Polygons with four sides are called QUADRILATERALS. There are various properties associated with specific kinds of quadrilaterals. The names of quadrilaterals studied in the book are listed below along with their properties.

Quadrilateral ABCD is a parallelogram. Opposite sides are parallel and congruent. Consecutive angles are supplementary. The diagonals bisect.

Quadrilateral KYSH is a rhombus. It is a parallelogram with four congruent sides. In addition to all the properties of a parallelogram, the diagonals are perpendicular and bisect the opposite angles.

Quadrilateral THOM is a rectangle. It is a parallelogram with four right angles. In addition to all the properties of a parallelogram, the diagonals are congruent.

If a rectangle is also a rhombus, then it is called a square. A square would have all the properties listed previously.
Two additional quadrilaterals are studied.

Quadrilateral HOEY is a **trapezoid**. It has exactly one set of parallel sides called bases. The segment connecting the midpoints of the non-parallel sides is parallel to the bases and has length equal to the average of the bases.

Quadrilateral WXYZ is a **kite**. It has one pair of opposite angles congruent and the diagonals are perpendicular.

**Example 1**

Use the information in the parallelogram at right to find \( m\angle BAD \), \( m\angle ADB \), AT, and BD.

**Solution:** \( m\angle BAD = 100^\circ \) since consecutive angles are supplementary.  
\( m\angle ADB = 80^\circ - 32^\circ = 48^\circ = 80^\circ - 32^\circ = 48^\circ \) since opposite angles are congruent. AT = 7 and BD = 20 since diagonals bisect.

**Example 2**

Use the information in the rhombus at right to find RQ, \( m\angle SPQ \), \( m\angle STR \), and RT.

**Solution:** RQ = 7 since all sides congruent. \( m\angle SPQ = 70^\circ \) since diagonals bisect opposite angles. \( m\angle STR = 90^\circ \) since diagonals are perpendicular. RT = 6 since diagonals bisect.
Example 3

Given that Q and R are midpoints in the trapezoid at right to find \(m\angle QMN\), \(m\angle QRN\), and QR.

**Solution:** \(m\angle QMN = 120^\circ\) since MN is parallel to PO.
\(m\angle QRN = 70^\circ\) since Q and R are midpoints, then QR is parallel to the bases and with parallel lines, corresponding angles are congruent.
\(QR = \frac{1}{2}(5 + 8) = 6.5\).

Find the required information and justify your answers.

For problems 1-4 use the parallelogram at right.

1. Find the perimeter.
2. If CT = 9, find AT.
3. If \(m\angle CDA = 60^\circ\), find \(m\angle CBA\) and \(m\angle BAD\).
4. If AT = 4x – 7 and CT = –x + 13, solve for x.

For problems 5-8 use the rhombus at right.

5. If PS = \(\sqrt{6}\), what is the perimeter of PQRS?
6. If PQ = 3x + 7 and QR = –x + 17, solve for x.
7. If \(m\angle PSM = 22^\circ\), find \(m\angle RSM\) and \(m\angle SPQ\).
8. If \(m\angle PMQ = 4x – 5\), solve for x.

For problems 9-12 use the quadrilateral at right.

9. If WX = YZ and WZ = XY, must WXYZ be a rectangle?
10. If \(m\angle WZY = 90^\circ\), must WXYZ be a rectangle?
11. If the information in problems 9-10 are both true, must WXYZ be a rectangle?
12. If WY = 15 and WZ = 9, what is YZ and XZ?
For problems 13-16 use the trapezoid at right with midpoints E and F.

13. If \( m \angle EDC = 60^\circ \), find \( m \angle AEF \).
14. If \( m \angle DCB = 5x + 20 \) and \( m \angle ABC = 3x + 10 \), solve for \( x \).
15. If \( AB = 6 \) and \( DC = 10 \), find \( EF \).
16. If \( EF = 9 \) and \( DC = 15 \), find \( AB \).

For problems 17-20 use the kite at right.

17. If \( m \angle XWZ = 95^\circ \), find \( m \angle XYZ \).
18. If \( m \angle WZT = 110^\circ \) and \( m \angle WXY = 40^\circ \), find \( m \angle ZWX \).
19. If \( WZ = 5 \) and \( WT = 4 \), find \( ZT \).
20. If \( WT = 4 \), \( TZ = 3 \), and \( TX = 10 \), find the perimeter of \( WXYZ \).

Answers

1. 44 units  
2. 9 units  
3. 60\(^\circ\), 120\(^\circ\)  
4. 4  
5. \( 4\sqrt{6} \)  
6. 2.5  
7. 22\(^\circ\), 136\(^\circ\)  
8. 23.75  
9. no  
10. no  
11. yes  
12. 12, 15  
13. 60\(^\circ\)  
14. 18.75  
15. 8  
16. 3  
17. 95\(^\circ\)  
18. 105\(^\circ\)  
19. 3  
20. \( 10 + 2\sqrt{116} \)