GEOMETRY
UNIT 1
WORKBOOK

CHAPTER 1
Tools of Geometry
For numbers 1 – 3, solve each equation.

1. \(8x - 2 = -9 + 7x\)
2. \(12 = -4(-6x - 3)\)
3. \(-5(1 - 5x) + 5(-8x - 2) = -4x - 8x\)

For numbers 4 – 6, simplify each expression by multiplying.

4. \(2x(-2x - 3)\)
5. \((8p - 2)(6p + 2)\)
6. \((n^2 + 6n - 4)(2n - 4)\)

For numbers 7 – 9, factor each expression.

7. \(b^2 + 8b + 7\)
8. \(b^2 + 16b + 64\)
9. \(2n^2 + 5n + 2\)

For numbers 10 – 14, solve each equation.

10. \(9n^2 + 10 = 91\)
11. \((k + 1)(k - 5) = 0\)
12. \(n^2 + 7n + 15 = 5\)
13. \(n^2 - 10n + 22 = -2\)
14. \(2m^2 - 7m - 13 = -10\)

For numbers 15 – 18, simplify each radical.

15. \(\sqrt{72}\)
16. \(\sqrt{80}\)
17. \(\sqrt{32}\)
18. \(\sqrt{90}\)
Undefined terms: words that are not formally defined, such as, point, line, and plane.

Collinear Points: points that lie on the same line.  

A and B are collinear points.

Coplanar Points: points that lie on the same plane.  

J, K, and L are coplanar points.

Example 1:  

a) Use the figure to name a line containing point K.

b) Use the figure to name a plane containing point L.

Example 2: Name the geometric shape modeled by a 10 \times 12 patio.
Example 3: Name the geometric shape modeled by a button on a table.

Two or more geometric figures **intersect** if they have one or more points in common.

The **intersection** of the figures is the set of points the figures have in common.

Example 4: Draw and label a figure for the following situation. Plane $R$ contains lines $AB$ and $DE$, which intersect at point $P$. Add point $C$ on plane $R$ so that it is not collinear with $\overline{AB}$ or $\overline{DE}$.

Example 5: Draw and label a figure for the following situation. $\overline{QR}$ on a coordinate plane contains $Q(-2, 4)$ and $R(4, -4)$. Add point $T$ so that $T$ is collinear with these points.

**Definitions** or **defined terms** are explained using undefined terms and / or other defined terms. **Space** is defined as a boundless, three dimensional set of all points. Space can contain lines and planes.

Example 6:

a) How many planes appear in this figure?

b) Name three points that are collinear.

c) Are points $A$, $B$, $C$, and $D$ coplanar? Explain.

d) At what point do $\overline{DB}$ and $\overline{CA}$ intersect?
Geometry
Section 1.1 Worksheet

For numbers 1 – 3, refer to the figure.

1. Name a line that contains points $T$ and $P$.

2. Name a line that intersects the plane containing points $Q$, $N$, and $P$.

3. Name the plane that contains $TN$ and $QR$.

For numbers 4 and 5, draw and label a figure for each relationship.

4. $\overline{AK}$ and $\overline{CG}$ intersect at point $M$.

5. A line contains $L(-4, -4)$ and $M(2, 3)$. Line $q$ is in the same coordinate plane but does not intersect $\overline{LM}$. Line $q$ contains point $N$.

For numbers 6 – 8, refer to the figure.

6. How many planes are shown in the figure?

7. Name three collinear points.


**VISUALIZATION** For numbers 9 – 13, name the geometric term(s) modeled by each object.

9. a car antenna

10. tip of pin

11. strings

12. a library card
14. The map shows some of the roads in downtown Little Rock. Lines are used to represent streets and points are used to represent intersections. Four of the street intersections are labeled. What street corresponds to line $AB$?

15. Marsha plans to fly herself from Gainsville to Miami. She wants to model her flight path using a straight line connecting the two cities on the map. Sketch her flight path on the map shown below.

16. Nathan’s mother wants him to go to the post office and the supermarket. She tells him that the post office, the supermarket and their home are collinear, and the post office is between the supermarket and their home. Make a map showing the three locations based on this information.

17. An architect models the floor, walls, and ceiling of a building with planes. To locate one of the planes that will represent a wall, the architect starts by marking off two points in the plane that represents the floor. What further information can the architect give to specify the plane that will represent the wall?

18. Mr. Riley gave his students some rods to represent lines and some clay to show points of intersection. Below is the figure Lynn constructed with all of the points of intersection and some of the lines labeled.

a) What is the intersection of lines $k$ and $n$?

b) Name the lines that intersect at point $C$.

c) Are there 3 points that are collinear and coplanar? If so, name them.
Geometry
Section 1.2 Notes: Linear Measure

Unlike a line, a line segment, or segment, can be measured because it has two endpoints.

A segment with endpoints $A$ and $B$ can be named as $\overline{AB}$ and is written as $AB$.

Example 1:

a) Find the length of $\overline{AB}$ using the ruler.

b) Find the length of $\overline{AB}$ using the ruler.

Example 2:

a) Find the length of $\overline{DE}$.

b) Find the length of $\overline{FG}$.

Recall that for any two real numbers $a$ and $b$, there is a real number $n$ that is between $a$ and $b$ such that $a < n < b$. This relationship also applies to points on a line and is called betweeness of points.

Key Concept  Betweenness of Points

<table>
<thead>
<tr>
<th>Words</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Point $M$ is between points $P$ and $Q$ if and only if $P$, $Q$, and $M$ are collinear and $PM + MQ = PQ$.</td>
<td></td>
</tr>
</tbody>
</table>
Example 3: Find \( XZ \). Assume that the figure is not drawn to scale.

\[ X \quad 4\frac{5}{8} \text{ in.} \quad Y \quad 2\frac{1}{2} \text{ in.} \quad Z \]

Example 4: Find \( LM \). Assume that the figure is not drawn to scale.

Example 5: Find the value of \( x \) and \( ST \) if \( T \) is between \( S \) and \( U \), \( ST = 7x \), \( SU = 45 \), and \( TU = 5x - 3 \).

Example 6: The Arial font is often used because it is easy to read. Study the word \textit{time} shown in Arial type. Each letter can be broken into individual segments. The letter T has two segments, a short horizontal segment, and a longer vertical segment. Assume that all segments overlap where they meet. Which segments are congruent?

\textbf{TIME}
Geometry

Section 1.2 Worksheet

For numbers 1 and 2, find the length of each line segment or object.

1. \[ E \quad F \]
   \[ \text{in.} \]
   \[ 1 \quad 2 \]

2. \[ \text{cm} \]
   \[ 1 \quad 2 \quad 3 \quad 4 \quad 5 \]

For numbers 3 – 5, find the measurement of each segment. Assume that each figure is not drawn to scale.

3. \[ \overline{PS} \]
   \[ P \quad Q \quad S \]
   \[ 18.4 \text{ cm} \quad 4.7 \text{ cm} \]

4. \[ \overline{AD} \]
   \[ A \quad C \quad D \]
   \[ 2\frac{3}{8} \text{ in.} \quad 1\frac{1}{4} \text{ in.} \]

5. \[ \overline{WX} \]
   \[ W \quad X \quad Y \]
   \[ 89.6 \text{ cm} \]
   \[ 100 \text{ cm} \]

For numbers 6 and 7, find the value of \( x \) and \( KL \) if \( K \) is between \( J \) and \( L \).

6. \( JK = 6x, KL = 3x, \) and \( JL = 27 \)

7. \( JK = 2x, KL = x + 2, \) and \( JL = 5x – 10 \)

For numbers 8 – 10, determine whether each pair of segments is congruent.

8. \( \overline{TU}, \overline{SW} \)

9. \( \overline{AD}, \overline{BC} \)

10. \( \overline{GF}, \overline{FE} \)

11. Jorge used the figure at the right to make a pattern for a mosaic he plans to inlay on a tabletop. Name all of the congruent segments in the figure.

12. Vera is measuring the size of a small hexagonal silver box that she owns. She places a standard 12 inch ruler alongside the box. About how long is one of the sides of the box?
13. Marshall lives 2300 yards from school and 1500 yards from the pharmacy. The school, pharmacy, and his home are all collinear, as shown in the figure. What is the total distance from the pharmacy to the school?

14. A hiking trail is 20 kilometers long. Park organizers want to build 5 rest stops for hikers with one on each end of the trail and the other 3 spaced evenly between. How much distance will separate successive rest stops?

15. A straight railroad track is being built to connect two cities. The measured distance of the track between the two cities is 160.5 miles. A mailstop is 28.5 miles from the first city. How far is the mailstop from the second city?

16. Lucy’s younger brother has three wooden cylinders. They have heights 8 inches, 4 inches, and 6 inches and can be stacked one on top of the other.

a) If all three cylinders are stacked one on top of the other, how high will the resulting column be? Does it matter in what order the cylinders are stacked?

b) What are all the possible heights of columns that can be built by stacking some or all of these cylinders?
The distance between two points is the length of the segment with those points as its endpoints.

**KeyConcept** Distance Formula (on Number Line)

Words: The distance between two points is the absolute value of the difference between their coordinates.

Symbols: If \( P \) has coordinate \( x_1 \) and \( Q \) has coordinate \( x_2 \), \( PQ = |x_2 - x_1| \) or \( |x_1 - x_2| \).

Example 1: Use the number line to find \( QR \).

To find the distance between two points \( A \) and \( B \) in the coordinate plane, you can form a right triangle with \( AB \) as its hypotenuse and point \( C \) as its vertex as shown. The use the Pythagorean Theorem to find \( AB \).

**KeyConcept** Distance Formula (in Coordinate Plane)

If \( P \) has coordinates \((x_1, y_1)\) and \( Q \) has coordinates \((x_2, y_2)\), then

\[
PQ = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}.
\]

Since the formula for finding the distance between two points involves taking the square root of a real number, distances can be irrational. An *irrational number* is a number that cannot be expressed as a terminating or repeating decimal.

Example 2: Find the distance between \( E(-4, 1) \) and \( F(3, -1) \).
The midpoint of a segment is the point halfway between the endpoints of the segment. If \( X \) is the midpoint of \( AB \), then \( AX = XB \) and \( AX \parallel XB \). You can find the midpoint of a segment on a number line by finding the mean, or the average of the coordinates of its endpoints.

**Example 3:** Marco places a couch so that its end is perpendicular and 2.5 feet away from the wall. The couch is 90” wide. How far is the midpoint of the couch back from the wall in feet?

**Example 4:** Find the coordinates of \( M \), the midpoint of \( GH \), for \( G(8, -6) \), and \( H(-14, 12) \).

**Example 5:** Find the coordinates of \( D \) if \( E(-6, 4) \) is the midpoint of \( DF \) and \( F \) has coordinates \((-5, -3)\).

**Example 6:** What is the measure of \( PR \) if \( Q \) is the midpoint of \( PR \)?
Any segment, line, or plane that intersects a segment is called a **segment bisector**.

In the figure at the right, $M$ is the midpoint of $PQ$. Plane $A$, $MJ$, $KM$, and point $M$ are all bisectors of $PQ$. 
Geometry
Section 1.3 Worksheet

For numbers 1 – 4, use the number line to find each measure.

1. $VW$
2. $TV$
3. $ST$
4. $SV$

For numbers 5 – 9, find the distance between each pair of points.

5. $L(-7, 0), Y(5, 9)$
6. $U(1, 3), B(4, 6)$
7. $V(-2, 5), M(0, -4)$
8. $C(-2, -1), K(8, 3)$

For numbers 11 – 14, use the number line to find the coordinate of the midpoint of each segment.

11. $RT$
12. $QR$
13. $ST$
14. $PR$

For numbers 15 and 16, find the coordinates of the midpoint of a segment with the given endpoints.

15. $K(-9, 3), H(5, 7)$
16. $W(-12, -7), T(-8, -4)$

For numbers 17 – 19, find the coordinates of the missing endpoint if $E$ is the midpoint of $DF$.

17. $F(5, 8), E(4, 3)$
18. $F(2, 9), E(-1, 6)$
19. $D(-3, -8), E(1, -2)$
20. The coordinates of the vertices of a quadrilateral are \(R(-1, 3), S(3, 3), T(5, -1),\) and \(U(-2, -1)\). Find the perimeter of the quadrilateral. Round to the nearest tenth.

21. Troop 175 is designing their new campground by first mapping everything on a coordinate grid. They have found a location for the mess hall and for their cabins. They want the bathrooms to be halfway between these two. What will be the coordinates of the location of the bathrooms?

22. Calvin’s home is located at the midpoint between Fast Pizza and Pizza Now. Fast Pizza is a quarter mile away from Calvin’s home. How far away is Pizza Now from Calvin’s home? How far apart are the two pizzerias?

23. Caroline traces out the spiral shown in the figure. The spiral begins at the origin. What is the shortest distance between Caroline’s starting point and her ending point?

24. The United States Capitol is located 800 meters south and 2300 meters to the east of the White House. If the locations were placed on a coordinate grid, the White House would be at the origin. What is the distance between the Capitol and the White House? Round your answer to the nearest meter.

25. Ben and Kate are making a map of their neighborhood on a piece of graph paper. They decide to make one unit on the graph paper correspond to 100 yards. First, they put their homes on the map as shown below.

a) How many yards apart are Kate’s and Ben’s homes?

b) Their friend Jason lives exactly halfway between Ben and Kate. Mark the location of Jason’s home on the map.
Geometry
Section 1.4 Notes: Angle Measure

A **ray** is a part of a line. It has one endpoint and extends indefinitely in one direction.

Rays are named by stating the endpoint first and then any other point on the ray.

If you choose a point on a line, that point determines exactly two rays called **opposite rays**.

An **angle** is formed by two **noncollinear** rays that have a common endpoint. The rays are called **sides** of the angle. The common endpoint is the **vertex**.

An angle divides a plane into three distinct parts.

* Points $Q$, $M$, and $N$ lie on the angle.
* Points $S$ and $R$ lie on the **interior** of the angle.
* Points $P$ and $O$ lie on the **exterior** of the angle.

**Example 1:**

a) Name all angles that have $B$ as a vertex.

b) Name the sides of $\angle 5$.

c) Write another name for $\angle 6$. 
Angles are measured in units called degrees. The **degree** results from dividing the distance around a circle into 360 parts.

Angles can be classified by their measures.

**Key Concept: Classify Angles**

<table>
<thead>
<tr>
<th>Right Angle</th>
<th>Acute Angle</th>
<th>Obtuse Angle</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Right Angle" /></td>
<td><img src="image2" alt="Acute Angle" /></td>
<td><img src="image3" alt="Obtuse Angle" /></td>
</tr>
</tbody>
</table>

- **Right Angle**: $m\angle A = 90$
- **Acute Angle**: $m\angle B < 90$
- **Obtuse Angle**: $180 > m\angle C > 90$

**Example 2:**

a) Measure $\angle TYV$ and classify it as **right**, **acute**, or **obtuse**.
b) Measure $\angle WYT$ and classify it as right, acute, or obtuse.

c) Measure $\angle TYU$ and classify it as right, acute, or obtuse.

Just as segments that have the same measure are congruent segments, angles that have the same measure are congruent angles.

In the figure, since $m\angle ABC = m\angle FED$, then $\angle ABC \cong \angle FED$. Matching numbers of arcs on a figure also indicate congruent angles, so $\angle CBE \cong \angle DEB$.

A ray that divides an angle into two congruent angles is called an angle bisector. If $\overline{YW}$ is the angle bisector of $\angle XYZ$, then the point $W$ lies in the interior of $\angle XYZ$ and $\angle XYW \cong \angle WYZ$. 
Example 3: Wall stickers of standard shapes are often used to provide a stimulating environment for a young child’s room. A five-pointed star sticker is shown with vertices labeled. Find $m\angle GBH$ and $m\angle HCI$ if $\angle GBH \cong \angle HCI$, $m\angle GBH = (2x + 5)^\circ$, and $m\angle HCI = (3x - 10)^\circ$. 
For numbers 1 – 10, use the figure at the right.

For numbers 1 – 4, name the vertex of each angle.

1. \( \angle 5 \)  
2. \( \angle 3 \)

3. \( \angle 8 \)  
4. \( \angle NMP \)

For numbers 5 – 8, name the sides of each angle.

5. \( \angle 6 \)  
6. \( \angle 2 \)

7. \( \angle MOP \)  
8. \( \angle OMN \)

For numbers 9 and 10, write another name for each angle.

9. \( \angle QPR \)  
10. \( \angle 1 \)

For numbers 11 – 14, classify each angle as right, acute, or obtuse. Then use a protractor to measure the angle to the nearest degree.

11. \( \angle UZW \)  
12. \( \angle YZW \)

13. \( \angle TZW \)  
14. \( \angle UZT \)

For numbers 15 and 16, in the figure \( \overline{CB} \) and \( \overline{CD} \) are opposite rays, \( \overline{CE} \) bisects \( \angle DCF \), and \( \overline{CG} \) bisects \( \angle FCB \).

15. If \( m \angle DCE = (4x + 15)^\circ \) and \( m \angle ECF = (6x - 5)^\circ \), find \( m \angle DCE \).

16. If \( m \angle FCG = (9x + 3)^\circ \) and \( m \angle GCB = (13x - 9)^\circ \), find \( m \angle GCB \).

17. The diagram shows a sign used to warn drivers of a school zone or crossing. Measure and classify each numbered angle.
18. Lina learned about types of angles in geometry class. As she was walking home she looked at the letters on a street sign and noticed how many are made up of angles. The sign she looked at was KLINE ST. Which letter(s) on the sign have an obtuse angle? What other letters in the alphabet have an obtuse angle?

19. A square has four right angle corners. Give an example of another shape that has four right angle corners.

20. Melinda wants to know the angle of elevation of a star above the horizon. Based on the figure, what is the angle of elevation? Is this angle an acute, right, or obtuse angle?

21. Nick has a slice of cake. He wants to cut it in half, bisecting the 46° angle formed by the straight edges of the slice. What will be the measure of the angle of each of the resulting pieces?

22. Central Street runs north-south and Spring Street runs east-west.
   a) What kind of angle do Central Street and Spring Street make?
   b) Valerie is driving down Spring Street heading east. She takes a left onto River Street. What type of angle did she have to turn her car through?
   c) What is the angle measure Valerie is turning her car when she takes the left turn?
### Geometry

#### Section 1.5 Notes: Angle Relationships

**Key Concept: Special Angle Pairs**

- **Adjacent angles**: Two angles that lie in the same plane and have a common vertex and a common side, but no common interior points.
  - **Examples**: $\angle 1$ and $\angle 2$ are adjacent angles.
  - **Nonexamples**: $\angle 3$ and $\angle ABC$ are nonadjacent angles.

- **A linear pair**: A pair of adjacent angles with noncommon sides that are opposite rays.
  - **Example**: $\angle 1$ and $\angle 2$
  - **Nonexample**: $\angle ADB$ and $\angle ADC$

- **Vertical angles**: Two nonadjacent angles formed by two intersecting lines.
  - **Examples**: $\angle 1$ and $\angle 2$; $\angle 3$ and $\angle 4$
  - **Nonexample**: $\angle AEB$ and $\angle DEC$

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**Example 1:**

a) Name an angle pair that satisfies the condition *two angles that form a linear pair*.

b) Name an angle pair that satisfies the condition *two acute vertical angles*.
Example 2: Find the measures of two supplementary angles if the measure of one angle is 6 less than five times the measure of the other angle.
Example 3: Find $x$ and $y$ so that $\overrightarrow{KO}$ and $\overrightarrow{HM}$ are perpendicular.

Example 4: Determine whether the following statement can be justified from the figure below. Explain.

a) $m\angle VYT = 90^\circ$

b) $\angle TYW$ and $\angle TYU$ are supplementary.

c) $\angle VYW$ and $\angle TYS$ are adjacent angles.
Geometry  
Section 1.5 Worksheet

For numbers 1 – 4, name an angle or angle pair that satisfies each condition.

1. Name two obtuse vertical angles.

2. Name a linear pair with vertex $B$.

3. Name an angle not adjacent to, but complementary to $\angle FGC$.

4. Name an angle adjacent and supplementary to $\angle DCB$.

5. Two angles are complementary. The measure of one angle is 21 more than twice the measure of the other angle. Find the measures of the angles.

6. If a supplement of an angle has a measure 78 less than the measure of the angle, what are the measures of the angles?

For numbers 7 and 8, use the figure at the right.

7. If $m\angle FGE = (5x + 10)\degree$, find the value of $x$ so that $\overline{FC} \perp \overline{AE}$.

8. If $m\angle BGC = (16x - 4)\degree$ and $m\angle CGD = (2x + 13)\degree$, find the value of $x$ so that $\angle BGD$ is a right angle.

For numbers 9 – 11, determine whether each statement can be assumed from the figure. Explain.

9. $\angle NQO$ and $\angle OQP$ are complementary.

10. $\angle SRQ$ and $\angle QRP$ is a linear pair.

11. $\angle MQN$ and $\angle MQR$ are vertical angles.

12. Darren sketched a map of the cross streets nearest to his home for his friend Miguel. Describe two different angle relationships between the streets.
13. A sign painter is painting a large “X”. What are the measures of angles 1, 2, and 3?

14. Matthew cuts a straight line segment through a rectangular sheet of paper. His cut goes right through a corner. How are the two angles formed at that corner related?

15. Ralph has sliced a pizza using straight line cuts through the center of the pizza. The slices are not exactly the same size. Ralph notices that two adjacent slices are complementary. If one of the slices has a measure of $2x^\circ$, and the other a measure of $3x^\circ$, what is the measure of each angle?

16. Carlo dropped a piece of stained glass and the glass shattered. He picked up the piece shown on the left. He wanted to find the piece that was adjoining on the right. What should the measurement of the angle marked with a question mark be? How is that angle related to the angle marked 106°?

17. A rectangular plaza has a walking path along its perimeter in addition to two paths that cut across the plaza as shown in the figure.

a) Find the measure of $\angle 1$.

b) Find the measure of $\angle 4$.

c) Name a pair of vertical angles in the figure. What is the measure of $\angle 2$?
Geometry
Section 1.6 Notes: Two-Dimensional Figures

**KeyConcept Polygons**

A **polygon** is a closed figure formed by a finite number of coplanar segments called **sides** such that

- the sides that have a common endpoint are noncollinear, and
- each side intersects exactly two other sides, but only at their endpoints.

The vertex of each angle is a **vertex of the polygon**. A polygon is named by the letters of its vertices, written in order of consecutive vertices.

The chart below gives you some additional figures that are polygons and some examples of figures that are not polygons.

<table>
<thead>
<tr>
<th>Polygons</th>
<th>Not Polygons</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Polygon Examples" /></td>
<td><img src="image2.png" alt="Not Polygon Examples" /></td>
</tr>
</tbody>
</table>

Polygons can be **concave** or **convex**. Suppose the line containing each side is drawn. If any of the lines contain any point in the interior of the polygon, then it is concave. Otherwise it is convex.

![Convex and Concave Polygons](image3.png)

Polygons are generally classified by its number of sides. The table below lists some common names for various categories of polygons. A polygon with \( n \) sides is an **\( n \)-gon**.

<table>
<thead>
<tr>
<th>Number of Sides</th>
<th>Polygon</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Triangle</td>
</tr>
<tr>
<td>4</td>
<td>Quadrilateral</td>
</tr>
<tr>
<td>5</td>
<td>Pentagon</td>
</tr>
<tr>
<td>6</td>
<td>Hexagon</td>
</tr>
<tr>
<td>7</td>
<td>Heptagon</td>
</tr>
<tr>
<td>8</td>
<td>Octagon</td>
</tr>
<tr>
<td>9</td>
<td>Nonagon</td>
</tr>
<tr>
<td>10</td>
<td>Decagon</td>
</tr>
<tr>
<td>11</td>
<td>Hendecagon</td>
</tr>
<tr>
<td>12</td>
<td>Dodecagon</td>
</tr>
<tr>
<td>( N )</td>
<td>( n )-gon</td>
</tr>
</tbody>
</table>
An **equilateral polygon** is a polygon in which all sides are congruent. An **equiangular polygon** is a polygon in which all angles are congruent.

A convex polygon that is both equilateral and equiangular is called a **regular polygon**. An **irregular polygon** is a polygon that is not regular.

Example 1: Name the polygon by its number of sides. Then classify it as convex or concave and regular or irregular.

a)

b)

The **perimeter** of a polygon is the sum of the lengths of the sides of the polygon. Some shapes have special formulas for perimeter, but are all derived from the same basic definition of perimeter.

The **circumference** of a circle is the distance around the circle.

The **area** of a figure is the number of square units needed to cover a surface.

### Key Concept: Perimeter, Circumference, and Area

<table>
<thead>
<tr>
<th>Triangle</th>
<th>Square</th>
<th>Rectangle</th>
<th>Circle</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Triangle" /></td>
<td><img src="image" alt="Square" /></td>
<td><img src="image" alt="Rectangle" /></td>
<td><img src="image" alt="Circle" /></td>
</tr>
<tr>
<td>$P = b + c + d$</td>
<td>$P = s + s + s + s$</td>
<td>$P = \ell + w + \ell + w$</td>
<td>$C = 2\pi r$ or $C = \pi d$</td>
</tr>
<tr>
<td>$A = \frac{1}{2}bh$</td>
<td>$A = s^2$</td>
<td>$A = \ell w$</td>
<td>$A = \pi r^2$</td>
</tr>
</tbody>
</table>

- $P =$ perimeter of polygon
- $A =$ area of figure
- $C =$ circumference
- $b =$ base, $h =$ height
- $\ell =$ length, $w =$ width
- $r =$ radius, $d =$ diameter
Example 2:

a) Find the perimeter and area of the figure.

b) Find the circumference and area of the figure.

Example 3: Multiple Choice: Terri has 19 feet of tape to mark an area in the classroom where the students may read. Which of these shapes has a perimeter or circumference that would use most or all of the tape?

a) square with side length of 5 feet  
b) circle with the radius of 3 feet  
c) right triangle with each leg length of 6 feet  
d) rectangle with a length of 8 feet and a width of 3 feet

Perimeter and Area on the Coordinate Plane

Example 4: Find the perimeter and area of a pentagon $ABCDE$ with $A(0, 4)$, $B(4, 0)$, $C(3, -4)$, $D(-3, -4)$, and $E(-3, 1)$. 
Example 5: Find the perimeter of quadrilateral WXYZ with W(2, 4), X(–3, 3), Y(–1, 0), and Z(3, –1).
For numbers 1 – 3, name each polygon by its number of sides and then classify it as *convex* or *concave* and *regular* or *irregular*.

1. 

2. 

3. 

For numbers 4 – 6, find the perimeter or circumference and area of each figure. Round to the nearest tenth.

4. 

5. 

6. 

For numbers 7 and 8, graph each figure with the given vertices and identify the figure. Then find the perimeter and area of the figure.

7. \(O(3, 2), P(1, 2), Q(1, -4), R(3, -4)\)

8. \(S(0, 0), T(3, -2), U(8, 0)\)

For numbers 9 and 10, use the rectangle from Number 4.

9. Suppose the length and width of the rectangle are doubled. What effect would this have on the perimeter? Justify your answer.

10. Suppose the length and width of the rectangle are doubled. What effect would this have on the area? Justify your answer.
11. Jasmine plans to sew fringe around the circular pillow shown in the diagram.

a) How many inches of fringe does she need to purchase?

b) If Jasmine doubles the radius of the pillow, what is the new area of the top of the pillow?

12. In the Uffizi gallery in Florence, Italy, there is a room filled with paintings by Bronzino called the Tribune room (La Tribuna in Italian). The floor plan of the room is shown here. What kind of polygon is the floor plan?

13. Vassia decides to jog around a city park. The park is shaped like a circle with a diameter of 300 yards. If Vassia makes one loop around the park, approximately how far has she run?

14. Around 1550, Agnolo Bronzino painted a portrait of Eleonore of Toledo and her son. The painting measures 115 centimeters by 96 centimeters. What is the area of the painting?

15. Jane takes a square piece of paper and folds it in half making a crease that connects the midpoints of two opposite sides. The original piece of paper was 8 inches on a side. What is the perimeter of the resulting rectangle?

16. Amy has a box of teriyaki sticks. They are all 15 inches long. She creates rectangles using the sticks by placing them end to end like the rectangle shown in the figure.

a) How many different rectangles can she make that use exactly 12 of the sticks? What are their dimensions?

b) What is the perimeter of each rectangle listed in part (a)?

c) Which of the rectangles in part (a) has the largest area?