explain your reasoning.

59. CHALLENGE Points $A$, $B$, $C$, and $D$ are noncollinear. What is the greatest number of planes that can be determined by points $A$, $B$, $C$ and $D$?
60. **REASONING** Is it possible for two points on the surface of a prism to be neither collinear nor coplanar? Justify your answer.

61. **WRITING IN MATH** Refer to Exercise 49. Give a real-life example of a finite plane. Is it possible to have a real-life object that is an infinite plane? Explain your reasoning.

62. [Diagram of a prism with labeled vertices A, B, C, D, E, F, G, H.]

Which statement about the figure below is **not** true?
A Point H lies in planes \(AGE\) and \(GED\).
B Planes \(GAB\), \(GFD\) and \(BED\) intersect at point \(E\).
C Points \(F\), \(E\), and \(B\) are coplanar.
D Points \(A\), \(H\), and \(D\) are collinear.

63. **ALGEBRA** What is the value of \(x\) if \(3x + 2 = 8\)?
   F \(-2\)
   G \(0\)
   H \(2\)
   J \(6\)

64. **GRIDDED RESPONSE** An ice chest contains 3 types of drinks: 10 apple juices, 15 grape juices, and 15 bottles of water. What is the probability that a drink selected randomly from the ice chest does not contain fruit juice?

65. **SAT/ACT** A certain school’s enrollment increased 6% this year over last year’s enrollment. If the school now has 1378 students enrolled, how many students were enrolled last year?
   A 1295
   B 1300
   C 1350
   D 1460

Simplify.

66. \(\sqrt{72}\)

67. \(\sqrt{18} \cdot \sqrt{14}\)

68. \(\sqrt[3]{44x^4y^3}\)

69. \(\frac{3}{\sqrt{18}}\)

70. \(\frac{\sqrt{28}}{\sqrt{75}}\)
71. \[ \frac{\sqrt{8a^6}}{\sqrt{108}} \]

72. \[ \frac{5}{4 - \sqrt{2}} \]

73. \[ \frac{4\sqrt{3}}{2 + \sqrt{5}} \]

74. **SHOPPING** Suppose you buy 3 shirts and 2 pairs of slacks on sale at a clothing store for $72. The next day, a friend buys 2 shirts and 4 pairs of slacks for $96. If the dress shirts you each bought were all the same price and the slacks were also all the same price, then the following system of equations represents this situation.
   
   \[ 3x + 2y = 72 \]
   \[ 2x + 4y = 96 \]

   What was the cost of each dress shirt and each pair of slacks?

   **Graph the following geometric figures.**

75. a triangle with vertices \( A(-5, 3), B(3, -4), C(-2, -3) \)

76. a rectangle with vertices \( P(-2, 1), Q(3, 4), R(5, 1), S(0, -2) \)

**GROCERIES** Find an approximate metric weight for each item.

77. ![Crunch n' Crisp Crackers](Net Wt: 15 oz)

78. ![FRESH SMILE Toothpaste](Net Wt: 8.2 oz)

79. ![Fast Toast Margarine](Net Wt: 2.5 lb)

   Replace each \( \bigcirc \) with \( >, <, \) or \( = \) to make a true statement.

80. \[ \frac{1}{4} \text{ in.} \bigcirc \frac{1}{2} \text{ in.} \]

81. \[ \frac{3}{4} \text{ in.} \bigcirc \frac{5}{8} \text{ in.} \]
82. \( \frac{3}{8} \text{ in.} \bigcirc \frac{6}{16} \text{ in.} \)

83. 18 mm \( \bigcirc \) 2 cm

84. 32 mm \( \bigcirc \) 3.2 cm

85. 0.8 m \( \bigcirc \) 8 cm

**Extend 1-1 Geometry Lab: Describing What You See - Exercises**

Write a description for each figure.

1. 

2. 

3. 

4. Draw and label a figure for the statement Planes \( N \) and \( P \) contain line \( a \).
1-2 Linear Measure - Check Your Understanding

Find the length of each line segment or object.

1. [Image of a fish with a ruler measuring its length]

2. [Image of a line segment CD with a ruler measuring its length]
Find the measurement of each segment. Assume that each figure is not drawn to scale.

5. \( \overline{CD} \)

6. \( \overline{RS} \)

**ALGEBRA** Find the value of \( x \) and \( BC \) if \( B \) is between \( C \) and \( D \).

7. \( CB = 2x \), \( BD = 4x \), and \( BD = 12 \)

8. \( CB = 4x - 9 \), \( BD = 3x + 5 \), and \( CD = 17 \)

9. **STATE FLAG** The Indiana State Flag was adopted in 1917. The measures of the segments between the stars and the flame are shown on the diagram in inches. List all of the congruent segments in the figure.
1-2 Linear Measure - Practice and Problem Solving

Find the length of each line segment.

10. \( \overline{EF} \)

11. \( \overline{XY} \)

12. \( \overline{KL} \)

Find the measurement of each segment.

13. \( \overline{HG} \)

14. \( \overline{EF} \)

15. \( \overline{JL} \)

16. \( \overline{PR} \)
20. **DONATIONS** The stacked bar graph shows the number of canned food items donated by the girls and the boys in a homeroom class over the last three years. Use the concept of betweenness of points to find the number of cans donated by the boys for each year. Explain your method.

   Find the value of the variable and $YZ$ if $Y$ is between $X$ and $Z$.

21. $XY = 11$, $YZ = 4c$, $XZ = 83$

22. $XY = 6b$, $YZ = 8b$, $XZ = 175$

23. $XY = 7a$, $YZ = 5a$, $XZ = 6a + 24$

24. $XY = 11d$, $YZ = 9d - 2$, $XZ = 5d + 28$

25. $XY = 4n + 3$, $YZ = 2n - 7$, $XZ = 22$

26. $XY = 3a - 4$, $YZ = 6a + 2$, $XZ = 5a + 22$

   Determine whether each pair of segments is congruent.
33. **Trusses** A truss is a structure used to support a load over a span, such as a bridge or the roof of a house. List all of the congruent segments in the figure.
34. **CONSTRUCTION** For each expression:
   - construct a segment with the given measure,
   - explain the process you used to construct the segment, and
   - verify that the segment you constructed has the given measure.
   a. $2(XY)$
   b. $6(WZ) - XY$

35. **BLUEPRINTS** Use a ruler to determine at least five pairs of congruent segments with labeled endpoints in the blueprint below.

![Blueprint Diagram]

36. **MULTIPLE REPRESENTATIONS** Betweenness of points ensures that a line segment may be divided into an infinite number of line segments.

   ![Segment Diagram]

   a. **GEOMETRIC** Use a ruler to draw a line segment 3 centimeters long. Label the endpoints $A$ and $D$. Draw two more points along the segment and label them $B$ and $C$. Draw a second line segment 6 centimeters long. Label the endpoints $K$ and $P$. Add four more points along the line and label them $L$, $M$, $N$, and $O$.

   b. **TABULAR** Use a ruler to measure the length of the line segment between each of the points you have drawn. Organize the lengths of the segments in $AD$ and $KP$ into a table. Include a column in your table to record the sum of these measures.

   c. **ALGEBRAIC** Give an equation that could be used to find the lengths of $AD$ and $KP$. Compare the lengths determined by your equation to the actual length, 3 centimeters.

37. **WRITING IN MATH** If point $B$ is between points $A$ and $C$, explain how you can find $AC$ if you know $AB$ and $BC$. Explain how you can find $BC$ if you know $AB$ and $AC$.

38. **OPEN ENDED** Draw a segment $AB$ that measures between 2 and 3 inches long. Then sketch a segment $CD$ congruent to $AB$, draw a segment $EF$ congruent to $AB$, and construct a segment $GH$ congruent to $AB$. Compare your methods.

39. **CHALLENGE** Point $K$ is between points $J$ and $L$. If $JK = x^2 - 4x$, $KL = 3x - 2$, and $JL = 28$, write and solve an equation to find the lengths of $JK$ and $KL$.

40. **REASONING** Determine whether the statement *If point $M$ is between points $C$ and $D$, then $CD$ is greater than either $CM$ or $MD$ is sometimes, never, or always true.* Explain.
41. **WRITING IN MATH** Why is it important to have a standard of measure? Refer to page 14, and include an advantage and disadvantage to the builders of the pyramids.

42. **SHORT RESPONSE** A 36-foot-long ribbon is cut into three pieces. The first piece of ribbon is half as long as the second piece of ribbon. The third piece is 1 foot longer than twice the length of the second piece of ribbon. How long is the longest piece of ribbon?

43. In the figure, points $A$, $B$, $C$, $D$, and $E$ are collinear. If $AE = 38$, $BD = 15$, and $BC \cong CD \cong DE$, what is the length of $AD$?
   
   A 7.5  
   B 15  
   C 22.5  
   D 30.5  

44. **SAT/ACT** If $f(x) = 7x^2 - 4x$, what is the value of $f(2)$?
   
   F -8  
   G 2  
   H 20  
   J 28  

45. **ALGEBRA**
   
   Simplify $(3x^3 - 2)(2x + 4) - 2x^2 + 6x + 7$.
   
   A $4x^3 + 14x - 1$  
   B $4x^3 - 14x + 15$  
   C $6x^3 + 12x^2 + 2x - 1$  
   D $6x^3 + 10x^2 + 2x - 1$  

   Refer to the figure.

46. What are two other names for $\overline{AB}$?

47. Give another name for plane $P$.

48. Name the intersection of plane $P$ and $\overline{AB}$.

49. Name three collinear points.
50. Name two points that are not coplanar.

51. **CLOCKS** The period of a pendulum is the time required for it to make one complete swing back and forth. The formula of the period \( P \) in seconds of a pendulum is \( P = 2\pi \sqrt{\frac{\ell}{32}} \), where \( \ell \) is the length of the pendulum in feet.
   a. What is the period of the pendulum in the clock shown to the nearest tenth of a second?
   b. About how many inches long should the pendulum be in order for it to have a period of 1 second?

52. \(-14n \geq 42\)

53. \(p + 6 > 15\)

54. \(-2a - 5 < 20\)

55. \(5x \leq 3x - 26\)

Evaluate each expression if \(a = -7\), \(b = 4\), \(c = -3\), and \(d = 5\).

56. \(b - c\)

57. \(|a - d|\)

58. \(|d - c|\)

59. \(\frac{b - a}{2}\)

60. \((a - c)^2\)

61. \(\sqrt{(a - b)^2 + (c - d)^2}\)
Extend 1-2 Extension Lesson: Precision and Accuracy - Practice and Problem Solving

Find the absolute error of each measurement. Then explain its meaning.

1. 12 yd

2. \(50\frac{4}{16}\) in.

3. 3.28 ft

4. 2.759 cm

5. **FIND THE ERROR** In biology class, Manuel and Jocelyn measure a beetle as shown. Manuel says that the beetle measures between \(\frac{5}{8}\) and \(\frac{3}{4}\) inches. Jocelyn says that it measures between \(\frac{9}{16}\) and \(\frac{5}{8}\) inches. Is either of their statements about the beetle’s measure correct? Explain your reasoning.

![Beetle Measurement](image)

6. **PYRAMIDS** Refer to the information about royal cubits on page 14 and in the caption at the left. What are the greatest and least possible lengths of the sides of the Great Pyramid of Giza?

   Caption: Research suggests that the design dimensions of the Great Pyramid of Giza in Egypt were 440 by 440 royal cubits. The sides of the pyramid are precise within 0.05%.

   Determine the number of significant digits in each measurement.

7. 4.05 in.

8. 53,000 mi

9. 0.0005 mm

10. 750,001 ft

11. **VOLUME** When multiplying or dividing measures, the product or quotient should have only as many significant digits as the multiplied or divided measurement showing the least number of significant digits. To how many significant digits should the volume of the rectangle prism shown be reported? Report the volume to this number of significant digits.
Name:

12. 48 in.
13. 2.0 mi
14. 11.14 cm
15. 0.6 m

Determine which measurement is more precise and which is more accurate. Explain your reasoning.

16. 22.4 ft; 5.82 ft
17. 25 mi; 8 mi
18. 9.2 cm; 42 mm
19. $18\frac{1}{4}$ in.; 125 yd

For each situation, determine the level of accuracy needed. Explain.

20. You are estimating the height of a person. Which unit of measure should you use: 1 foot, 1 inch, or $\frac{1}{16}$ inch?
21. You are estimating the height of a mountain. Which unit of measure should you use: 1 foot, 1 inch, or $\frac{1}{16}$ inch?

22. **PERIMETER** The perimeter of a geometric figure is the sum of the lengths of its sides. Jermaine uses a ruler divided into inches and measures the sides of a rectangle to be $2\frac{1}{4}$ inches and $4\frac{3}{4}$ inches.
   a. What is the least possible perimeter of the rectangle? Explain.
   b. What is the greatest possible perimeter of the rectangle? Explain.

23. **WRITING IN MATH** Give an example of a situation in which having a measure with an absolute error of 0.5 mile would likely not cause a problem. Give an example of a situation in which this same absolute error would likely cause a problem.
1-3 Distance and Midpoints - Check Your Understanding

Use the number line to find each measure.

1. \( XY \)
2. \( WZ \)

TIME CAPSULE Graduating classes have buried time capsules on the campus of East Side High School for over twenty years. The points on the diagram show the position of three time capsules. Find the distance between each pair of time capsules.

3. \( A(4, 9), B(2, -3) \)
4. \( A(4, 9), C(9, 0) \)
5. \( B(2, -3), C(9, 0) \)
6. Which two time capsules are the closest to each other? Which are farthest apart?

Use the number line to find the coordinate of the midpoint of each segment.

7. \( AC \)
8. \( BD \)

Find the coordinates of the midpoint of a segment with the given endpoints.

9. \( J(5, -3), K(3, -8) \)
10. \( M(7, 1), N(4, -1) \)
11. Find the coordinates of \( G \) if \( F(1, 3.5) \) is the midpoint of \( GJ \) and \( J \) has coordinates \((6, -2)\).
12. **ALGEBRA** Point $M$ is the midpoint of $\overline{CD}$. What is the value of $a$ in the figure?
1-3 Distance and Midpoints - Practice and Problem Solving

Use the number line to find each measure.

13. \( JL \)
14. \( JK \)
15. \( KP \)
16. \( NP \)
17. \( JP \)
18. \( LN \)

Find the distance between each pair of points.

19.

20.

21.
22. 

23. 

24. 

25. $X(1, 2), Y(5, 9)$

26. $P(3, 4), Q(7, 2)$

27. $M(-3, 8), N(-5, 1)$

28. $Y(-4, 9), Z(-5, 3)$

29. $A(2, 4), B(5, 7)$

30. $C(5, 1), D(3, 6)$
31. **HIKING** Vivian is planning to hike to the top of Humphreys Peak on her family vacation. The coordinates of the peak of the mountain and of the base of the trail are shown. If the trail can be approximated by a straight line, estimate the length of the trail. *(Hint: 1 mi = 5280 ft)*

**NEIGHBORHOODS** Penny and Akiko live in the locations shown on the map below.

![Map of Penny and Akiko's neighborhoods](image)

32.  
   a. If each square on the grid represents one block and the bottom left corner of the grid is the location of the origin, what is the distance from Penny’s house to Akiko’s?
   
   b. If Penny moves three blocks to the north and Akiko moves 5 blocks to the west, how far apart will they be?

   Use the number line to find the coordinate of the midpoint of each segment.

33. \(\overline{HK}\)

34. \(\overline{JL}\)

35. \(\overline{EF}\)

36. \(\overline{FG}\)

37. \(\overline{FK}\)

38. \(\overline{EL}\)

Find the coordinates of the midpoint of a segment with the given endpoints.

39. \(C(22, 4), B(15, 7)\)

40. \(W(12, 2), X(7, 9)\)

41. \(D(-15, 4), E(2, -10)\)

42. \(V(-2, 5), Z(3, -17)\)

43. \(X(-2.4, -14), Y(-6, -6.8)\)
44. \(J(-11.2, -3.4), K(-5.6, -7.8)\)

45. 

![Diagram](attachment:image)

**Find the coordinates of the missing endpoint if \(B\) is the midpoint of \(AC\).**

46. 

![Diagram](attachment:image)

**ALGEBRA** Suppose \(M\) is the midpoint of \(FG\). Use the given information to find the missing measure or value.

47. \(C(-5, 4), B(-2, 5)\)

48. \(A(1, 7), B(-3, 1)\)

49. \(A(-4, 2), B(6, -1)\)

50. \(C(-6, -2), B(-3, -5)\)

51. \(A(4, -0.25), B(-4, 6.5)\)

52. \(C\left(\frac{5}{3}, -6\right), B\left(\frac{8}{3}, 4\right)\)

53. \(FM = 3x - 4, MG = 5x - 26, FG = ?\)

54. \(FM = 5y + 13, MG = 5 - 3y, FG = ?\)

55. \(MG = 7x - 15, FG = 33, x = ?\)

56. \(FM = 8a + 1, FG = 42, a = ?\)
**Name:**

**BASKETBALL** The dimensions of a basketball court are shown below. Suppose a player throws the ball from a corner to a teammate standing at the center of the court.

![Basketball Court Diagram](image)

57. a. If center court is located at the origin, find the ordered pair that represents the location of the player in the bottom right corner.
   b. Find the distance that the ball travels.

**SPREADSHEETS** Spreadsheets can be used to perform calculations quickly. The spreadsheet below can be used to calculate the distance between two points. Values are used in formulas by using a specific cell name. The value of $x_1$ is used in a formula using its cell name, A2.

![Spreadsheets Midpoint Calculation](image)

Use the information at the left to write a formula for the indicated cell that could be used to calculate the indicated value using the coordinates $(x_1, y_1)$ and $(x_2, y_2)$ as the endpoint of a segment.

58. E2; the $x$-value of the midpoint of the segment
59. F2; the $y$-value of the midpoint of the segment
60. G2; the length of the segment

**Name the point(s) that satisfy the given condition.**

61. two points on the $x$-axis that are 10 units from $(1, 8)$
62. two points on the $y$-axis that are 25 units from $(-24, 3)$

63. **COORDINATE GEOMETRY** Find the coordinates of $B$ if $B$ is halfway between $AC$ and $C$ is halfway between $AD$.

![Coordinate Geometry Diagram](image)
ALGEBRA Determine the value(s) of \( n \).

64. \( J(n, n+2), K(3n, n - 1), JK = 5 \)

65. \( P(3n, n - 7), Q(4n, n + 5), PQ = 13 \)

**GEOGRAPHY** Wilmington, North Carolina, is located at \((34.3^\circ, 77.9^\circ)\), which represents north latitude and west longitude. Winston-Salem is in the northern part of the state at \((36.1^\circ, 80.2^\circ)\).

![Map of North Carolina](image)

66. a. Find the latitude and longitude of the midpoint of the segment between Wilmington and Winston-Salem.  
b. Use an atlas or the Internet to find a city near the location of the midpoint.  
c. If Winston-Salem is the midpoint of the segment with one endpoint at Wilmington, find the latitude and longitude of the other endpoint.  
d. Use an atlas or the Internet to find a city near the location of the other endpoint.

67. **MULTIPLE REPRESENTATIONS** In this problem, you will explore the relationship between a midpoint of a segment and the midpoint between the endpoint and the midpoint.  
a. **GEOMETRIC** Use a straightedge to draw three different line segments. Label the endpoints \( A \) and \( B \).  
b. **GEOMETRIC** On each line segment, find the midpoint of \( \overline{AB} \) and label it \( C \). Then find the midpoint of \( \overline{AC} \) and label it \( D \).  
c. **TABULAR** Measure and record \( AB, AC, \) and \( AD \) for each line segment. Organize your results into a table.  
d. **ALGEBRAIC** If \( AB = x \), write an expression for the measures \( AC \) and \( AD \).  
e. **VERBAL** Make a conjecture about the relationship between \( AB \) and each segment if you were to continue to find the midpoints of a segment and a midpoint you previously found.

68. **WRITING IN MATH** Explain how the Pythagorean Theorem and the Distance Formula are related.

69. **REASONING** Is the point one third of the way from \((x_1, y_1)\) to \((x_2, y_2)\) sometimes, always, or never the point \( \left( \frac{x_1 + x_2}{3}, \frac{y_1 + y_2}{3} \right) \)? Explain.

70. **CHALLENGE** Point \( P \) is located on the segment between point \( A(1, 4) \) and point \( D(7, 13) \). The distance from \( A \) to \( P \) is twice the distance from \( P \) to \( D \). What are the coordinates of point \( P \)?

71. **OPEN ENDED** Draw a segment and name it \( \overline{AB} \). Using only a compass and a straightedge, construct a segment \( \overline{CD} \) such that \( CD = \frac{1}{4} AB \). Explain and then justify your construction.

72. **WRITING IN MATH** Describe a method of finding the midpoint of a segment that has one endpoint at \((0, 0)\). Give an example using your method, and explain why your method works.
73. Which of the following best describes the first step in bisecting $AB$?

A From point $A$, draw equal arcs on $CD$ using the same compass width.
B From point $A$, draw equal arcs above and below $AB$ using a compass width of $\frac{1}{3}AB$.
C From point $A$, draw equal arcs above and below $AB$ using a compass width greater than $\frac{1}{2}AB$.
D From point $A$, draw equal arcs above and below $AB$ using a compass width less than $\frac{1}{2}AB$.

74. **ALGEBRA** Beth paid $74.88 for 3 pairs of jeans. All 3 pairs of jeans were the same price. How much did each pair of jeans cost?
   
   F $24.96
   G $37.44
   H $74.88
   J $224.64

75. **SAT/ACT** If $5^{2x-3} = 1$, then $x =$
   
   A 0.4
   B 1.5
   C 1.6
   D 2

76. **GRIDDED RESPONSE** One endpoint of $AB$ has coordinates $(-3, 5)$. If the coordinates of the midpoint of $AB$ are $(2, -6)$, what is the approximate length of $AB$?

   Find the length of each object.

77. [Image of a centipede]
Name:

78.

Draw and label a figure for each relationship.

79. \( \overline{FG} \) lies in plane \( M \) and contains point \( H \).

80. Lines \( r \) and \( s \) intersect at point \( W \).

81. **TRUCKS** A sport-utility vehicle has a maximum load limit of 75 pounds for its roof. You want to place a 38-pound cargo carrier and 4 pieces of luggage on top of the roof. Write and solve an inequality to find the average allowable weight for each piece of luggage.

   Solve each equation.

82. \( 8x - 15 = 5x \)

83. \( 5y - 3 + y = 90 \)

84. \( 16a + 21 = 20a - 9 \)

85. \( 9k - 7 = 21 - 3k \)

86. \( 11z - 13 = 3z + 17 \)

87. \( 15 + 6n = 4n + 23 \)
1-4 Angle Measure - Check Your Understanding

Use the figure at the right.

1. Name the vertex of $\angle 4$.

2. Name the sides of $\angle 3$.

3. What is another name for $\angle 2$?

4. What is another name for $\angle UXY$?

Copy the diagram shown, and extend each ray. Classify each angle as right, acute, or obtuse. Then use a protractor to measure the angle to the nearest degree.

5. $\angle CFD$

6. $\angle AFD$

7. $\angle BFC$

8. $\angle AFB$

**ALGEBRA** In the figure, $\overline{KJ}$ and $\overline{KL}$ are opposite rays, $\overline{KN}$ bisects $\angle LKM$.

9. If $m\angle LKM = 7x - 5$ and $m\angle NKM = 3x + 9$, find $m\angle LKM$.

10. If $m\angle NKL = 7x - 9$ and $m\angle JKM = x + 3$, find $m\angle JKN$. 
11. **CARPENTRY** A miter cut is used to build picture frames with corners that meet at right angles.
   
   a. José mites the ends of some wood for a picture frame at congruent angles. What is the degree measure of his cut? Explain and classify the angle.
   
   b. What does the joint represent in relation to the angle formed by the two pieces?
1-4 Angle Measure - Practice and Problem Solving

For Exercises 12–29, use the figure at the right.

Name the vertex of each angle.

12. \( \angle 4 \)
13. \( \angle 7 \)
14. \( \angle 2 \)
15. \( \angle 1 \)

Name the sides of each angle.

16. \( \angle TPQ \)
17. \( \angle VNM \)
18. \( \angle 6 \)
19. \( \angle 3 \)

Write another name for each angle.

20. \( \angle 9 \)
21. \( \angle OPT \)
22. \( \angle MQS \)
23. \( \angle 5 \)

24. Name an angle with vertex \( N \) that appears obtuse.

25. Name an angle with vertex \( Q \) that appears acute.

26. Name a point in the interior of \( \angle VRQ \).

27. Name a point in the exterior of \( \angle MRT \).
Copy the diagram shown, and extend each ray. Classify each angle as right, acute, or obtuse. Then use a protractor to measure the angle to the nearest degree.

30. $\angle GFK$
31. $\angle EFK$
32. $\angle LFK$
33. $\angle EFH$
34. $\angle GFH$
35. $\angle EFL$

36. **CLOCKS** Determine at least three different times during the day when the hands on a clock form each of the following angles. Explain.
   a. right angle
   b. obtuse angle
   c. congruent acute angles

**ALGEBRA** In the figure, $\overline{BA}$ and $\overline{BC}$ are opposite rays. $\overline{BH}$ bisects $\angle EBC$.

37. If $m\angle ABE = 2n + 7$ and $m\angle EBF = 4n - 13$, find $m\angle ABE$.
38. If $m\angle EBH = 6x - 20$ and $m\angle HBC = 8x - 30$, find $m\angle EBH$.
39. If $m\angle ABF = 7b - 24$ and $m\angle ABE = 2b$, find $m\angle EBF$.
40. If $m\angle EBC = 31a - 2$ and $m\angle EBH = 4a + 45$, find $m\angle HBC$.
41. If $m\angle ABF = 8s - 6$ and $m\angle ABE = 2(s + 11)$, find $m\angle EBF$.
42. If $m\angle EBC = 3r + 10$ and $m\angle ABE = 2r - 20$, find $m\angle EBF$. 
MAPS Estimate the measure of the angle formed by each city or location listed, the North Pole, and the Prime Meridian.

43. a. Nuuk, Greenland
   b. Fairbanks, Alaska
   c. Reykjavik, Iceland
   d. Prime Meridian

NAVIGATION Use the photo and the information at the left.

44. a. With the center of the compass as its vertex, what is the measure of the angle between due west and due north?
   b. What is the measure of the angle between due north and north-west?
   c. How does the north-west ray relate to the angle in part a?

Plot the points in a coordinate plane and sketch \( \angle XYZ \). Then classify it as right, acute, or obtuse.

45. \( X(5, -3), Y(4, -1), Z(6, -2) \)

46. \( X(6, 7), Y(2, 3), Z(4, 1) \)

PHYSICS When you look at a pencil in water, it looks bent. This illusion is due to refraction, or the bending of light when it moves from one substance to the next.
47. a. What is \( m \angle 1 \)? Classify this angle as acute, right, or obtuse.
b. What is \( m \angle 2 \)? Classify this angle as acute, right, or obtuse.
c. Without measuring, determine how many degrees the path of the light changes after it enters the water. Explain your reasoning.

**MULTIPLE REPRESENTATIONS** In this problem, you will explore the relationship of angles that compose opposite rays.

48. a. **GEOMETRIC** Draw four lines, each with points \( A, B, \) and \( C \). Draw \( \overline{BD} \) for each line, varying the placement of point \( D \). Use a protractor to measure \( \angle ABD \) and \( \angle DBC \) for each figure.
b. **TABULAR** Organize the measures for each figure into a table. Include a column in your table to record the sum of these measures.
c. **VERBAL** Make a conjecture about the sum of the measures of the two angles. Explain your reasoning.
d. **ALGEBRAIC** If \( x \) is the measure of \( \angle ABD \) and \( y \) is the measure of \( \angle DBC \), write an equation that relates the two angle measures.

49. **OPEN ENDED** Draw an obtuse angle named \( \angle ABC \). Measure \( \angle ABC \). Construct an angle bisector \( \overline{BD} \) of \( \angle ABC \). Explain the steps in your construction and justify each step. Classify the two angles formed by the angle bisector.

50. **CHALLENGE** Describe how you would use a protractor to measure the angle shown.

51. **REASONING** The sum of two acute angles is sometimes, always, or never an obtuse angle. Explain.

52. **CHALLENGE** \( \overline{MP} \) bisects \( \angle LMN \), \( \overline{MQ} \) bisects \( \angle LMP \), and \( \overline{MR} \) bisects \( \angle QMP \). If \( m \angle RMP = 21 \), find \( m \angle LMN \). Explain your reasoning.

53. **WRITING IN MATH** Rashid says that he can estimate the measure of an acute angle using a piece of paper to within six degrees of accuracy. Explain how this would be possible. Then use this method to estimate the measure of the angle shown.
Name:

54. Which of the following angles measures closest to 60°?
A

B

C

D

55. SHORT RESPONSE Leticia surveyed 50 English majors at a university to see if the school should play jazz music in the cafeteria during lunch. The school has 75 different majors and a total of 2000 students. Explain why the results of Leticia’s survey are or are not representative of the entire student body.

56. In the figure below, if \( m \angle BAC = 38 \), what must be the measure of \( \angle BAD \) in order for \( \overline{AC} \) to be an angle bisector?
F 142
G 76
H 52
J 38

57. SAT/ACT If \( n \) is divisible by 2, 5, and 14, which of the following is also divisible by these numbers?
A \( n + 7 \)
B \( n + 10 \)
C \( n + 14 \)
D \( n + 70 \)

Find the distance between each pair of points. Round to the nearest hundredth.
58. \( A(-1, -8), B(3, 4) \)
59. \( C(0, 1), D(-2, 9) \)
60. \( E(-3, -12), F(5, 4) \)
61. \( G(4, -10), H(9, -25) \)
62. \( J\left(1, \frac{1}{4}\right), K\left(-3, \frac{7}{4}\right) \)
63. \( L\left(-5, \frac{8}{5}\right), M\left(5, \frac{2}{5}\right) \)

Find the value of the variable and \( ST \) if \( S \) is between \( R \) and \( T \).

64. \( RS = 7a, ST = 12a, RT = 76 \)
65. \( RS = 12, ST = 2x, RT = 34 \)

PHOTOGRAPHY Photographers often place their cameras on tripods. In the diagram, the tripod is placed on an inclined surface, and the length of each leg is adjusted so that the camera remains level with the horizon. Are the feet of the tripod coplanar? Explain your reasoning.

Complete each sentence.

67. \( 54 \text{ in.} = \ ? \text{ ft} \)
68. \( 275 \text{ mm} = \ ? \text{ m} \)
69. \( 7 \text{ gal} = \ ? \text{ pt} \)

Solve each equation.

70. \( (90 - x) - x = 18 \)
71. \( (5x + 3) + 7x = 180 \)
72. \( (13x + 10) + 2x = 90 \)
Name:

73. \((180 - x) - 4x = 56\)

74. \((4n + 17) + (n - 2) = 180\)

75. \((8a - 23) + (9 - 2a) = 90\)
Chapter 1 - Tools of Geometry - Mid-Chapter Quiz: Lessons 1-1 through 1-4

Use the figure to complete each of the following.

1. Name another point that is collinear with points $U$ and $V$.

2. What is another name for plane $Y$?

3. Name a line that is coplanar with points $P$, $Q$, and $W$.

4. Find the value of $x$ and $AC$ if $B$ is between points $A$ and $C$.
   
   $AB = 12$, $BC = 8x - 2$, $AC = 10x$

5. $AB = 5x$, $BC = 9x - 2$, $AC = 11x + 7.6$

6. Find $CD$ and the coordinate of the midpoint of $\overline{CD}$.

7. Find the coordinates of the midpoint of each segment. Then find the length of each segment.

8.
9. $P(26, 12)$ and $Q(8, 42)$
10. $M(6, -41)$ and $N(-18, -27)$
11. **MAPS** A map of a town is drawn on a coordinate grid. The high school is found at point $(3, 1)$ and town hall is found at $(-5, 7)$. (Lesson 1-3)
a. If the high school is at the midpoint between the town hall and the town library, at which ordered pair should you find the library?
b. If one unit on the grid is equivalent to 50 meters, how far is the high school from town hall?
12. **MULTIPLE CHOICE** The vertex of $\angle ABC$ is located at the origin. Point $A$ is located at $(5, 0)$ and Point $C$ is located at $(0, 2)$. How can $\angle ABC$ be classified?
   - A acute
   - B obtuse
   - C right
   - D scalene

In the figure, $\overline{XA}$ and $\overline{XE}$ are opposite rays, and $\angle AXC$ is bisected by $\overline{XB}$.

13. If $m \angle AXC = 8x - 7$ and $m \angle AXB = 3x + 10$, find $m \angle AXC$.
14. If $m \angle CXD = 4x + 6$, $m \angle DXE = 3x + 1$, and $m \angle CXE = 8x - 2$, find $m \angle DXE$.

Classify each angle as *acute*, *right*, or *obtuse*.

15. $\angle WQY$
16. $\angle YQZ$
1-5 Angle Relationships - Check Your Understanding

Name an angle pair that satisfies each condition.

1. two acute vertical angles

2. two obtuse adjacent angles

3. **CAMERAS** Cameras use lenses and light to capture images.
   
   a. What type of angles are formed by the object and its image?
   b. If the measure of \( \angle 2 \) is 15, what is the measure of \( \angle 1 \)?

4. **ALGEBRA** The measures of two complementary angles are \( 7x + 17 \) and \( 3x - 20 \). Find the measures of the angles.

5. **ALGEBRA** Lines \( x \) and \( y \) intersect to form adjacent angles 2 and 3. If \( m \angle 2 = 3a - 27 \) and \( m \angle 3 = 2b + 14 \), find the values of \( a \) and \( b \) so that \( x \) is perpendicular to \( y \).

Determine whether each statement can be assumed from the figure. Explain.

6. \( \angle CAD \) and \( \angle DAB \) are complementary.

7. \( \angle EDB \) and \( \angle BDA \) are adjacent, but they are neither complementary nor supplementary.
1-5 Angle Relationships - Practice and Problem Solving

Name an angle or angle pair that satisfies each condition.

8. two adjacent angles
9. two acute vertical angles
10. two obtuse vertical angles
11. two complementary adjacent angles
12. two complementary nonadjacent angles
13. two supplementary adjacent angles
14. a linear pair whose vertex is F
15. an angle complementary to $\angle FDG$
16. an angle supplementary to $\angle CBF$
17. an angle supplementary to $\angle JAE$

18. **MAPS** You are using a compass to drive 23° east of north. Express your direction in another way using an acute angle and two of the four directions: north, south, east, and west. Explain your reasoning.

Find the value of each variable.

19.
25. **ALGEBRA** \( \angle E \) and \( \angle F \) are supplementary. The measure of \( \angle E \) is 54 more than the measure of \( \angle F \). Find the measures of each angle.

26. **ALGEBRA** The measure of an angle’s supplement is 76 less than the measure of the angle. Find the measure of the angle and its supplement.

27. **ALGEBRA** The measure of the supplement of an angle is 40 more than two times the measure of the complement of the angle. Find the measure of the angle.

28. **ALGEBRA** \( \angle 3 \) and \( \angle 4 \) form a linear pair. The measure of \( \angle 3 \) is four more than three times the measure of \( \angle 4 \). Find the measure of each angle.

**ALGEBRA** Use the figure at the right.

29. If \( m \angle KNL = 6x - 4 \) and \( m \angle LNM = 4x + 24 \), find the value of \( x \) so that \( \angle KNM \) is a right angle.
30. If \( m \angle JNP = 3x - 15 \) and \( m \angle JNL = 5x + 59 \), find the value of \( x \) so that \( \angle JNP \) and \( \angle JNL \) are supplements of each other.

31. If \( m \angle LNM = 8x + 12 \) and \( m \angle JNL = 12x - 32 \), find \( m \angle JNP \).

32. If \( m \angle JNP = 2x + 3 \), \( m \angle KNL = 3x - 17 \), and \( m \angle KNJ = 3x + 34 \), find the measure of each angle.

33. **PHYSICS** As a ray of light meets a mirror, the light is reflected. The angle at which the light strikes the mirror is the **angle of incidence**. The angle at which the light is reflected is the **angle of reflection**. The angle of incidence and the angle of reflection are congruent. In the diagram at the right, if \( m \angle RMI = 106 \), find the angle of reflection and \( m \angle RMJ \).

![Reflection Diagram](image)

34. **ALGEBRA** Rays \( AB \) and \( BC \) are perpendicular. Point \( D \) lies in the interior of \( \angle ABC \). If \( m \angle ABD = 3r + 5 \) and \( m \angle DBC = 5r - 27 \), find \( m \angle ABD \) and \( m \angle DBC \).

35. **ALGEBRA** \( WX \) and \( YZ \) intersect at point \( V \). If \( m \angle WVV = 4a + 58 \) and \( m \angle XYV = 2b - 18 \), find the values of \( a \) and \( b \) so that \( WX \) is perpendicular to \( YZ \).

Determine whether each statement can be assumed from the figure. Explain.

36. \( \angle 4 \) and \( \angle 7 \) are vertical angles.

37. \( \angle 4 \) and \( \angle 8 \) are supplementary.

38. \( p \perp t \)

39. \( \angle 3 \equiv \angle 6 \)

40. \( \angle 5 \equiv \angle 3 + \angle 6 \)

41. \( \angle 5 \) and \( \angle 7 \) form a linear pair.
42. **GARDENING** In the diagram of the pruning shears shown, \( m \angle 1 = m \angle 3 \). What conclusion can you reach about the relationship between \( \angle 4 \) and \( \angle 2 \)? Explain.

![Diagram of pruning shears](image)

**FLIGHT** Use the diagram of the Ames-Dryden aircraft shown.

![Diagram of airplane](image)

43. Identify a pair of vertical angles.

44. Identify two pairs of supplementary angles.

45. If \( m \angle 1 = 110 \), what is \( m \angle 3 \)? \( m \angle 4 \)?

46. What is the minimum possible value for \( m \angle 2 \)? the maximum?

47. Is there a wing position in which none of the angles are obtuse? Explain.

48. **MULTIPLE REPRESENTATIONS** In this problem, you will explore the relationship between the sum of the interior angles of a triangle and the angles vertical to them.
   
a. **GEOMETRIC** Draw three sets of three intersecting lines and label each as shown.
   
b. **TABULAR** For each set of lines, measure and record \( m \angle 1 \), \( m \angle 2 \), and \( m \angle 3 \) in a table. Record \( m \angle 1 + m \angle 2 + m \angle 3 \) in a separate column.
   
c. **VERBAL** Explain how you can find \( m \angle 4 \), \( m \angle 5 \), and \( m \angle 6 \) when you know \( m \angle 1 \), \( m \angle 2 \), and \( m \angle 3 \).
   
d. **ALGEBRAIC** Write an equation that relates \( m \angle 1 + m \angle 2 + m \angle 3 \) to \( m \angle 4 + m \angle 5 + m \angle 6 \). Then use substitution to write an equation that relates \( m \angle 4 + m \angle 5 + m \angle 6 \) to an integer.

![Diagram of intersecting lines](image)

49. **REASONING** Are there angles that do not have a complement? Explain.

50. **OPEN ENDED** Draw a pair of intersecting lines that forms a pair of complementary angles. Explain your reasoning.
51. **CHALLENGE** If a line, line segment, or ray is a perpendicular to a plane, it is perpendicular to every line, line segment, or ray in the plane that intersects it.
   a. If a line is perpendicular to each of two intersecting lines at their point of intersection, then the line is perpendicular to the plane determined by them. If line $a$ is perpendicular to line $\ell$ and line $m$ at point $X$, what must also be true?
   b. If a line is perpendicular to a plane, then any line perpendicular to the given line at the point of intersection with the given plane is in the given plane. If line $a$ is perpendicular to plane $P$ and line $m$ at point $X$, what must also be true?
   c. If a line is perpendicular to a plane, then every plane containing the line is perpendicular to the given plane. If line $a$ is perpendicular to plane $P$, what must also be true?

![Diagram of perpendicular lines and planes]

52. **WRITING IN MATH** Describe three different ways you can determine that an angle is a right angle.

53. What is $m \angle RMS$ in the figure below?

   ![Diagram with angles]

   A 26
   B 38
   C 52
   D 128

54. **EXTENDED RESPONSE** For a fundraiser, a theater club is making 400 cookies. They want to make twice as many chocolate chip as peanut butter cookies and three times as many peanut butter as oatmeal raisin cookies. Determine how many of each type of cookie the theater club will make. Show your work.

55. **ALGEBRA** Which inequality is graphed below?

   ![Graph with shaded region]

   F $y > -\frac{1}{3}x + 1$
   G $y < -\frac{1}{3}x + 1$
   H $y \geq -\frac{1}{3}x + 1$
   J $y \leq -\frac{1}{3}x + 1$
56. SAT/ACT One third of a number is three more than one fourth the same number. What is the number?
   A 12
   B 36
   C 42
   D 48

   Copy the diagram shown and extend each ray. Classify each angle as right, acute, or obtuse. Then use a protractor to measure the angle to the nearest degree.

   \[ \angle ABC \]

   \[ \angle DBC \]

   \[ \angle ABD \]

   Find the coordinates of the midpoint of a segment with the given endpoints.

   60. \( P(3, -7), Q(9, 6) \)

   61. \( A(-8, -5), B(1, 7) \)

   62. \( J(-7, 4), K(3, 1) \)

   63. SNOWBOARDING In the design on the snowboard shown, \( \overline{BD} \) bisects \( \overline{SN} \) at \( R \). If \( SN = 163 \) centimeters, find \( RN \).

   Name the congruent sides and angles in each figure.

   64.

   65.
Extend 1-5 Geometry Lab: Constructing Perpendiculars - Model and Analyze the Results

Model and Analyze the Results

1. Draw a line and construct a line perpendicular to it through a point on the line.

2. Draw a line and construct a line perpendicular to it through a point not on the line.

3. How is the second construction similar to the first one?
1-6 Two-Dimensional Figures - Check Your Understanding

Name each polygon by its number of sides. Then classify it as convex or concave and regular or irregular.

1. 

2. 

SIGNS Identify the shape of each traffic sign and classify it as regular or irregular.

3. stop

4. caution or warning

5. slow moving vehicle

Find the perimeter or circumference and area of each figure. Round to the nearest tenth.
6. [Diagram of a square with side length labeled 11 ft]

7. [Diagram of a circle with radius labeled 12.5 cm]

8. [Diagram of a triangle with sides labeled 15 m, 17 m, and 8 m]

9. **MULTIPLE CHOICE** Vanessa is making a banner for the game. She has 20 square feet of fabric. What shape will use *most* or all of the fabric?
   - A a square with a side length of 4 feet
   - B a rectangle with a length of 4 feet and a width of 3.5 feet
   - C a circle with a radius of about 2.5 feet
   - D a right triangle with legs of about 5 feet

10. **COORDINATE GEOMETRY** Find the perimeter and area of \( \triangle ABC \) with vertices \( A(-1, 2) \), \( B(3, 6) \), and \( C(3, -2) \).

1-6 Two-Dimensional Figures - Practice and Problem Solving

Name each polygon by its number of sides. Then classify it as *convex* or *concave* and *regular* or *irregular*.

11. [Diagram of a triangle]
Find the perimeter or circumference and area of each figure. Round to the nearest tenth.
21. 

22. 

23. **CRAFTS** Joy has a square picture that is 4 inches on each side. The picture is framed with a length of ribbon. She wants to use the same piece of ribbon to frame a circular picture. What is the maximum radius of the circular frame?

24. **LANDSCAPING** Mr. Jackson has a circular garden with a diameter of 10 feet surrounded by edging. Using the same length of edging, he is going to create a square garden. What is the maximum side length of the square?

**COORDINATE GEOMETRY** Graph each figure with the given vertices and identify the figure. Then find the perimeter and area of the figure.

25. \( D(-2, -2), E(-2, 3), F(2, -1) \)

26. \( J(-3, -3), K(3, 2), L(3, -3) \)

27. \( P(-1, 1), Q(3, 4), R(6, 0), S(2, -3) \)

28. \( T(-2, 3), U(1, 6), V(5, 2), W(2, -1) \)

29. **CHANGING DIMENSIONS** Use the rectangle at the right.
   a. Find the perimeter of the rectangle.
   b. Find the area of the rectangle.
   c. Suppose the length and width of the rectangle are doubled. What effect would this have on the perimeter? the area? Justify your answer.
   d. Suppose the length and width of the rectangle are halved. What effect does this have on the perimeter? the area? Justify your answer.
30. **CHANGING DIMENSIONS** Use the triangle at the right.
   a. Find the perimeter of the triangle.
   b. Find the area of the triangle.
   c. Suppose the side lengths and height of the triangle were doubled. What effect would this have on the perimeter? the area? Justify your answer.
   d. Suppose the side lengths and height of the triangle were divided by three. What effect would this have on the perimeter? the area? Justify your answer.

31. **ALGEBRA** A rectangle of area 360 square yards is 10 times as long as it is wide. Find its length and width.

32. **ALGEBRA** A rectangle of area 350 square feet is 14 times as wide as it is long. Find its length and width.

33. **DISC GOLF** The diameter of the most popular brand of flying disc used in disc golf measures between 8 and 10 inches.
   a. Find the minimum and maximum circumference of these flying discs to the nearest tenth.
   b. Describe the range of possible areas for these flying discs to the nearest tenth.

   **ALGEBRA** Find the perimeter or circumference for each figure with the given information.

34. The area of a square is 36 square units.

35. The length of a rectangle is half the width. The area is 25 square meters.

36. The area of a circle is $25\pi$ square units.

37. The area of a circle is $32\pi$ square units.

38. A rectangle’s length is 3 times its width. The area is 27 square inches.

39. A rectangle’s length is twice its width. The area is 48 square inches.

   **ALGEBRA** Find the length of each side of the polygon for the given perimeter.

40. $P = 33$ in.
Name:

41. \( P = 50 \text{ cm} \)

42. \( P = 28 \text{ ft} \)

43. **SWIMMING POOLS** Ms. Neus has a circular swimming pool that is 20 feet in diameter. She wants to build a square fence around the pool so that the fence is a minimum of 6 feet from any edge of the pool.
   a. How much fencing will she need?
   b. What percent of the area enclosed by the fence is not occupied by the pool?

44. **WHICH ONE DOESN'T BELONG?** Identify the term that does not belong with the other three. Explain your reasoning.

   - square
   - circle
   - triangle
   - pentagon

45. **CHALLENGE** The vertices of a rectangle with side lengths of 10 and 24 are on a circle of radius 13 units. Find the area between the figures.

46. **REASONING** Name a polygon that is always regular and a polygon that is sometimes regular. Explain your reasoning.

47. **OPEN ENDED** Draw a pentagon. Is your pentagon convex or concave? Is your pentagon regular or irregular? Justify your answers.

48. **CHALLENGE** A rectangular room measures 20 feet by 12.5 feet. How many 5-inch square tiles will it take to cover the floor of this room? Explain.

49. **WRITING IN MATH** Describe two possible ways that a polygon can be equiangular but not a regular polygon.
50. Find the perimeter of the figure.

A 17 cm  
B 25 cm  
C 28 cm  
D 31 cm

51. **PROBABILITY** In three successive rolls of a fair number cube, Matt rolls a 6. What is the probability of Matt rolling a 6 if the number cube is rolled a fourth time?

   F $\frac{1}{6}$  
   G $\frac{1}{4}$  
   H $\frac{1}{3}$  
   J 1

52. **SHORT RESPONSE** Miguel is planning a party for 80 guests. According to the pattern in the table, how many gallons of ice cream should Miguel buy?

<table>
<thead>
<tr>
<th>Number of Guests</th>
<th>Gallons of Ice Cream</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>16</td>
<td>4</td>
</tr>
<tr>
<td>24</td>
<td>6</td>
</tr>
<tr>
<td>32</td>
<td>8</td>
</tr>
</tbody>
</table>

53. **SAT/ACT** A frame 2 inches wide surrounds a painting that is 18 inches wide and 14 inches tall. What is the area of the frame?

A 84 in$^2$  
B 144 in$^2$  
C 252 in$^2$  
D 396 in$^2$

Determine whether each statement can be assumed from the figure. Explain.

54. $\angle KJN$ is a right angle.

55. $\angle PLN \cong \angle NLM$

56. $\angle PNL$ and $\angle MNL$ are complementary.
57. $\angle KLN$ and $\angle MLN$ are supplementary.

58. **TABLE TENNIS** The diagram shows the angle of play for a table tennis player. If a right-handed player has a strong forehand, he should stand to the left of the center line of his opponent’s angle of play.
   a. What geometric term describes the center line?
   b. If the angle of play shown in the diagram measures $43^\circ$, what is $m \angle BAD$?

   Name an appropriate method to solve each system of equations. Then solve the system.

59. $\begin{align*}
-5x + 2y &= 13 \\
2x + 3y &= -9
\end{align*}$

60. $\begin{align*}
y &= -5x + 7 \\
y &= 3x - 17
\end{align*}$

61. $\begin{align*}
x - 8y &= 16 \\
7x - 4y &= -18
\end{align*}$

   Evaluate each expression if $P = 10$, $B = 12$, $h = 6$, $r = 3$, and $\ell = 5$. Round to the nearest tenth, if necessary.

62. $\frac{1}{2}P\ell + B$

63. $\frac{1}{3}Bh$

64. $\frac{1}{3}\pi r^2 h$

65. $2\pi rh + 2\pi r^2$
Extend 1-6 Geometry Software Investigation: Two-Dimensional Figures - Analyze the Results

Analyze the Results

1. Add the side measures from Activity 2. How does this compare to the result in Activity 3?

2. What is the sum of the angle measures of ΔXYZ?

3. Repeat the activities for each figure.
   a. irregular quadrilateral
   b. square
   c. pentagon
   d. hexagon

4. Draw another quadrilateral and find its perimeter. Then enlarge your figure using the Dilate command. How does changing the sides affect the perimeter?

5. Compare your results with those of your classmates.

6. Make a conjecture about the sum of the measures of the angles in any triangle.

7. What is the sum of the measures of the angles of a quadrilateral? pentagon? hexagon?

8. How are the sums of the angles of polygons related to the number of sides?


10. When the sides of a polygon are changed by a common factor, does the perimeter of the polygon change by the same factor as the sides? Explain.
1-7 Three-Dimensional Figures - Check Your Understanding

Determine whether the solid is a polyhedron. Then identify the solid. If it is a polyhedron, name the bases, faces, edges, and vertices.

1.

Find the surface area and volume of each solid to the nearest tenth.

2.
5. **PARTY FAVORS** Lawana is making cone-shaped hats 4 inches in diameter, 6.5 inches tall, with a slant height of 6.8 inches for party favors. Find each measure to the nearest tenth.
   a. the volume of candy that will fill each cone
   b. the area of material needed to make each hat assuming there is no overlap of material

1-7 Three-Dimensional Figures - Practice and Problem Solving

Identify the solid modeled by each object. State whether the solid modeled is a polyhedron.
Determine whether the solid is a polyhedron. Then identify the solid. If it is a polyhedron, name the bases, faces, edges, and vertices.
Name:

Find the surface area and volume of each solid to the nearest tenth.

18.

19.

20.

21.

22.

23.

24. **SANDBOX** A rectangular sandbox is 3 feet by 4 feet. The depth of the box is 8 inches, but the depth of the sand is \( \frac{3}{4} \) of the depth of the box. Find each measure to the nearest tenth.
   a. the surface area of the sandbox assuming there is no lid
   b. the volume of sand in the sandbox

25. **ART** Fernando and Humberto Campana designed the Inflating Table shown at the left. The diameter of the table is \( 15 \frac{1}{2} \) inches. Suppose the height of the cylinder is \( 11 \frac{3}{4} \) inches. Find each measure to the nearest tenth.
   Assume that the sides of the table are perpendicular to the bases of the table.
   a. the volume of air that will fully inflate the table
   b. the surface area of the table when fully inflated
Name:

26. **FOOD** In 1999, Marks & Spencer, a British department store, created the biggest sandwich ever made. The tuna and cucumber sandwich was in the form of a triangular prism. Suppose each slice of bread was 8 inches thick. Find each measure to the nearest tenth.
   a. the surface area in square feet of the sandwich when filled
   b. the volume of filling in cubic feet to the nearest tenth

![Triangular Prism Diagram]

27. **ALGEBRA** The surface area of a cube is 54 square inches. Find the length of each edge.

28. **ALGEBRA** The volume of a cube is 729 cubic centimeters. Find the length of each edge.

29. **PAINTING** Tara is painting her family’s fence. Each post is composed of a square prism and a square pyramid. The height of the pyramid is 4 inches. Determine the surface area and volume of each post.

![Fence Post Diagram]

30. **COLLECT DATA** Use a ruler or tape measure and what you have learned in this lesson to find the surface area and volume of a soup can.

31. **CAKES** Cakes come in many shapes and sizes. Often they are stacked in two or more layers, like those in the diagrams shown below.

![Cake Diagrams]

   a. If each layer of the rectangular prism cake is 3 inches high, calculate the area of the cake that will be frosted assuming there is no frosting between layers.
   b. Calculate the area of the cylindrical cake that will be frosted, if each layer is 4 inches in height.
   c. If one can of frosting will cover 50 square inches of cake, how many cans of frosting will be needed for each cake?
   d. If the height of each layer of cake is 5 inches, what does the radius of the cylindrical cake need to be, so the same amount of frosting is used for both cakes? Explain your reasoning.
32. **CHANGING UNITS** A gift box has a surface area of 6.25 square feet. What is the surface area of the box in square inches?

33. **CHANGING UNITS** A square pyramid has a volume of 4320 cubic inches. What is the volume of this pyramid in cubic feet?

34. **EULER’S FORMULA** The number of faces \( F \), vertices \( V \), and edges \( E \) of a polyhedron are related by Euler’s (OY luhrz) Formula: \( F + V = E + 2 \). Determine whether Euler’s Formula is true for each of the figures in Exercises 18–23.

35. **CHANGING DIMENSIONS** A rectangular prism has a length of 12 centimeters, width of 18 centimeters, and height of 22 centimeters. Describe the effect on the volume of a rectangular prism when each dimension is doubled.

36. **MULTIPLE REPRESENTATIONS** In this problem, you will investigate how changing the length of the radius of a cone affects the cone’s volume.
   a. **TABULAR** Create a table showing the volume of a cone when doubling the radius. Use radius values between 1 and 8.
   b. **GRAPHICAL** Use the values from your table to create a graph of radius versus volume.
   c. **VERBAL** Make a conjecture about the effect of doubling the radius of a cone on the volume. Explain your reasoning.
   d. **ALGEBRAIC** If \( r \) is the radius of a cone, write an expression showing the effect doubling the radius has on the cone’s volume.

37. **FIND THE ERROR** Alex and Emily are calculating the surface area of the rectangular prism shown. Is either of them correct? Explain your reasoning.

38. **REASONING** Is a cube a regular polyhedron? Explain.

39. **CHALLENGE** Describe the solid that results if the number of sides of each base increases infinitely. The bases of each solid are regular polygons inscribed in a circle.
   a. pyramid
   b. prism

40. **OPEN ENDED** Draw an irregular 14-sided polyhedron in which all of the sides are congruent and all of the angles are congruent.

41. **CHALLENGE** Find the volume of a cube that has a total surface area of 54 square millimeters.
42. **WRITING IN MATH** Write a description of a prism in your school or home that another person could use to recreate the prism. Explain your reasoning for choosing each characteristic in your description.

43. **GRIDDED RESPONSE** What is the surface area of the triangular prism in square centimeters?

![Image of a triangular prism with dimensions 3 cm, 4 cm, and 3.6 cm]

44. **ALGEBRA** What is the value of \((-0.8)^2 + (-0.3)^3\)?
   
   A 0.613  
   B 0.627  
   C 0.370  
   D 0.327

45. The length of each side of a cube is multiplied by 5. What is the change in the volume of the cube?
   
   F The volume is 125 times the original volume.  
   G The volume is 25 times the original volume.  
   H The volume is 10 times the original volume.  
   J The volume is 5 times the original volume.

46. **SAT/ACT** What is the difference in surface area between a cube with an edge length of 7 inches and a cube with edge length of 4 inches?
   
   A 33 in\(^2\)  
   B 66 in\(^2\)  
   C 99 in\(^2\)  
   D 198 in\(^2\)

   Name each polygon by its number of sides. Then classify it as **convex** or **concave** and **regular** or **irregular**.

47. ![Polygon with 4 sides]

48. ![Polygon with 5 sides]

49. ![Polygon with 8 sides]

   Find the value of each variable.
50. \[ 5x^\circ \quad (x - 6)^\circ \]

51. \[ (12x + 7)^\circ \quad (14x - 13)^\circ \]

52. \[ (8x + 6)^\circ \quad (17x - 2)^\circ \]

GAMES What type of geometric intersection is modeled in each photograph?

53. [Image of a dartboard]

Sketch the next two figures in each pattern.

56. [Images of triangles, squares, pentagons, and hexagons]

57. [Images of dots forming patterns]
58.

59.

Extend 1-7 Geometry Lab: Orthographic Drawings and Nets
- Model and Analyze

Model and Analyze

1. Make a model of a figure given the orthographic drawing. Then find the volume of the model.

2. Make a model of a figure given the net. Then find the surface area of the model.

Study Guide and Review - Vocabulary Check - Chapter 1

Fill in the blank in each sentence with the vocabulary term that best completes the sentence.

1. A _____ is a flat surface made up of points that extends infinitely in all directions.

2. A set of points that all lie on the same line are said to be _____.

3. If two lines intersect to form four right angles, the lines are called _____.

4. If the sum of the measures of two angles is 180, then the angles are called _____ angles.
Study Guide and Review - Lesson-by-Lesson Review - Chapter 1

Use the figure to complete each of the following.

5. Name the intersection of lines \(a\) and \(c\).

6. Give another name for line \(b\).

7. Name a point that is not contained in any of the three lines \(a\), \(b\), or \(c\).
8. Give another name for plane $WPX$.

Name the geometric term that is best modeled by each item.

9. 

10. 

Find the value of the variable and $XP$, if $X$ is between $P$ and $Q$.

11. $XQ = 13$, $XP = 5x - 3$, $PQ = 40$

12. $XQ = 3k$, $XP = 7k - 2$, $PQ = 6k + 16$

Determine whether each pair of segments is congruent.

13. $\overline{AB}, \overline{CD}$

14. $\overline{XY}, \overline{YZ}$

15. DISTANCE The distance from Salvador’s job to his house is 3 times greater than the distance from his house to school. If his house is between his job and school and the distance from his job to school is 6 miles, how far is it from Salvador’s house to school?

Find the distance between each pair of points.

16. $A(-3, 1)$, $B(7, 13)$

17. $P(2, -1)$, $Q(10, -7)$

Find the coordinates of the midpoint of a segment with the given endpoints.
Name:

18. \( L(-3, 16), M(17, 4) \)

19. \( C(32, -1), D(0, -12) \)

Find the coordinates of the missing endpoint if \( M \) is the midpoint of \( XY \).

20. \( X(-11, -6), M(15, 4) \)

21. \( M(-4, 8), Y(19, 0) \)

22. **HIKING** Carol and Marita are hiking in a state park and decide to take separate trails. The map of the park is set up on a coordinate grid. Carol’s location is at the point \( (7, 13) \) and Marita is at \( (3, 5) \).
   a. Find the distance between them.
   b. Find the coordinates of the point midway between their locations.

For Exercises 23–26, refer to the figure below.

![Figure](image)

23. Name the vertex of \( \angle 7 \).

24. Write another name for \( \angle 4 \).

25. Name the sides of \( \angle 2 \).

26. Name a pair of opposite rays.

27. **SIGNS** A sign at West High School has the shape shown. Measure each of the angles and classify them as right, acute, or obtuse.

![Figure](image)

For Exercises 28–30, refer to the figure below.

28. Name an angle supplementary to \( \angle TVY \).
29. Name a pair of vertical angles with vertex $W$.

30. If $m \angle SXW = 5x - 16$, find the value of $x$ so that $\overline{SX} \perp \overline{WY}$.

31. PARKING The parking arm shown below rests in a horizontal position and opens to a vertical position. After the arm has moved $24^\circ$, how many more degrees does it have to move so that it is vertical?

Name each polygon by its number of sides. Then classify it as convex or concave and regular or irregular.

32.

33.

34. Find the perimeter of quadrilateral $ABCD$ with vertices $A(-3, 5), B(0, 5), C(2, 0)$, and $D(-5, 0)$.

35. PARKS Westside Park received 440 feet of chain-link fencing as a donation to build an enclosed play area for dogs. The park administrators need to decide what shape the area should have. They have three options: (1) a rectangle with length of 100 feet and width of 120 feet, (2) a square with sides of length 110 feet, or (3) a circle with radius of approximately 70 feet. Find the areas of all three enclosures and determine which would provide the largest area for the dogs.

Identify each solid. Name the bases, faces, edges, and vertices.

36.

37.

Find the surface area and volume of each solid.
42. **BUILDING** Chris is building a trunk like the one shown below. His design is a square prism. What is the volume of the trunk?

43. **HOCKEY** A regulation hockey puck is a cylinder made of vulcanized rubber 1 inch thick and 3 inches in diameter. Find the surface area and volume of a hockey puck.
Chapter 1 - Tools of Geometry - Practice Test - Chapter 1

Use the figure to name each of the following.

1. the line that contains points $Q$ and $Z$

2. two points that are coplanar with points $W, X,$ and $Y$

3. the intersection of lines $a$ and $b$

Find the value of the variable if $P$ is between $J$ and $K$.

4. $JP = 2x$, $PK = 7x$, $JK = 27$

5. $JP = 3y + 1$, $PK = 12y - 4$, $JK = 75$

6. $JP = 8z - 17$, $PK = 5z + 37$, $JK = 17z - 4$

Find the coordinates of the midpoint of a segment with the given endpoints.

7. $(16, 5)$ and $(28, -13)$

8. $(-11, 34)$ and $(47, 0)$

9. $(-4, -14)$ and $(-22, 9)$

Find the distance between each pair of points.

10. $(43, -15)$ and $(29, -3)$

11. $(21, 5)$ and $(28, -1)$

12. $(0, -5)$ and $(18, -10)$

13. **ALGEBRA** The measure of $\angle X$ is 18 more than three times the measure of its complement. Find the measure of $\angle X$. 
Name:

14. Find the value of $x$ that will make lines $a$ and $b$ perpendicular in the figure below.

For Exercises 15–18, use the figure below.

15. Name the vertex of $\angle 3$.

16. Name the sides of $\angle 1$.

17. Write another name for $\angle 6$.

18. Name a pair of angles that share exactly one point.

19. **MULTIPLE CHOICE** If $m\angle 1 = m\angle 2$, which of the following statements is true?

   A $\angle 2 \cong \angle 4$
   B $\angle 2$ is a right angle.
   C $\ell \perp m$
   D All of the above

   Find the perimeter of each polygon.

20. triangle $XYZ$ with vertices $X(3, 7)$, $Y(-1, -5)$, and $Z(6, -4)$

21. rectangle $PQRS$ with vertices $P(0, 0)$, $Q(0, 7)$, $R(12, 7)$, and $S(12, 0)$

22. **SAFETY** A severe weather siren in a local city can be heard within a radius of 1.3 miles. If the mayor of the city wants a new siren that will cover double the area of the old siren, what should the radius of the new siren be? Round to the nearest tenth of a mile.
Refer to the figure at the right.

23. Name the base.

24. Find the surface area.

25. Find the volume.

Chapter 1 - Tools of Geometry - Preparing for Standardized Tests - Chapter 1

Read each question. Then fill in the correct answer on the answer document provided by your teacher or on a sheet of paper.

1. What is the interior angle measure of a regular pentagon?

   A 60°
   B 108°
   C 120°
   D 180°

2. What is the value of $x$ in the figure at the right?

   F 10
   G 12
   H 14
   J 15
Chapter 1 - Tools of Geometry - Standardized Test Practice
- Cumulative, Chapter 1

Read each question. Then fill in the correct answer on the answer document provided by your teacher or on a sheet of paper.

1. If the dimensions of the prism below were doubled, by what factor would the volume of the prism increase?

   ![](image)

   A 2  
   B 4  
   C 8  
   D 16

2. Find the distance between $M(-3,1)$ and $N(2,8)$ on a coordinate plane.

   F 6.1 units  
   G 6.9 units  
   H 7.3 units  
   J 8.6 units
Name:

3. Which of the following terms best describes points $F$, $G$, and $H$?

A collinear  
B congruent  
C coplanar  
D skew

4. What is the length of segment $BD$?

F 17.4 m  
G 18.3 m  
H 18.8 m  
J 19.1 m

5. In the figure below, what is the measure of angle $CDN$?

A $58^\circ$  
B $62^\circ$  
C $68^\circ$  
D $70^\circ$

6. Find the perimeter of the figure below.

F 20 cm  
G 29 cm  
H 32 cm  
J 41 cm
Name:

7. What is the relationship of $\angle 1$ and $\angle 2$?

A complementary  
B linear pair  
C supplementary angles  
D vertical angles

Record your answers on the answer sheet provided by your teacher or on a sheet of paper.

8. Find the distance between points $R$ and $S$ on the coordinate grid below. Round to the nearest tenth.

9. Sylvester found the length of his parents’ driveway to be 38.5 feet. Find the precision for this measurement and explain its meaning.

10. Suppose two lines intersect in a plane.
   a. What do you know about the two pairs of vertical angles formed?
   b. What do you know about the pairs of adjacent angles formed?

11. GRIDDED RESPONSE  How many planes are shown in the figure below?

12. GRIDDED RESPONSE  What is the total surface area of the cone? Round your answer to the nearest square centimeter.
13. **GRIDDED RESPONSE**  What is the value of $x$ in the figure?

**Record your answers on a sheet of paper. Show your work.**

14. Julie’s room has the dimensions shown below.

   ![Diagram of a rectangle with dimensions 18 ft by 11 ft]

   a. Find the perimeter of her room.
   b. Find the area of her room.
   c. If the length and the width doubled, what effect would it have on the perimeter?
   d. What effect would it have on the area?