An $\text{a} + \text{b} + \text{c}$ because it is made of $\text{a}$ $\text{b}$ $\text{c}$ $\text{d}$ $\text{e}$ $\text{f}$ $\text{g}$ $\text{h}$ $\text{i}$ $\text{j}$ $\text{k}$ $\text{l}$ $\text{m}$ $\text{n}$ $\text{o}$ $\text{p}$ $\text{q}$ $\text{r}$ $\text{s}$ $\text{t}$ $\text{u}$ $\text{v}$ $\text{w}$ $\text{x}$ $\text{y}$ $\text{z}$ $\text{A}$ $\text{B}$ $\text{C}$ $\text{D}$ $\text{E}$ $\text{F}$ $\text{G}$ $\text{H}$ $\text{I}$ $\text{J}$ $\text{K}$ $\text{L}$ $\text{M}$ $\text{N}$ $\text{O}$ $\text{P}$ $\text{Q}$ $\text{R}$ $\text{S}$ $\text{T}$ $\text{U}$ $\text{V}$ $\text{W}$ $\text{X}$ $\text{Y}$ $\text{Z}$ $\text{0}$ $\text{1}$ $\text{2}$ $\text{3}$ $\text{4}$ $\text{5}$ $\text{6}$ $\text{7}$ $\text{8}$ $\text{9}$
Game: Cross the Ocean

**Materials**
- Graphing calculator
- Ruler
- Number cube

**Setup**
Your teacher will divide the class into pairs.

**Game Play**
Players choose points on opposite sides of the board from which to start (left or right). On your turn, choose a target point to which you would like to move, being certain that your path is straight and does not touch an “island” in the ocean. Roll the number cube to determine what calculation to make, using the point you are on and the target point to which you would like to move.

- **Roll a 1, 2, or 3:** Find the distance between the two points.
- **Roll a 4 or 5:** Find the midpoint of the segment between the two points.
- **Roll a 6:** Use your first point as one endpoint and your target point as the midpoint of a segment. You must find the other endpoint of this segment that may be on or across an island.

Do your calculations by hand. Your opponent can check your work using a graphing calculator. If you are correct, use a ruler to draw your path and “move” to the target point. Note that you always move to the point you selected, not to the midpoint or endpoint of a segment that you calculated. You may not attempt to connect two points if your opponent has already done so.

**Ending the Game**
The game ends when one player wins by securing a path from one side of the board to the other. Check students’ work.

---

**ANSWERS**

**1-5** Activity: Vertical Angles

Exploring Angle Pairs

Use geometry software to do this activity.

**Construct**
Construct lines \( \overrightarrow{AC} \) and \( \overrightarrow{BD} \). Construct point \( E \) on \( \overrightarrow{BD} \) such that \( A \) is between \( D \) and \( B \). Construct point \( F \) on \( \overrightarrow{AC} \) such that \( A \) is between \( C \) and \( E \).

**Locate**
1. a. \( \angle AEB \) and \( \angle AEC \) are adjacent angles. **Answers may vary. Sample:** \( \angle EAB \), \( \angle BAC \)
   b. There are 4 pairs of adjacent angles in the picture.
2. a. \( \angle EAB \) and \( \angle EAD \) are vertical angles.
   b. \( \angle BAC \) and \( \angle EAD \) are vertical angles.
3. a. \( \angle EAB \) and \( \angle EAD \) are a linear pair.
   b. So the measures of the angles in part (a) add to 180°.
   c. This means the angle pair in part (a) can also be called **Supplementary**.

**Investigate**
Measure all four angles. Drag points \( B \) and \( C \) and observe the effect on the angle measures. \( \angle BAC \) and \( \angle EAD \) are called vertical angles.

4. Make a conjecture about vertical angles. They are congruent.
5. Use “Calculate” to determine the sum of \( m \angle EAD \) and \( m \angle EAB \). Justify this result. \( m \angle EAD + m \angle EAB = 180^\circ \)
6. Use “Calculate” to determine the sum of \( m \angle EAC \) and \( m \angle EAB \). Justify this result. \( m \angle EAC + m \angle EAB = 180^\circ \)
7. Based on your answers to Exercises 5 and 6, what is the value of the expression \( m \angle EAC + m \angle EAD? \) Justify this result. \( m \angle EAC + m \angle EAD = 180^\circ \)
8. How does your result in Exercise 7 justify the conjecture made in Exercise 1? \( m \angle EAC = m \angle EAD \)

**Extend**
Draw two pairs of vertical angles. Construct the angle bisectors of all four angles formed. Check students’ work.

10. Make a conjecture about the angle bisectors of the two pairs of vertical angles formed by the intersection of two lines. Use the geometry software functions “Measure,” “Angle,” and “Calculate” to verify this conjecture. They are perpendicular.

11. Challenge
   Justify the result found in Exercise 10. **Answers may vary. Sample:** Adjacent angles are supplementary. The angle bisectors of these angles make a pair of angles that are complementary.

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**1-7** Game: Cross the Ocean

Midpoint and Distance in the Coordinate Plane

**Materials**
- Graphing calculator
- Ruler
- Number cube

**Setup**
Your teacher will divide the class into pairs.

**Game Play**
Players choose points on opposite sides of the board from which to start (left or right). On your turn, choose a target point to which you would like to move, being certain that your path is straight and does not touch an “island” in the ocean. Roll the number cube to determine what calculation to make, using the point you are on and the target point to which you would like to move.

- **Roll a 1, 2, or 3:** Find the distance between the two points.
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Do your calculations by hand. Your opponent can check your work using a graphing calculator. If you are correct, use a ruler to draw your path and “move” to the target point. Note that you always move to the point you selected, not to the midpoint or endpoint of a segment that you calculated. You may not attempt to connect two points if your opponent has already done so.

**Ending the Game**
The game ends when one player wins by securing a path from one side of the board to the other. Check students’ work.

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**1-6** Puzzle: Mystery Pictures

**Basic Constructions**

**Materials**
- Compass
- Straight edge

Using only a compass and straight edge, follow the directions to construct the mystery picture.

1. Find and label C, the midpoint of AB.
2. Draw \( \overrightarrow{TT} \) such that point D is above C on the perpendicular bisector of AB.
3. Draw \( \overrightarrow{TT} \) such that point E is below C on the perpendicular bisector of AB and CE = \( \frac{1}{4} \) AB.
4. Draw \( \overrightarrow{TT} \), \( \overrightarrow{WW} \), \( \overrightarrow{FF} \), and \( \overrightarrow{TT} \).
5. Starting at point E, draw a curve through the intersections of each pair of equilateral triangles.

**Constructions may vary. Sample is given.**

1. Construct \( \overrightarrow{RJ} \) such that \( m \angle RJ \equiv \angle HGF \) and \( RJ = BJ \).
2. Construct \( \overrightarrow{SK} \) such that \( m \angle SK = \frac{1}{2} m \angle HGF \) and \( SK = KL \).
3. Construct \( \overrightarrow{TM} \) such that \( m \angle TM \equiv m \angle HGF \) and TN = MN.
4. Draw an arc with radius 10 through the exterior points of \( \overrightarrow{RJ} \).
5. Draw an arc with radius LP through the exterior points of \( \overrightarrow{SK} \).
6. Draw an arc with radius NO through the exterior points of \( \overrightarrow{TM} \).

**Challenge**
Design your own mystery picture, and provide directions for its construction. Check students’ work.

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**1-8** Puzzle: Cross-Number

**Perimeter, Circumference, and Area**

Fill in the cross-number puzzle with your answers to the given clues. All answers should be rounded to the thousandths place when necessary. Each digit and decimal point of your answer goes in its own box.

<table>
<thead>
<tr>
<th>Across</th>
<th>Down</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. perimeter of a square with side length 3.6 cm</td>
<td>1. perimeter of a rectangle with dimensions 2.5 in. and 1.5 in.</td>
</tr>
<tr>
<td>2. perimeter of a triangle with side lengths of 11.9 in., 10.4 in., and 8.5 in.</td>
<td>2. perimeter of a rectangle with dimensions 3.4 in. and 10.9 m</td>
</tr>
<tr>
<td>3. area of a circle with a 12-ft diameter</td>
<td>3. area of a triangle with a base of 24.5 cm and height of 11.3 cm</td>
</tr>
<tr>
<td>4. area of a circle with a 7.5-cm radius</td>
<td>4. area of a rectangle with dimensions 3.6 m and 5.9 m</td>
</tr>
<tr>
<td>5. circumference of a circle with a 10-ft diameter</td>
<td>5. area of a square with side length 0.125 cm</td>
</tr>
<tr>
<td>6. area of a rectangle with dimensions 4.7 m and 3.9 m</td>
<td>6. area of a square with side length 8.125 cm</td>
</tr>
<tr>
<td>7. circumference of a circle with a 10-ft diameter</td>
<td>7. area of a rectangle with dimensions 8.125 cm and height of 11.3 cm</td>
</tr>
<tr>
<td>8. area of a rectangle with dimensions 8.125 m and 3.9 m</td>
<td>8. area of a square with side length 3.6 cm</td>
</tr>
</tbody>
</table>

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