Ready, Set, Go!

Ready

Topic: Geometric figures

One of the cool things about geometric figures is that our world is filled with them. For instance, my bathroom mirror is a perfect rectangle and the tiles on my floor are squares. Plus, the edges of these shapes are straight lines or line segments which are pieces of lines, since theoretically a line goes on forever.

1. Look around your world and make a list of the things you see that have a geometric shape. Here are some shapes to begin with. Think of all you can and be prepared to share your lists with the class.

<table>
<thead>
<tr>
<th>Triangle</th>
<th>Trapezoid</th>
<th>Parallelogram</th>
<th>Cube</th>
<th>Perpendicular lines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Answers will vary based on your surroundings.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Set

Topic: Linear pairs

2. Fold a piece of paper, making a smooth crease. Open the paper and examine the shape that you made. Is it a line? Will it always be a line? Justify your thinking. **It will always be a line segment since it does not curve.**

3. Look at a wall where it meets the ceiling. How would you describe the intersection of the wall and the ceiling? The intersection will be a line segment.

Imagine folding a circle exactly in half so that the fold passes through the center of the circle. This fold is called the diameter of the circle. It is a line segment with a length, but it is also a special kind of angle called a **straight angle.**

In order to "see" the angle, think of the center of the circle. That point is the vertex of the angle. Either side of the vertex is a radius of the circle. Whenever you draw 2 radii of the circle you make an angle. **When the two radii extend in exactly opposite directions and share a common endpoint (the center), they make a line or a straight angle.**

14. How many degrees do you think are in a straight angle? Use features of the diagram to justify your answer.

![Diagram of a circle with labeled parts](image)

180°

A circle has 360° and a straight angle is half of a circle, which is 180°.
If two angles share a vertex and together they make a straight angle, then the two angles are called a linear pair. (Below are 3 examples of linear pairs.)

Examples of linear pairs in real life:

- http://www.flickr.com/photos/angle_dore/6365060845
- http://www.flickr.com/photos/truthlying/3845031/sizes/

5. Draw at least 2 diagrams of a real life linear pair.

Drawings will vary depending on your surroundings.
Go
Topic: The algebra of linear pairs.

For 2 angles to be a linear pair, they must share a vertex and a side, and the sum of their measures must equal 180°.

Find the measure of the missing angle.

6. \[ \begin{align*}
120^\circ & \quad ? \\
60^\circ &
\end{align*} \]

7. \[ \begin{align*}
35^\circ & \quad ? \\
145^\circ &
\end{align*} \]

8. \[ \begin{align*}
90^\circ & \quad ? \quad 90^\circ
\end{align*} \]

9. \[ \begin{align*}
155^\circ & \quad ? \quad 25^\circ
\end{align*} \]

10. Linear pairs could be defined as being supplementary angles because they always add up to 180°. Are all supplementary angles linear pairs? Explain your answer.

Linear pairs share a vertex and ray. Supplementary angles are two angles that add up to 180°.

Find the supplement of the given angle. Then draw the two angles as linear pairs. Label each angle with its measure.

11. \( m_{\angle ABC} = 72^\circ \) B will be the vertex.

12. \( m_{\angle GHK} = 113^\circ \) H will be the vertex.

13. \( m_{\angle XYZ} = 24^\circ \) Y will be the vertex.

14. \( m_{\angle JMS} = 168^\circ \) M will be the vertex.
Set

Topic: Construction of midpoint, perpendicular bisector, and angle bisector and using "givens" to solve problems.

The figure on the right demonstrates the construction of a perpendicular bisector of a segment.

Use the diagram to guide you in constructing the perpendicular of the following line segments. Mark the right angle with the correct symbol for right angles. Indicate the segments are congruent by using slash marks.

The figure on the right demonstrates the construction of an angle bisector. Use the diagram to guide you in constructing the angle bisector of the following angles. Mark your bisected angles as congruent.
Examine the diagram and add any information that you are given. Think how you can use what you have been given and what you know to answer the question. Plan a strategy for finding the value of $x$. Follow your plan. Justify each step.

20. Given: $m \angle C = 90^\circ$

21. Given $m \angle ABC = 90^\circ$

22. Given: $\triangle BEC, \triangle CED,$ and $\triangle DAB$ are right triangles.

23. Given: $\overline{CF}$ bisects $\angle ECD$, $m \angle ECF = 2x + 10$, and $m \angle FCD = 3x - 18$. Find $m \angle FCE = 60^\circ$.

Have you answered the question?
This problem asks you to do more than find the value of $x$. 

$2x + 10 = 3x - 18$

$2x = x$

$2(2x) + 10$

$5x + 10$

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Go

Topic: Translations, reflections, and rotations

Perform the following transformations on the diagram below.

24. Label points C, E, D with the correct ordered pairs.

25. Translate ΔCED down 4 and right 6. Label the image as ΔC'E'D' and include the new ordered pairs.

26. Draw \overrightarrow{CC'}, \overrightarrow{EE'}, and \overrightarrow{DD'}. What is the slope of each of these line segments? \[ m = \frac{4}{-6} = -\frac{2}{3} \]

27. Reflect ΔCED across the x = 0 line. Label the image ΔC''E''D''. Include the new ordered pairs. Draw \overrightarrow{CC''} and \overrightarrow{EE''}. Why didn't you need to draw \overrightarrow{DD''}? It's the same point.

C''(4,0)  \quad E''(3,3)  \quad D''(0,4)

What is the relationship between \overrightarrow{CC'} and \overrightarrow{EE'} to the x = 0 line? They are perpendicular.

28. Rotate ΔCED 180° about the point (-2, 0). Label the image ΔC'''E'''D'''.
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Remember that when you write a congruence statement such as $\triangle ABC \cong \triangle FGH$, the corresponding parts of the two triangles must be the parts that are congruent. For instance, $\angle A \cong \angle F$, $AB \cong FG$, $\angle B \cong \angle G$, $BC \cong GH$. Also, recall that the congruence patterns for triangles, ASA, SAS, and SSS, are what we can use to justify triangle congruence.

The segments and angles in each problem below are corresponding parts of 2 congruent triangles. Make a sketch of the two triangles. Then write a congruence statement for each pair of triangles represented. State the congruence pattern that justifies your statement.

1. $\overline{ML} \cong \overline{JI}$, $\overline{JR} \cong \overline{JB}$, $\angle L \cong \angle J$
   - Congruence statement: $\triangle MLR \cong \triangle JIB$
   - Congruence pattern: SAS

2. $\overline{WB} \cong \overline{QR}$, $\overline{BP} \cong \overline{RS}$, $\overline{WP} \cong \overline{QS}$
   - Congruence statement: $\triangle WBP \cong \triangle QRS$
   - Congruence pattern: SSS

3. $\overline{CY} \cong \overline{RP}$, $\overline{EY} \cong \overline{BP}$, $\angle Y \cong \angle P$
   - Congruence statement: $\triangle CYE \cong \triangle RPB$
   - Congruence pattern: SAS

4. $\overline{BC} \cong \overline{JK}$, $\overline{BA} \cong \overline{JM}$, $\angle B \cong \angle J$
   - Congruence statement: $\triangle ABC \cong \triangle JKM$
   - Congruence pattern: SAS

5. $\overline{DF} \cong \overline{XZ}$, $\overline{FY} \cong \overline{ZW}$, $\angle F \cong \angle Z$
   - Congruence statement: $\triangle DFW \cong \triangle AXZ$
   - Congruence pattern: SAS

6. $\overline{WX} \cong \overline{AB}$, $\overline{XZ} \cong \overline{BC}$, $\overline{WZ} \cong \overline{AC}$
   - Congruence statement: $\triangle WXZ \cong \triangle ABC$
   - Congruence pattern: SSS
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Recall the following definitions:

**In a triangle:**
- an **altitude** is a line segment drawn from a vertex perpendicular to the opposite side (or an extension of the opposite side).

- a **median** is a line segment drawn from a vertex to the midpoint of the opposite side.

- an **angle bisector** is a line segment or ray drawn from a vertex that cuts the angle in half.

- a **perpendicular bisector of a side** is a line drawn perpendicular to a side of the triangle through its midpoint.

Be sure to use the correct notation for a segment in the following problems.

7. Name a segment in \( \triangle GHM \) that is an altitude.

\[ \overline{G H} \]

8. Name a segment in \( \triangle GHM \) that is an angle bisector.

\[ \overline{G E} \]

9. Name a segment in \( \triangle GHM \) that is NOT an altitude.

\[ \overline{E D} \]

10. Create a perpendicular bisector by marking two segments congruent in \( \triangle GHM \). Name the segment that is now the perpendicular bisector.

\[ \overline{E D} \]

**Use \( \triangle DEF \) in problems 11 – 13.**

11. Construct the altitude from vertex D to \( \overline{EF} \).

12. Construct the median from D to \( \overline{EF} \).

13. Construct the perpendicular bisector of \( \overline{EF} \).
Go

Topic: Transformations

Perform the following transformations on ΔABC. Use a straight edge to connect the corresponding points with a line segment. Answer the questions.

15. Reflect ΔABC over \( \overline{LK} \). Label your new image ΔA'B'C'.
16. What do you notice about the line segments \( \overline{AA'}, \overline{BB'}, \) and \( \overline{CC'} \)? They are parallel to each other.
17. Compare line segments \( \overline{AB}, \overline{BC}, \) and \( \overline{CA} \) to \( \overline{A'B'}, \overline{B'C'}, \) and \( \overline{C'A'} \). What is the same and what is different about these segments? The lengths are the same, but the slopes are different.
18. Translate ΔABC down 8 units and right 10 units. Label your new image ΔA''B''C''.
19. What do you notice about the line segments \( \overline{AA''}, \overline{BB''}, \) and \( \overline{CC''} \)? They are parallel to each other and the same length.
20. Compare line segments \( \overline{AB}, \overline{BC}, \) and \( \overline{CA} \) to \( \overline{A''B''}, \overline{B''C''}, \) and \( \overline{C''A''} \). What is the same and what is different about these segments? Same length and same slope, but different location.
21. Translate ΔABC down 10 units and reflect it over the Y-axis. Label your new image ΔA'''B'''C'''
22. What do you notice about the line segments \( \overline{A'A''}, \overline{B'B''}, \) and \( \overline{C'C''} \)? They cross each other.
23. Compare line segments \( \overline{AB}, \overline{BC}, \) and \( \overline{CA} \) to \( \overline{A''B''}, \overline{B''C''}, \) and \( \overline{C''A''} \). What is the same and what is different about these segments?

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Topic: Special quadrilaterals

Identify each quadrilateral as a trapezoid, parallelogram, rectangle, rhombus, square, or none of these. List ALL that apply.

1. Parallelogram
2. Rectangle
3. Trapezoid
4. Parallelogram
5. None
6. Parallelogram

7. Verify the parallel postulates below by naming the line segments in the pre-image and its image that are still parallel. Use correct mathematical notation.
   a. After a translation, corresponding line segments in an image and its pre-image are always parallel or lie along the same line.

   b. After a rotation of 180°, corresponding line segments in a pre-image and its image are parallel or lie on the same line.
c. After a reflection, line segments in the pre-image that are parallel to the line of reflection will be parallel to the corresponding line segments in the image.

**Go**

Topic: Identifying congruence patterns in triangles

For each pair of triangles write a congruence statement and justify your statement by identifying the congruence pattern you used. Then justify that the triangles are congruent by connecting corresponding vertices of the pre-image and image with line segments.

How should those line segments look?

8. \( \triangle BCD \cong \triangle GEP \)

9. \( \triangle EFG \cong \triangle LTH \)

10. \( \triangle FGH \cong \triangle MJK \)

11. \( \triangle EFG \cong \triangle HJL \)

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Topic: Properties of quadrilaterals.

1. Use what you know about triangles to write a paragraph proof that proves that the sum of the angles in a quadrilateral is $360^\circ$.

2. Find the measure of $x$ in quadrilateral $ABGC$.

   \[33x + 30 = 360\]
   \[33x = 330\]
   \[x = 10\]

Match the equation with the correct line in the graph of lines $p$, $q$, $r$, and $s$.

3. $y = \frac{3}{4}x + 2 \quad S$

4. $y = -\frac{3}{4}x + 2 \quad Q$

5. $y = \frac{3}{4}x + 4 \quad R$

6. $y = -\frac{3}{4}x + 4 \quad P$

7. Describe the shape made by the intersection of the 4 lines. List as many observations as you can about the shape and its features.

   - Rhombus
   - Diagonals are perpendicular
   - All sides are equal
   - Opposite sides are parallel
   - The top and bottom angles are equal
   - The left and right angles are equal

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Topic: Parallel lines with a transversal, vertical angles, and the exterior angle of a triangle

Label each picture as showing parallel lines with a transversal, vertical angles, or an exterior angle of a triangle. Highlight the geometric feature you identified. Can you find all 3 features in 1 picture? Where?

8. Vertical angles

9. Vertical angles

10. Exterior ∠ of Δ

11. Parallel w/ trans

vert. ∠’s

12. Vert. ∠’s

13. Vert. ∠’s

14. Parallel w/ trans

(extend parallel lines)

15. Vert. ∠’s

Parallel w/ trans

(extend lines)

16. Vert. ∠’s

(ext. of Δ)

(extend lines)
Find the value of the 2 remote interior angles in the figures below.

17. \[ 8x + 10^\circ = 100^\circ \]
   \[ x = 15 \]

18. \[ 7x + 2 = 72 \]
   \[ x = 10 \]

19. \[ 15x - 9 = 111 \]
   \[ 15x = 120 \]
   \[ x = 8 \]

Indicate whether each pair of angles is **congruent** or **supplementary** by trusting how they look. Lines \( p \) and \( q \) are parallel.

20. \( \angle 5 \) and \( \angle 8 \) **Congruent**

21. \( \angle 2 \) and \( \angle 6 \) **Congruent**

22. \( \angle 2 \) and \( \angle 8 \) **Supplementary**

23. \( \angle 4 \) and \( \angle 6 \) **Supplementary**

24. \( \angle 3 \) and \( \angle 5 \) **Supplementary**

25. \( \angle 1 \) and \( \angle 3 \) **Supplementary**

**Go**

**Topic:** Complementary and supplementary angles.

Find the complement and the supplement of the given angles. It is possible for the complement or supplement not to exist.

26. \( 37^\circ \)
   - Complement: \( 53^\circ \)
   - Supplement: \( 143^\circ \)

27. \( 59^\circ \)
   - Complement: \( 31^\circ \)
   - Supplement: \( 121^\circ \)

28. \( 89^\circ \)
   - Complement: not possible
   - Supplement: \( 90^\circ \)

29. \( 111^\circ \)
   - Complement: not possible
   - Supplement: \( 69^\circ \)

30. \( 3^\circ \)
   - Complement: \( 87^\circ \)
   - Supplement: \( 177^\circ \)

31. \( 90^\circ \)
   - Not possible
   - \( 90^\circ \)

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Topic: Sketching quadrilaterals based on specific features.

Sketch the quadrilateral by connecting the points in alphabetical order. Close the figure.

1. In both figures, the lines are perpendicular bisectors of each other.
   a. Are the quadrilaterals you sketched congruent?  \( \text{NO} \)
   b. What additional requirement(s) is/are needed to make the figures congruent? \( \overline{AC} = \overline{PR} \) \( \overline{BD} = \overline{QS} \) This would need to be true.

2. In both figures one set of opposite sides are parallel and congruent.
   a. Are the quadrilaterals you sketched congruent?  \( \text{NO} \)
   b. What additional requirement(s) is/are needed to make the figures congruent? Point \( W \) would need to be directly above Point \( Z \) and the same distance away.

3. In both figures corresponding angles are congruent. As Point \( J \) to Point \( M \),
   a. Are the quadrilaterals you sketched congruent?  \( \text{NO (similar)} \)
   b. What additional requirement(s) is/are needed to make the figures congruent? Corresponding sides would need to be the same length.

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Topic: Properties of parallelograms

4. Quadrilateral BCDE below was formed by 2 sets of intersecting parallel lines. Figure 2 is the image of figure 1. It has been rotated 180°. Find the center of rotation for figure 1. Make a list of everything that has been preserved in the rotation. Then make a list of anything that has changed. Is quadrilateral BCDE a parallelogram? How do you know?

The following theorems all concern parallelograms:
- Opposite sides of a parallelogram are congruent.
- Opposite angles of a parallelogram are congruent.
- Consecutive angles of a parallelogram are supplementary.
- The diagonals of a parallelogram bisect each other.

Give a reason from the list above that explains why it is NOT possible for each figure below to be a parallelogram. List ALL that apply.

5. 

- Opposite angles are not equal.
- Consecutive angles are not supplementary.

6. 

- Opposite sides are not equal.
Each quadrilateral below is a parallelogram. Find the values of x, y, and z.

7. \[ x = 21^\circ \quad y = 141^\circ \quad z = 18^\circ \]

8. \[ x = 55^\circ \quad y = 80^\circ \quad z = 100^\circ \]

9. \[ x = 35^\circ \quad y = 23^\circ \quad z = 77^\circ \]

Go

Topic: Using correct mathematical symbols

Rewrite the phrases below using correct mathematical symbols.

Example: Eleven plus eight is nineteen. \[ 11 + 8 = 19 \]

11. Triangle ABC is congruent to triangle GHJ.

12. Segment BV is congruent to segment PR.

13. Three feet are equal to one yard.

14. Line TR is parallel to line segment WQ.

15. Ray VP is perpendicular to segment GH.

16. Angle 3 is congruent to angle 5.

17. The distance between W and X is 7 feet.

18. The length of segment AB is equal to the length of TR.

19. The measure of angle SRT is equal to the measure of angle CDE. \[ \angle SRT = \angle CDE \]

20. Explain when it is proper to use an equal sign and when it is proper to use the congruent symbol. The equal sign is used to show measurements are the same, while the congruent signs are used to show corresponding parts have the same size and shape.
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Topic: Constructing perpendicular bisectors and angle bisectors

Use a compass and a straightedge to bisect the following line segments.

1. A __________ B

2. T __________ S

3. When we construct the bisector of a segment, we are also constructing the perpendicular bisector. Must a bisector of a segment always be a perpendicular line?

   \[ \text{\textit{NO}, it can be any angle.} \]

4. Construct the midpoint \( B \) of \( MS \).
   Then connect point \( B \) to point \( H \).

5. Construct the 3 medians of \( \triangle ABC \).

6. Construct the 3 perpendicular bisectors of \( \triangle ABC \).

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7. Construct the angle bisector of $\angle XYZ$.
8. Construct the 3 angle bisectors of $\triangle ABC$.

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Topic: Tests for parallelograms

Determine whether each quadrilateral is a parallelogram. Write YES if it is. If it is NOT a parallelogram, make a sketch of a quadrilateral that has the given features.

9. 1 pair of opposite sides is parallel and it has 2 consecutive right angles \( \text{no} \)

10. The quadrilateral has 4 right angles. \( \text{yes} \)

11. 1 pair of opposite sides is parallel and congruent \( \text{yes} \)

12. 1 pair of opposite sides is parallel. The other pair of opposite sides is congruent. \( \text{no} \)

13. Consecutive angles are supplementary. \( \text{yes} \)

14. The diagonals are perpendicular. \( \text{yes} \)

15. The flowchart on the right has the most general 4-sided polygon at the top and the most specific one at the bottom. Around each box, write in the details that make the specific quadrilateral unique.

Explain why the arrows point up instead of down.

The lower shape is also the upper shapes.

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Topic: Features of triangles and quadrilaterals

State whether each statement is true or false. If it is false, explain why or rewrite the statement to make it true.

16. If a triangle is equilateral, then the median and the altitude are the same segments. **True**

17. The perpendicular bisectors of the sides of a triangle also bisect the angles. **False**

18. Some of the angles in a triangle equal 180°. **False**

19. An altitude of a triangle may fall on the exterior of the triangle. **True**

20. The 3rd angle in a triangle is always the supplement to the sum of the other 2 angles. **True**

21. In a right triangle, the 2 acute angles are always complementary. **True**

22. All squares are also rectangles. **False**

23. A rhombus is always a square. **False**

24. If a figure is a trapezoid, then it is also a parallelogram. **False**

25. The diagonals of a rectangle bisect the angles. **False**

26. A parallelogram can have 2 obtuse angles. **True**

27. The figure made by two pair of intersecting parallel lines is always a parallelogram. **True**

28. All of the angles in a parallelogram can be congruent. **False**

29. A diagonal always divides a quadrilateral into 2 congruent triangles. **False**

30. If a quadrilateral goes through a translation, the sides of the pre-image and image will remain parallel. **True**