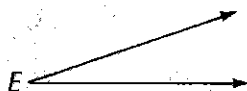


Congruent Angles

Ruler and compass can be used to copy an angle.

Given: angle E
Construct: angle GHI congruent to angle E .



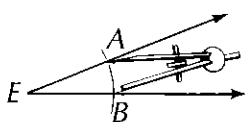
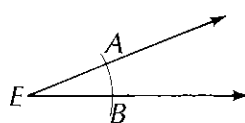
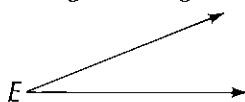
1. Draw a ray with endpoint H .
2. Using the compass, draw an arc with centre E cutting the arms of $\angle E$ at A and B .

With centre H and the same radius, draw an arc cutting the ray at I .

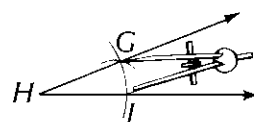
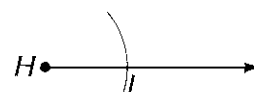
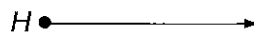
3. Make the compass radius equal to AB . With centre I and the same radius, draw an arc to intersect the first arc at G . Draw ray HG .

$$\angle GHI \cong \angle E$$

Original Angle:



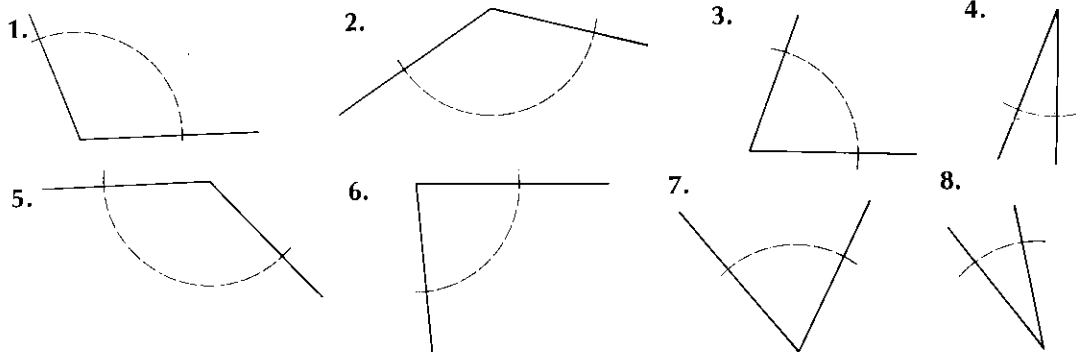
New Angle:



1. Consider the set of counting numbers less than 25.
Write the ratio for each.
 - a. even numbers to odd.
 - b. prime numbers to composite.
 - c. numbers divisible by 3 to numbers divisible by 4.
2. Solve for the missing term.
 - a. $15:24 = x:56$
 - b. $\frac{x}{16} = \frac{45}{40}$
 - c. $12:15 = 60:x$
3. Solve.
 - a. It cost Mr. Santana \$450 to pave 3 m^2 of patio with flagstones. How much would it cost him to pave 10 m^2 ?
 - b. How much should a dozen donuts cost if they are sold at 2 for 75 cents?
 - c. About how much should 2 cans of peas cost if they are on sale at 3 cans for 79 cents?
 - d. How long would it take the Lee family to travel 700 km if they travel 450 km in 9 h?
4. Write as a percent.
 - a. $\frac{7}{50}$
 - b. $1\frac{1}{2}$
 - c. $\frac{6}{1000}$
5. Write as a fraction.
 - a. 72%
 - b. 275%
 - c. 4.5%
6. Find the percent.
 - a. 45 out of 50
 - b. 2 out of 80
 - c. 16 out of 20
7. Find the part.
 - a. 35% of 80
 - b. $9\frac{1}{2}\%$ of 1000
 - c. 180% of 60
8. Find the whole.
 - a. 60% of what is 30?
 - b. 300% of what is 1500?
 - c. $10\frac{1}{2}\%$ of what is 21?
9. Solve.
 - a. There are 250 Grade 8 students in Willowbrook School. One hundred twenty of the students are boys. What percent of the students are girls?
 - b. Trent figures that he spends 12.5% more this year on his model cars than he did last year. If he spent \$124.50 last year, how much will he be spending this year?

EXERCISES

Use ruler and compass to construct a congruent angle.



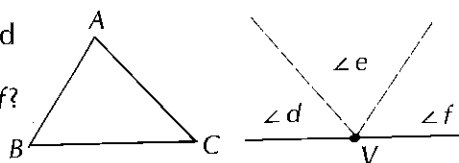
PRACTICE

- Draw an angle that approximates the given size. Then construct an angle congruent to each.

a. 45° b. 90° c. 120° d. 20° e. 60° f. 150° g. 80°

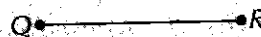
- Draw any acute triangle ABC . Using a common vertex V , construct $\angle d$, $\angle e$, and $\angle f$ congruent to $\angle A$, $\angle B$, and $\angle C$.

- What is the sum of $\angle d$, $\angle e$, and $\angle f$?
- What is $\angle A + \angle B + \angle C$?



Congruent Segments

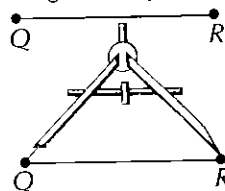
Given: segment QR
Construct: segment ST congruent to QR .



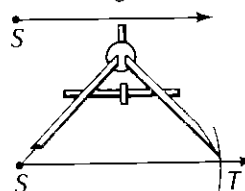
- With a ruler, draw a ray with endpoint S .
- With compass radius QR and centre S , draw an arc cutting the ray at T .

$$\overline{ST} \cong \overline{QR}$$

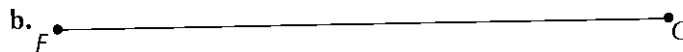
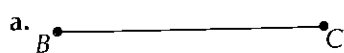
Original Segment:



New Segment:

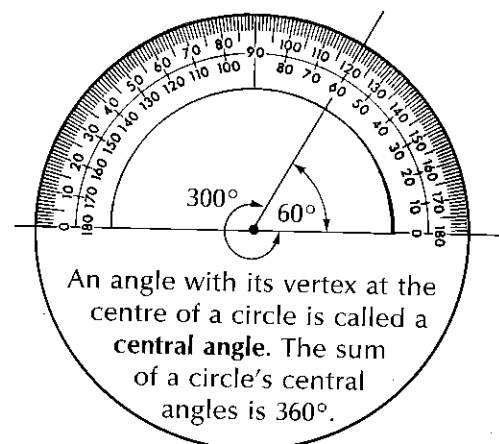
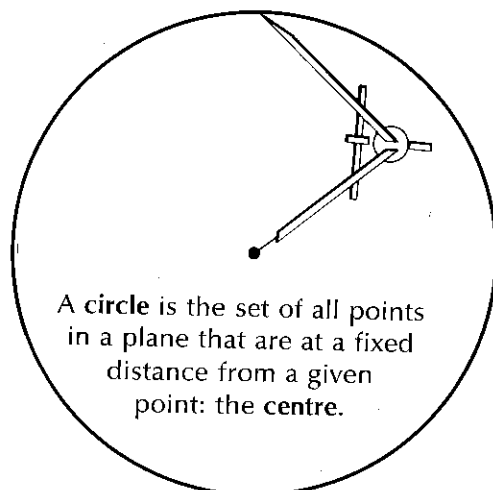


- Construct segments congruent to the given segment.

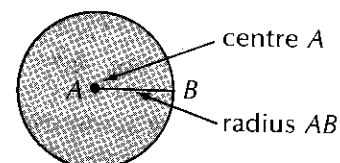


Circles

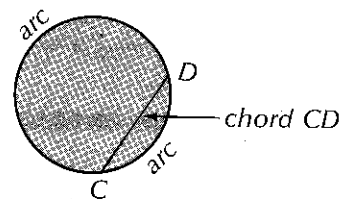
A circle can be constructed with a compass.



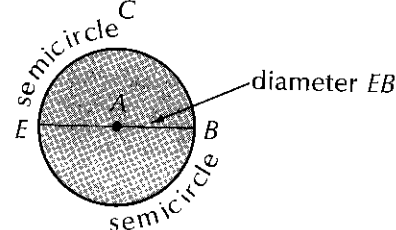
The **radius** of a circle is a segment joining the centre of the circle to a point on the circle.



A **chord** is a segment with endpoints on the circle. A chord divides a circle into two **arcs**.



A **diameter** is a chord passing through the centre of the circle. The arcs formed by the diameter are called **semicircles**. The length of a diameter is twice the length of a radius.

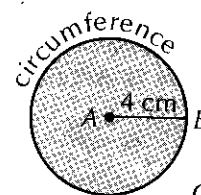


$$d = 2r$$

The **circumference** is the distance around a circle. The **ratio** of a circle's circumference to its diameter is about 22:7. The exact ratio is a non-repeating decimal called pi (π).

$$\pi = \frac{\text{circumference}}{\text{diameter}} = 3.141\,592\,653\ldots$$

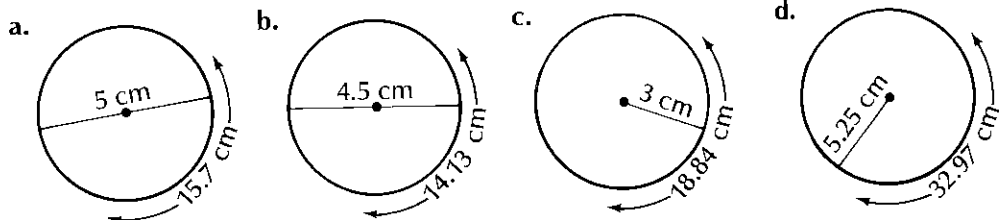
To find the circumference, use the formula
 $C = \pi d$ or $C = 2\pi r$.



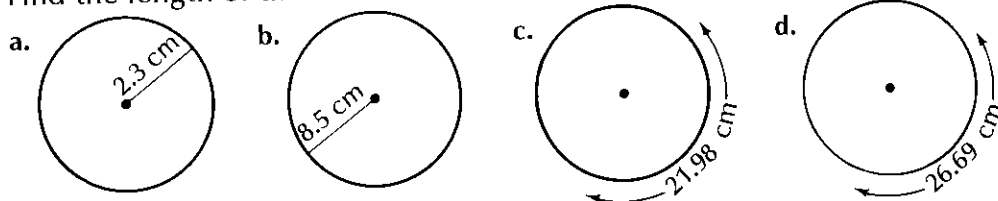
$$\begin{aligned} C &= \pi d \\ C &\approx 3.14(8) \\ C &\approx 25.12 \text{ (cm)} \end{aligned}$$

EXERCISES

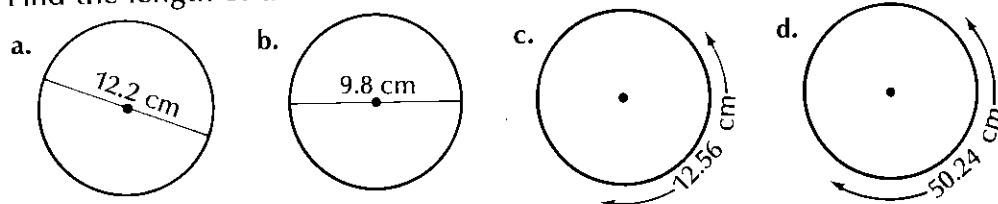
- Use a compass to draw a circle with the given *radius*.
a. 6 cm b. 4.5 cm c. 4 cm d. 9 cm
- Use a compass to draw a circle with the given *diameter*.
a. 10 cm b. 4 cm c. 3 cm d. 5 cm
- Estimate π using the given measurements. Use a calculator.



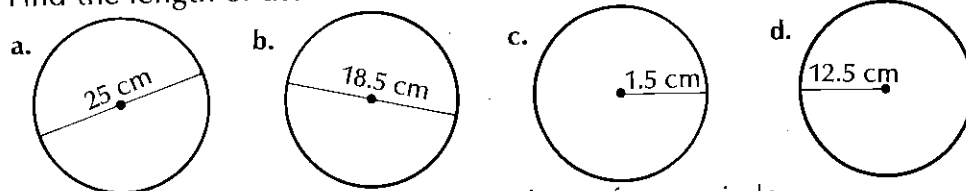
- Find the length of the diameter. Use $\pi \approx 3.14$ for (c) and (d).



- Find the length of the radius. Use $\pi \approx 3.14$ for (c) and (d).

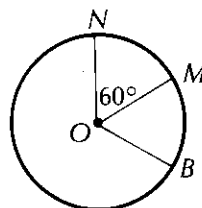


- Find the length of the circumference. Use $\pi \approx 3.14$.



- Use a protractor to draw two semicircles to form a circle. Label the endpoints of each semicircle A and B. Draw and identify segment AB. What is \overline{AB} ?

- In the diagram at the right, $\angle MOB \cong \angle NOM$. What is the size of central angle BON?



PRACTICE

1. Find the missing lengths. Use $\pi \approx 3.14$.
Use a compass to draw a circle with the given dimensions.

a. $r = 6$
 $d = \blacksquare$
 $C = \blacksquare$

b. $r = 4.5$
 $d = \blacksquare$
 $C = \blacksquare$

c. $r = 2$
 $d = \blacksquare$
 $C = \blacksquare$

d. $r = \blacksquare$
 $d = 10$
 $C = \blacksquare$

e. $r = \blacksquare$
 $d = 7$
 $C = \blacksquare$

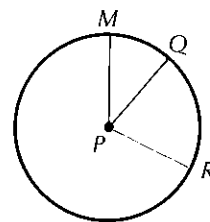
f. $r = \blacksquare$
 $d = 5$
 $C = \blacksquare$

g. $r = \blacksquare$
 $d = \blacksquare$
 $C = 37.68$

h. $r = \blacksquare$
 $d = \blacksquare$
 $C = 47.1$

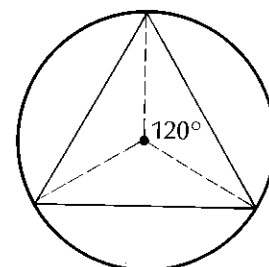
i. $r = \blacksquare$
 $d = \blacksquare$
 $C = 78.5$

2. Draw a circle with a protractor.
Draw central angles $MPQ = 40^\circ$
and $QPR = 75^\circ$.
What is the size of central angle RPM ?



3. To draw an equilateral triangle, three points were marked 120° apart, on a circle. Follow a similar procedure to draw each regular polygon.

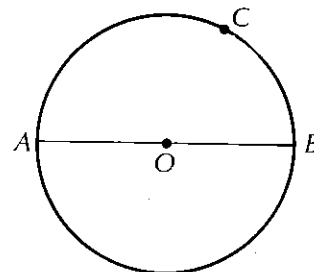
- a square
- a hexagon (6 sides)
- an octagon (8 sides)
- a decagon (10 sides)
- a dodecagon (12 sides)



$$360^\circ \div 3 = 120^\circ$$

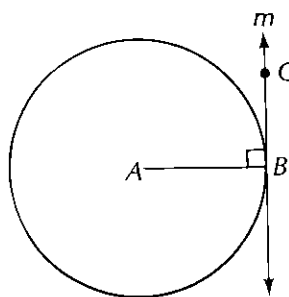
4. Draw a circle with diameter $AB = 10$ cm. Locate point C anywhere on the circle. Draw chords AC and BC .

- What is the size of $\angle ACB$?
- Classify $\triangle ABC$.
- Place points D, E , and F on the circumference. Draw triangles ADB, AEB , and AFB .
What kind of triangle was always made?
What conclusion can you make?



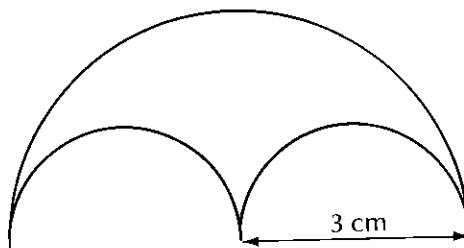
5. A **tangent** is a line which intersects a circle at just one point. Line m is tangent to the circle.

- How is line m related to the radius?
- Point C is located in line m . Express the length AC in terms of AB and BC .
- Draw a circle and three tangents. Does the relationship in the diagram always hold true between the radius and the tangent?



6. For a circle having a 3 cm radius and centre A , identify each point described below as *interior*, *exterior*, or *on the circle*.

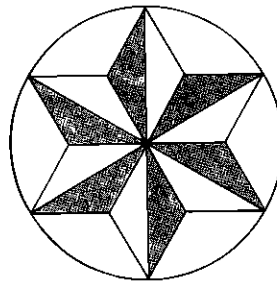
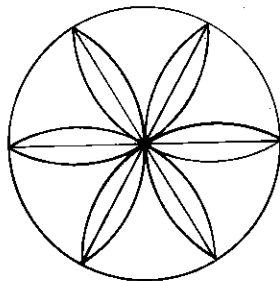
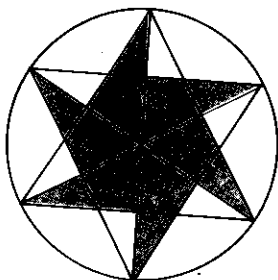
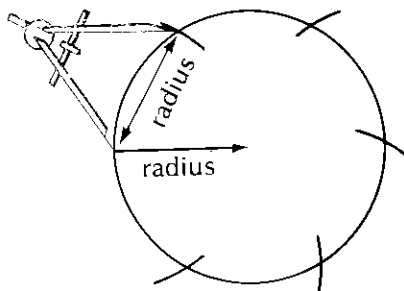
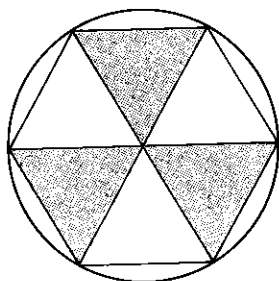
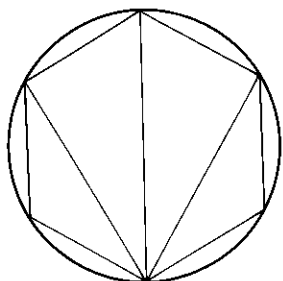
- Point B is 1.7 cm from A .
- Point C is 30 mm from A .
- Point D is 4.5 cm from A .
- Point E is 2.8 cm from A .



7. What is the perimeter of the shaded region?

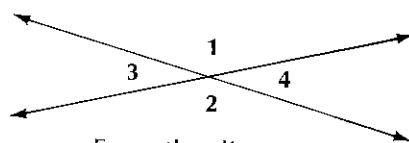
Circle Designs

Study these designs made with ruler and compass. Use the construction ideas to make these and other designs.



Angle Relationships

When two lines *intersect*, two pairs of **opposite angles** are formed.



From the diagram:

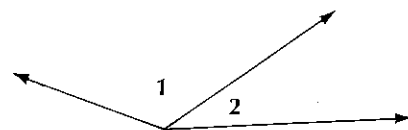
$$\angle 1 + \angle 4 = 180^\circ$$

$$\angle 2 + \angle 4 = 180^\circ$$

$$\text{Therefore } \angle 1 = \angle 2.$$

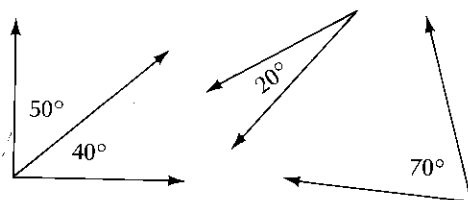
Opposite angles are always congruent.

Two angles that share a *common side* and vertex and do not overlap are called **adjacent angles**.



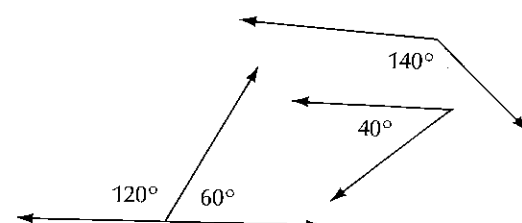
$\angle 1$ and $\angle 2$ are adjacent.

When the sum of the sizes of two angles is 90° , the angles are called **complementary**.



Angles of 50° and 40° are complementary.
Angles of 20° and 70° are complementary.

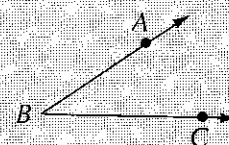
When the sum of the sizes of two angles is 180° , the angles are called **supplementary**.



The 120° and 60° angles are supplementary.
The 140° and 40° angles are supplementary.

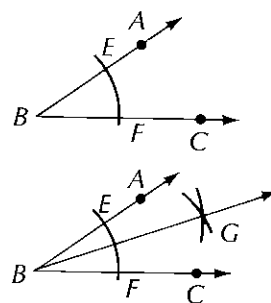
Two adjacent, congruent angles are formed when an angle is **bisected**.

Given: Angle ABC
Construct: BG to bisect $\angle ABC$.



1. With B as centre, draw an arc cutting \overline{BA} at E and \overline{BC} at F .
2. Using E and F as centres, and with a suitable radius, draw two arcs intersecting at G .
3. Draw \overline{BG} .

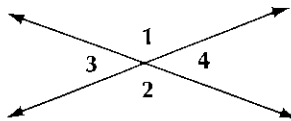
\overline{BG} bisects $\angle ABC$ into two adjacent, congruent angles, $\angle ABG$ and $\angle GBC$.



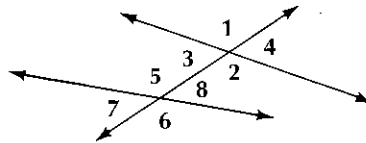
EXERCISES

1. Name the pairs of *opposite angles* in each figure.

a.

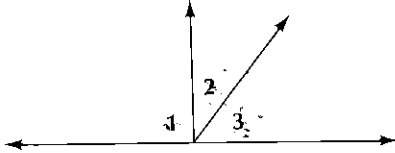


b.

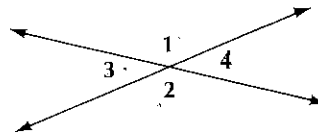


2. Name the pairs of *adjacent angles* in each figure.

a.

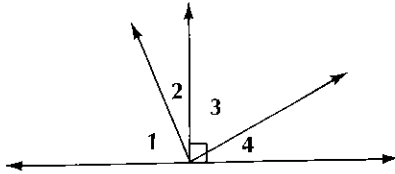


b.

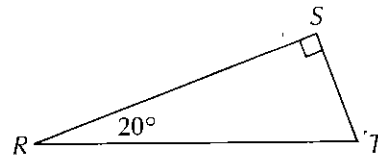


3. Name the pairs of *complementary angles* in each figure.

a.

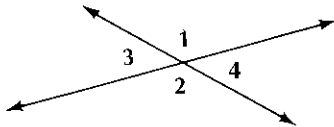


b.

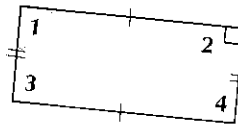


4. Name the pairs of *supplementary angles* in each figure.

a.

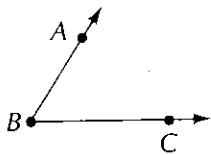


b.

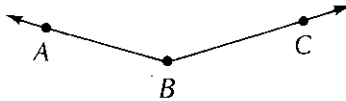


5. Trace each $\angle ABC$. Then construct angle bisector BD for each angle traced.

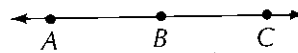
a.



b.



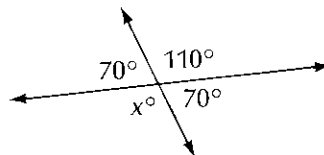
c.



6. Use a protractor to draw an angle of the given size and a compass to construct the angle bisector.

a. 90° b. 140° c. 30° d. 100° e. 120°

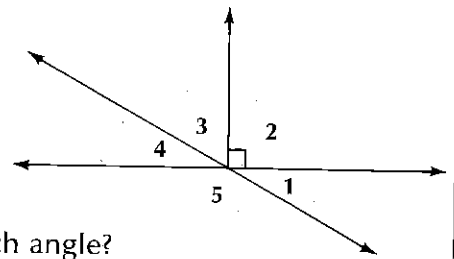
7. Describe two ways of finding x .



PRACTICE

1. Write *true* or *false*.

- $\angle 1$ and $\angle 2$ are opposite angles.
- $\angle 3$ and $\angle 4$ are complementary angles.
- $\angle 2$ and $\angle 3$ are adjacent angles.
- $\angle 1$ and $\angle 3$ are complementary angles.



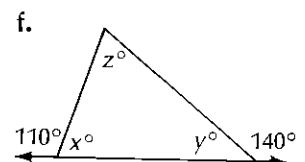
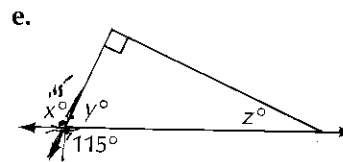
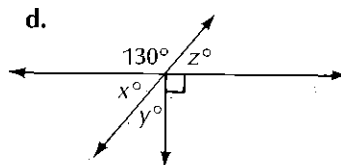
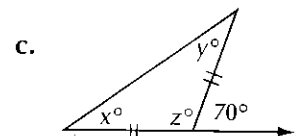
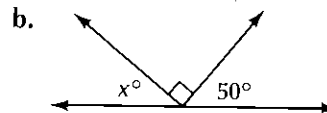
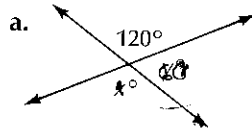
2. What size of angle is complementary to each angle?

- 20°
- 38°
- 75°
- 64°
- 48°

3. What size of angle is supplementary to each angle?

- 15°
- 105°
- 78°
- 24°
- 116°

4. Find each unknown angle.



5. a. If two opposite angles are complementary, what is the size of each angle?

b. The supplementary adjacent angle to a right angle must be what kind of angle?

6. With a protractor, draw $\angle ABC = 110^\circ$. With a compass, construct angle bisector BD .

a. What is the size of $\angle ABD$?

b. What relationship holds between $\angle ABD$ and $\angle DBC$?

7. Draw triangles with the dimensions given below.

Bisect the three angles of each triangle.

What occurs in each case?

Test your finding by bisecting the angles of other triangles.

a. equilateral $\triangle ABC$, $AB = 8$ cm

b. right $\triangle PQR$, $PQ = 8$ cm, $QR = 4$ cm, $\angle Q = 90^\circ$

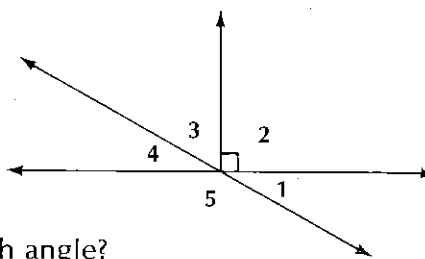
c. any isosceles $\triangle STU$, $ST = TU$

d. any scalene $\triangle DEF$

PRACTICE

1. Write *true* or *false*.

- $\angle 1$ and $\angle 2$ are opposite angles.
- $\angle 3$ and $\angle 4$ are complementary angles.
- $\angle 2$ and $\angle 3$ are adjacent angles.
- $\angle 1$ and $\angle 3$ are complementary angles.



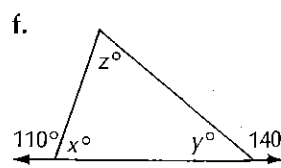
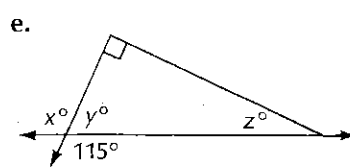
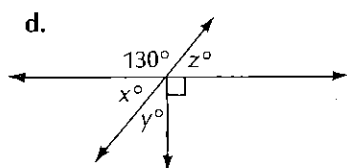
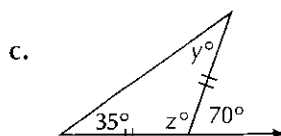
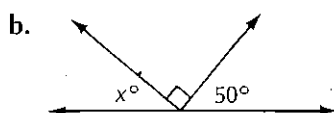
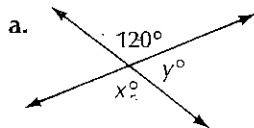
2. What size of angle is complementary to each angle?

- 20°
- 38°
- 75°
- 64°
- 48°

3. What size of angle is supplementary to each angle?

- 15°
- 105°
- 78°
- 24°
- 116°

4. Find each unknown angle.



5. a. If two opposite angles are complementary, what is the size of each angle?

b. The supplementary adjacent angle to a right angle must be what kind of angle?

6. With a protractor, draw $\angle ABC = 110^\circ$. With a compass, construct angle bisector BD .

a. What is the size of $\angle ABD$?

b. What relationship holds between $\angle ABD$ and $\angle DBC$?

7. Draw triangles with the dimensions given below.

Bisect the three angles of each triangle.

What occurs in each case?

Test your finding by bisecting the angles of other triangles.

a. equilateral $\triangle ABC$, $AB = 8$ cm

b. right $\triangle PQR$, $PQ = 8$ cm, $QR = 4$ cm, $\angle Q = 90^\circ$

c. any isosceles $\triangle STU$, $ST = TU$

d. any scalene $\triangle DEF$

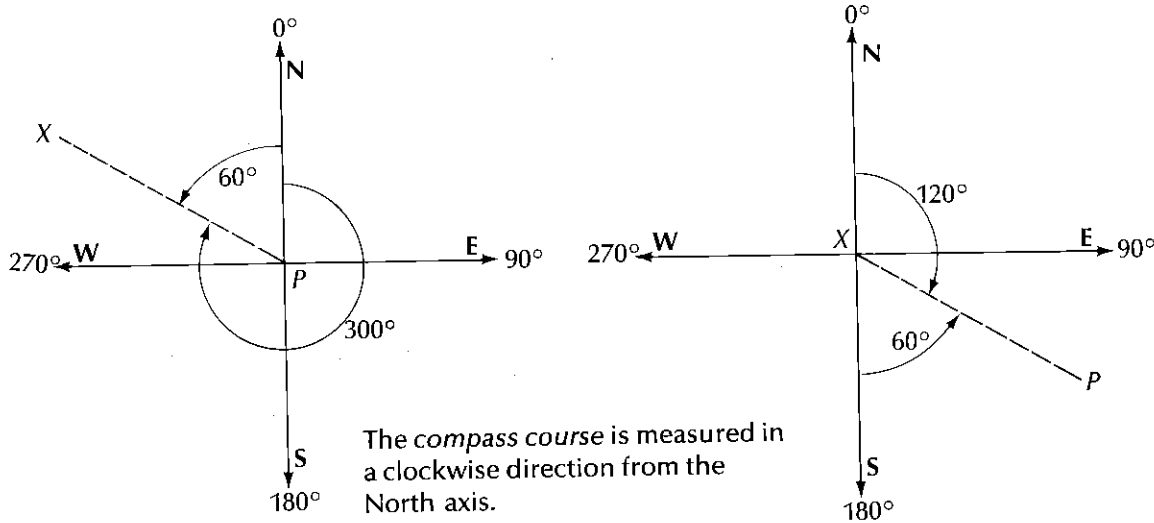
Navigation Angles

In the diagram below, an observer standing on an island at point P sights a ship X . To the observer, the ship's *bearing* is 60° West of North.

The ship is travelling away from the island. The *compass course* of ship X in relation to North is 300° .

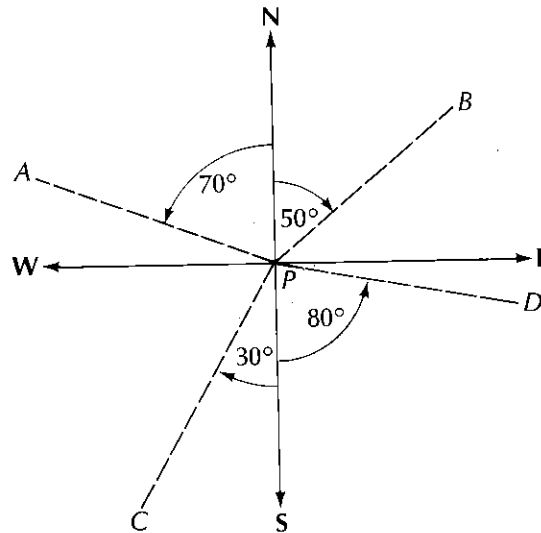
If the ship's captain looks back to the island, the island's bearing is 60° East of South.

To turn around and travel back to the island, the ship would set a compass course of 120° .



The diagram at the right shows four other ships sighted by an island observer.

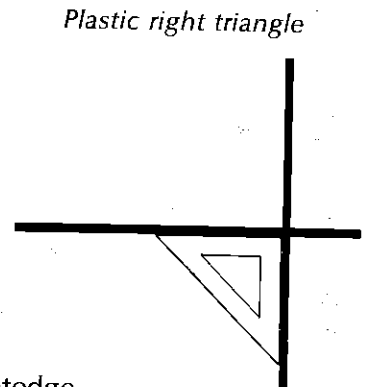
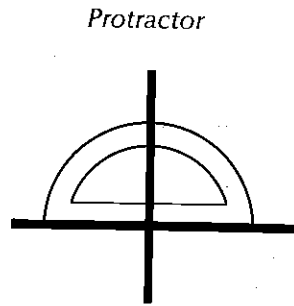
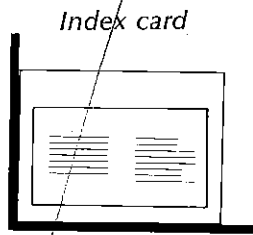
1. Give the bearing of each ship to the observer standing at point P on the island.
2. All four ships are travelling away from the island. What is the compass course of each?
3. Give the bearing of the island as seen by the captain of each ship.
4. Suppose each ship travelled back to the island. What would each new compass course be?



Perpendicular Lines

Lines which form 90° angles when they intersect are called **perpendicular**.

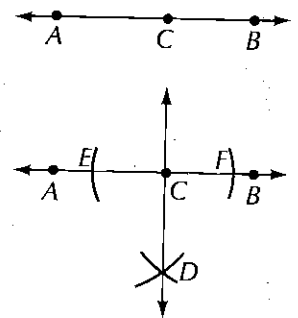
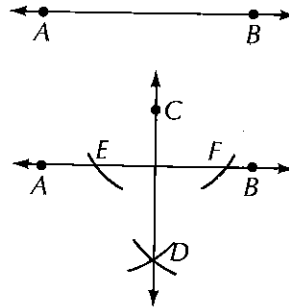
There are several ways to draw and test perpendicular lines.



Below are some perpendicular line constructions using straightedge and compass.

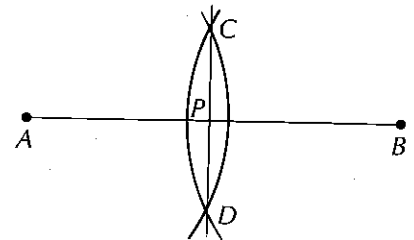
Given: \overline{AB} and point C (C may or may not lie on \overline{AB})
Construct: \overline{CD} perpendicular to \overline{AB} .

1. With centre C , construct arcs cutting \overline{AB} at E and F .
2. With centres at E and F , construct two arcs intersecting at D .
3. Draw \overline{CD} .
 $\overline{CD} \perp \overline{AB}$



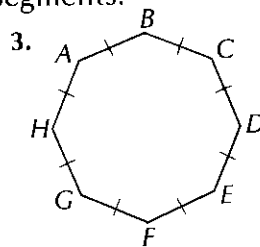
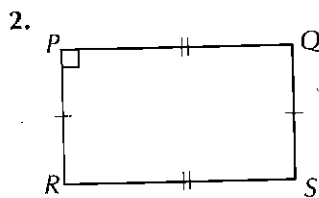
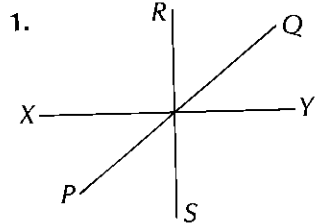
Given: \overline{AB}
Construct: the perpendicular bisector of \overline{AB} .

1. Using A and B as centres and a suitable radius, construct two arcs intersecting at C and D .
2. Draw \overline{CD} .
 \overline{CD} is the perpendicular bisector of \overline{AB} .
 $\overline{AP} \cong \overline{PB}$



EXERCISES

Using the symbol \perp , identify the pairs of perpendicular segments.

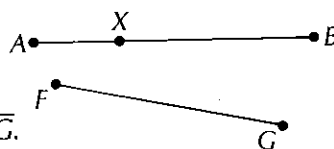
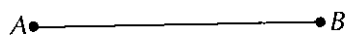


PRACTICE

1. Draw segments and points similar to these.

a. Construct $\overline{XY} \perp \overline{AB}$.

• X



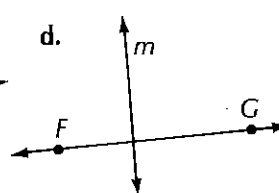
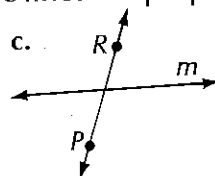
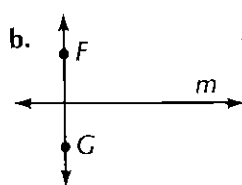
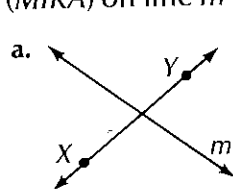
b. Construct \overline{XY} as a perpendicular bisector of \overline{FG} .

2. Draw a circle with a 6 cm radius and two diameters perpendicular to each other. Draw four chords that join the diameter endpoints. Identify the new figure.

3. Use a compass and a ruler to draw a rectangle, 4 cm by 6 cm.

4. Use a compass and a ruler to draw a square with area 9 cm^2 .

5. Trace each pair of intersecting lines. Place a clear plastic mirror (MIRA) on line m to test whether or not the lines are perpendicular.



Explain the difference in reflection images for the perpendicular and the non-perpendicular lines.

Centre Search

Make a few different-sized circles by tracing around the rims of cans, drinking glasses, dinner plates, and so on.

Use your knowledge of circles and geometric constructions to locate the *centre* of each circle.

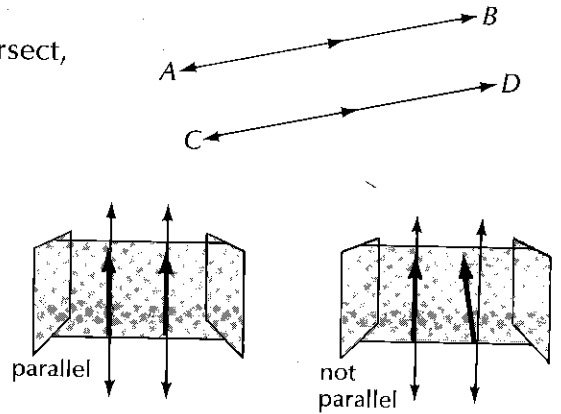
Parallel Lines

If two lines in the same plane do not intersect, they are called **parallel lines**.

The markings \parallel indicate parallel lines.

$\overleftrightarrow{AB} \parallel \overleftrightarrow{CD}$ means \overleftrightarrow{AB} is parallel to \overleftrightarrow{CD} .

A clear plastic mirror (MIRA) can be used to test and draw parallel lines.



Cutting two parallel lines by a third line, called a **transversal**, creates several **corresponding angles** which are congruent.

Corresponding angles in the diagram:

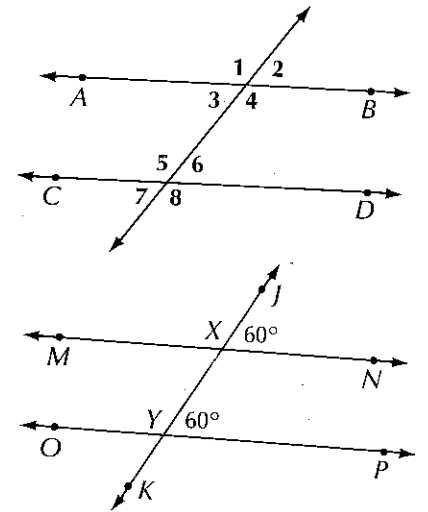
$$\begin{aligned}\angle 1 &\cong \angle 5 & \angle 2 &\cong \angle 6 \\ \angle 3 &\cong \angle 7 & \angle 4 &\cong \angle 8\end{aligned}$$

If the corresponding angles are congruent when a transversal cuts a pair of lines, the lines are parallel.

$$\angle JXN \text{ and } \angle XYP = 60^\circ$$

$$\therefore \angle JXN \cong \angle XYP$$

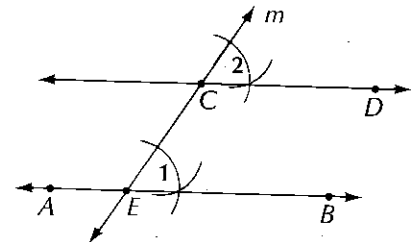
$$\therefore \overleftrightarrow{MN} \parallel \overleftrightarrow{OP}$$



A transversal can be used to construct parallel lines.

Given: \overleftrightarrow{AB} and point C
Construct: \overleftrightarrow{CD} parallel to \overleftrightarrow{AB} .

1. Draw line m through C cutting \overleftrightarrow{AB} at any point E.
2. Construct $\angle 2$ congruent to $\angle 1$. $\angle 1$ and $\angle 2$ are corresponding angles.
Therefore $\overleftrightarrow{AB} \parallel \overleftrightarrow{CD}$.

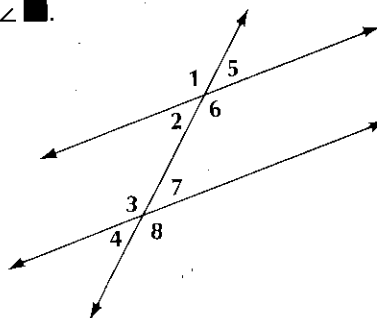


EXERCISES

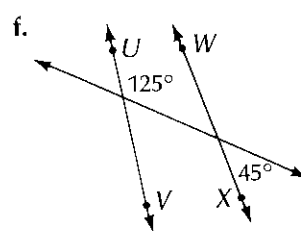
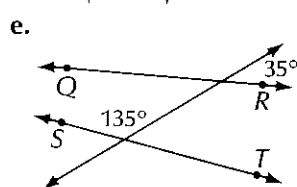
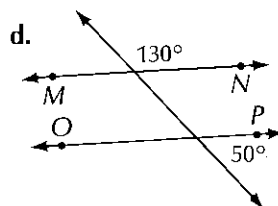
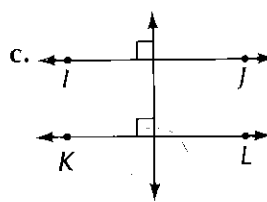
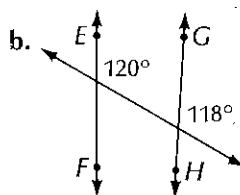
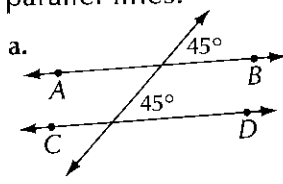
1. Describe five pairs of parallel lines you see on your way to school.

2. Use the diagram to complete each statement.

- $\angle 1$ corresponds to $\angle \blacksquare$ and is opposite $\angle \blacksquare$.
- $\angle 6$ corresponds to $\angle \blacksquare$ and is opposite $\angle \blacksquare$.
- $\angle 7$ corresponds to $\angle \blacksquare$ and is opposite $\angle \blacksquare$.
- $\angle 2 \cong \angle \blacksquare, \angle \blacksquare,$ and $\angle \blacksquare$.
- $\angle 3 \cong \angle \blacksquare, \angle \blacksquare,$ and $\angle \blacksquare$.
- $\angle 5 \cong \angle \blacksquare, \angle \blacksquare,$ and $\angle \blacksquare$.
- If $\angle 5 = 50^\circ$, then $\angle 7 = \blacksquare^\circ$.
- If $\angle 4 = 45^\circ$, then $\angle 7 = \blacksquare^\circ$.
- If $\angle 3 = 120^\circ$, then $\angle 7 = \blacksquare^\circ$.

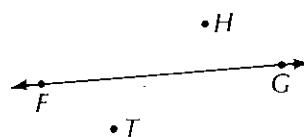


3. Write a statement using the symbol \parallel for each pair of parallel lines.

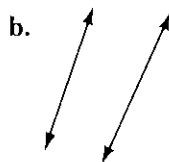
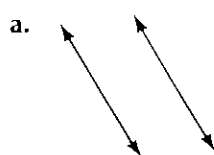


4. Make a diagram similar to the one at the right.

- Construct a line through H parallel to \overleftrightarrow{FG} .
- Construct a line through T parallel to \overleftrightarrow{FG} .

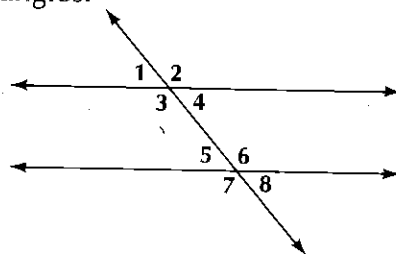


5. Use a clear plastic mirror (MIRA) to test if the pair of lines are parallel. Write yes or no.

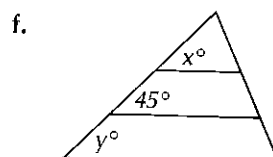
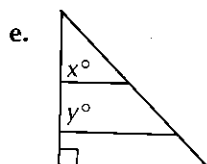
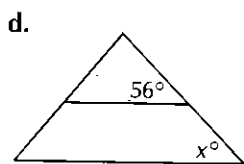
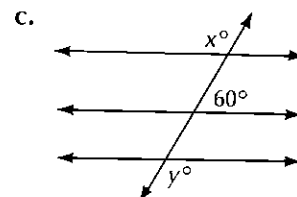
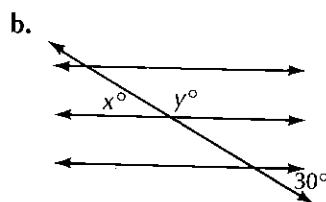
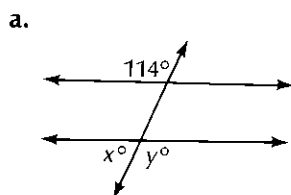


PRACTICE

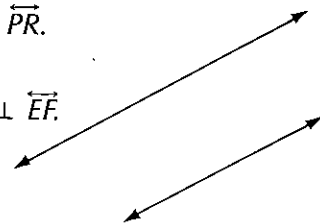
1. Refer to the diagram at the right.
 - a. Name pairs of congruent opposite angles.
 - b. Name pairs of congruent corresponding angles.
 - c. If $\angle 4 = 70^\circ$, then $\angle 8 = \blacksquare^\circ$.
 - d. If $\angle 7 = 130^\circ$, then $\angle 2 = \blacksquare^\circ$.
 - e. If $\angle 1 = 55^\circ$, then $\angle 7 = \blacksquare^\circ$.
 - f. If $\angle 3 = 118^\circ$, then $\angle 8 = \blacksquare^\circ$.



2. Assume all horizontal lines are parallel. Find each unknown angle.

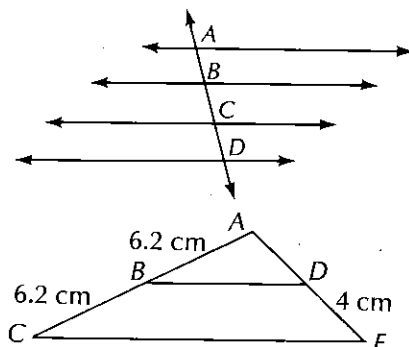


3. Construct \overleftrightarrow{LM} , \overleftrightarrow{ST} , and \overleftrightarrow{PR} so that $\overleftrightarrow{LM} \parallel \overleftrightarrow{ST}$ and $\overleftrightarrow{LM} \perp \overleftrightarrow{PR}$. What relationship holds between \overleftrightarrow{ST} and \overleftrightarrow{PR} ?
4. Construct \overleftrightarrow{AB} , \overleftrightarrow{CD} , and \overleftrightarrow{EF} so that $\overleftrightarrow{AB} \perp \overleftrightarrow{CD}$ and $\overleftrightarrow{AB} \perp \overleftrightarrow{EF}$. What relationship holds between \overleftrightarrow{CD} and \overleftrightarrow{EF} ?

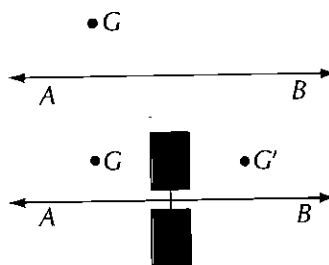


5. Use a clear plastic mirror (MIRA) to test if the pair of lines are parallel. Write yes or no.
6. The pairs of parallel lines, going from top to bottom, are an equal distance apart. They cut off congruent segments on the transversal.

- a. Name the pairs of congruent segments.
- b. Assume the horizontal lines in the triangle are parallel. What is AD ?
- c. Is $\angle ABD \cong \angle ACF$? Explain.
- d. Are $\triangle ABD$ and $\triangle ACF$ similar? Why?



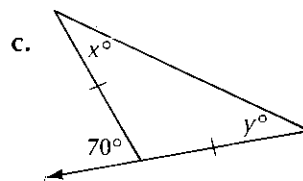
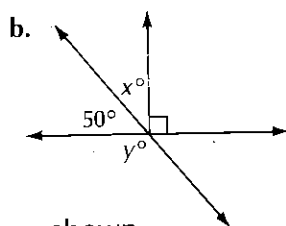
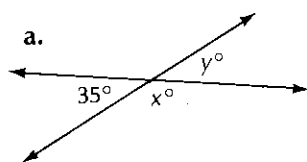
7. Given: \overleftrightarrow{AB} and point G
 Construct: a line through G parallel to \overleftrightarrow{AB} .
- Stand *MIRA* perpendicular to \overleftrightarrow{AB} .
 - Mark the image of G . Label it G' .
 - Draw line GG' .
 $\overleftrightarrow{GG'} \parallel \overleftrightarrow{AB}$



REVIEW

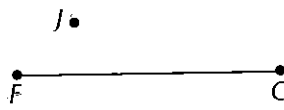
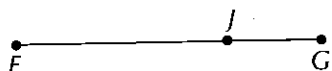
- Use a protractor to draw an angle of the given size.
 Then use a compass to construct a congruent angle.
 a. 75° b. 130° c. 40° d. 100°
- Find the missing length. Use $\pi \approx 3.14$.
 Use a compass to draw a circle with the given dimensions.
 a. $r = 4$
 $d = \blacksquare$
 $C = \blacksquare$
 b. $r = \blacksquare$
 $d = 12$
 $C = \blacksquare$
 c. $r = \blacksquare$
 $d = \blacksquare$
 $C = 10.99$

3. Find the unknown angles.

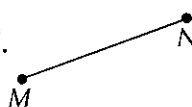


4. Draw diagrams similar to those shown.

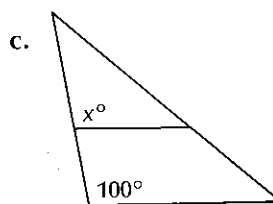
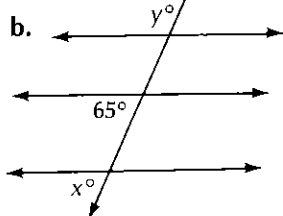
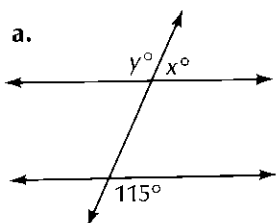
- a. Construct $\overline{JK} \perp \overline{FG}$.



- b. Construct \overline{JK} as the perpendicular bisector of \overline{MN} .

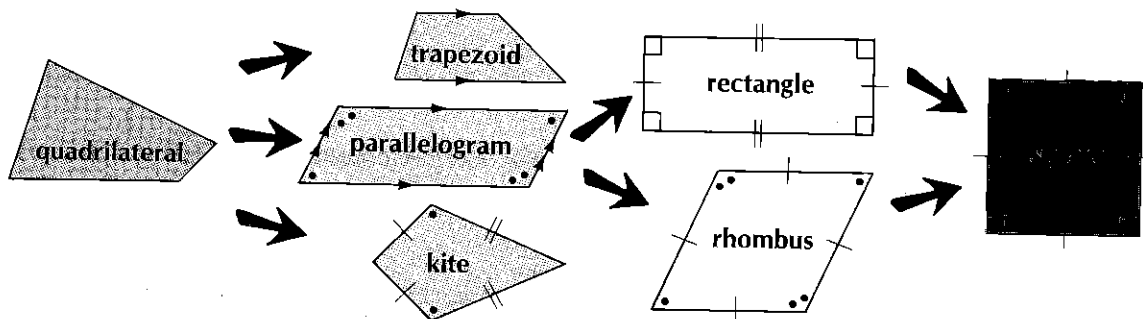


5. Assume all horizontal lines are parallel.
 Find each unknown angle size.

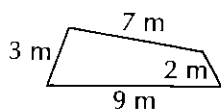


Quadrilaterals

A **quadrilateral** is a four-sided polygon.

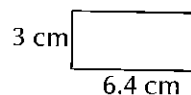


The *perimeter* (P) of a quadrilateral is the sum of the lengths of its four sides.



$$P = 3 + 7 + 9 + 2$$

$$P = 21 \text{ m}$$



$$P = 2(l + w)$$

$$P = 2(3 + 6.4)$$

$$P = 18.8 \text{ cm}$$

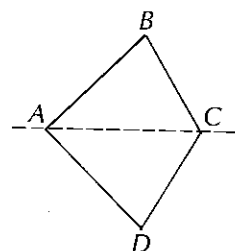
The *sum of the interior angles* of a polygon can be found by drawing diagonals to cut the polygon into triangles.

Diagonal AC cuts quadrilateral $ABCD$ into two triangles.

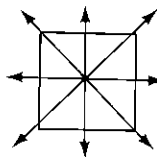
In triangle ABC : $\angle A + \angle B + \angle C = 180^\circ$

In triangle ACD : $\angle A + \angle D + \angle C = 180^\circ$

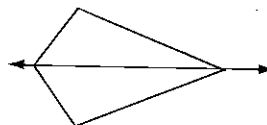
Therefore, the sum of the interior angles of the quadrilateral is $2 \times 180^\circ$ or 360° .



Some quadrilaterals have *line symmetry*.



A square has
4 lines of symmetry.



A kite has one
line of symmetry.

EXERCISES

Which quadrilaterals have the following properties?

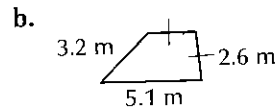
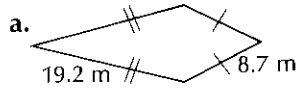
- | | | |
|-----------------------------|------------------------------|-----------------------|
| 1. 1 pair of parallel sides | 2. 2 pairs of parallel lines | 3. 1 line of symmetry |
| 4. 2 lines of symmetry | 5. 4 congruent sides | 6. 4 equal angles |

Find the perimeter.

- | | |
|------------------------------|-------------------------------|
| 7. a square with 9.8 m sides | 8. a rectangle 5.6 m by 8.4 m |
|------------------------------|-------------------------------|

PRACTICE

1. Identify each figure.
Then find the perimeter.



2. Copy and complete the table. Write yes or no.

Quadrilateral	Opposite sides parallel?	Opposite sides congruent?	Opposite angles equal?	How many lines of symmetry?
Square				
Parallelogram				
Kite				
Rectangle				
Rhombus				
Trapezoid				

3. True or False?

- Every parallelogram is a quadrilateral.
- Every square is a rhombus.
- Every parallelogram is a square.
- Every square is a rectangle.

4. Copy and complete the table.

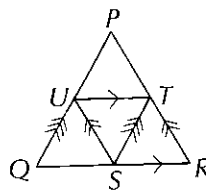
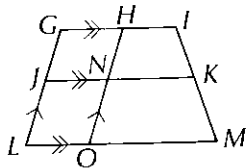
Polygon	Number of Sides	Number of Triangles	Sum of Interior Angles
Triangle	3	$\triangle 1$	
Quadrilateral	4	$\square 2$	
Pentagon			
Hexagon			

- What is the sum of the interior angles of a decagon? dodecagon?
- Write a formula for the sum of the interior angles of a polygon with n sides.

Quadrilateral Search

Identify all of the specific quadrilaterals in each diagram.

- parallelograms and trapezoids
- trapezoids and rhombuses

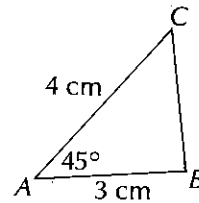


Polygons

Compass, ruler, and protractor are useful tools for drawing polygons of specific sizes.

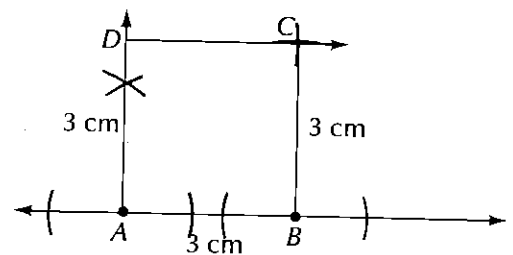
Given: $AB = 3$ cm, $AC = 4$ cm, $\angle A = 45^\circ$
Draw: triangle ABC

1. Draw \overline{AB} with a ruler.
2. Use a protractor to draw a 45° angle at A .
3. Mark point C 4 cm from A .
4. Draw \overline{BC} .



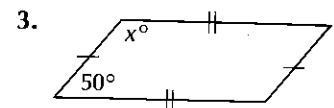
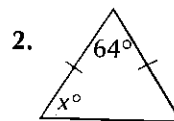
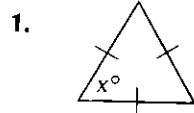
Given: four sides of 3 cm
Draw: square $ABCD$

1. Draw a line. Mark A and B , 3 cm apart.
2. Construct a line through A perpendicular to \overline{AB} .
3. Mark D 3 cm from A .
4. Draw arcs with radius 3 cm, centre D and B , intersecting at C .
5. Join \overline{DC} and \overline{BC} .

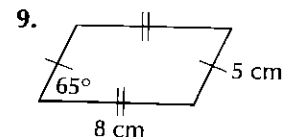
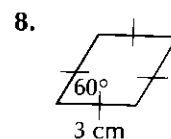
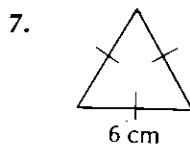
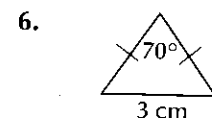
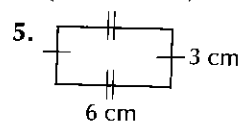
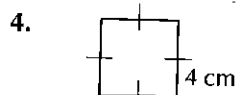


EXERCISES

Find x .

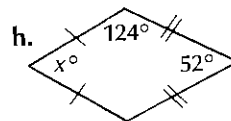
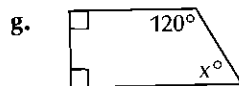
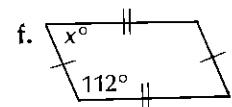
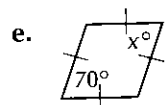
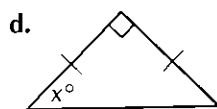
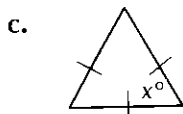
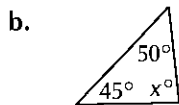
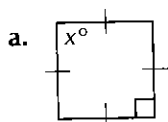


Draw the polygons using compass, ruler, and protractor.

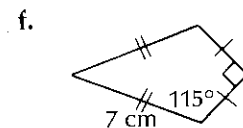
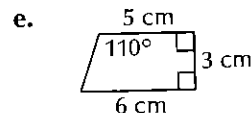
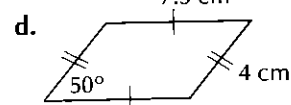
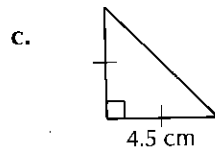
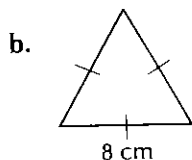
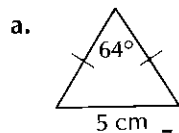


PRACTICE

1. Find x .



2. Draw each polygon.



3. Draw an 8 cm by 8 cm square.

Bisect each angle. Construct perpendicular bisectors to each side.

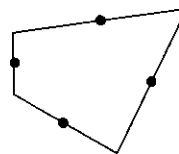
4. Repeat the activity in question 3 for each of the following.

a. an 8 cm by 8 cm rhombus

b. a 6 cm by 10 cm rectangle

c. a 6 cm by 10 cm parallelogram with a 60° angle

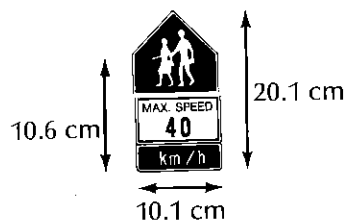
5. Draw five different quadrilaterals. For each, find the midpoint of each of the four sides. Join the midpoints of adjacent sides. Describe the results.



6. Do the rays that bisect the angles of a triangle intersect at the same point as the perpendicular bisectors of each side? Use an equilateral triangle, a 30° - 60° right triangle, and an isosceles right triangle to justify your answer.

School Zone Signs

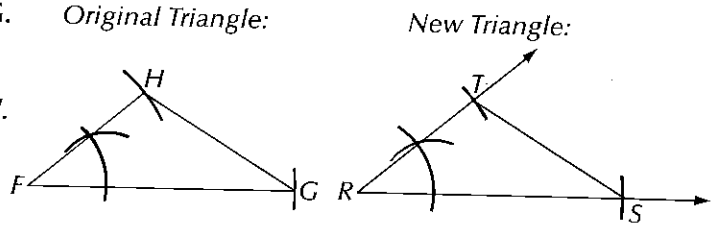
Use your knowledge about geometric constructions to draw models of the signs shown with the given dimensions.



Congruent Triangles

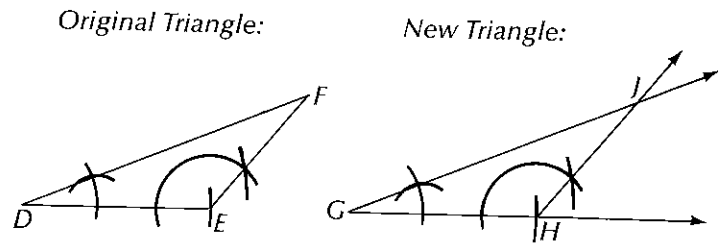
Side-Angle-Side (SAS) Method of Copying a Triangle:

1. Construct \overline{RS} so that $RS = FG$. *Original Triangle:*
2. Copy $\angle F$ at point R .
3. Construct \overline{RT} so that $RT = FH$.
Draw \overline{TS} .
 $\triangle RST \cong \triangle FGH$



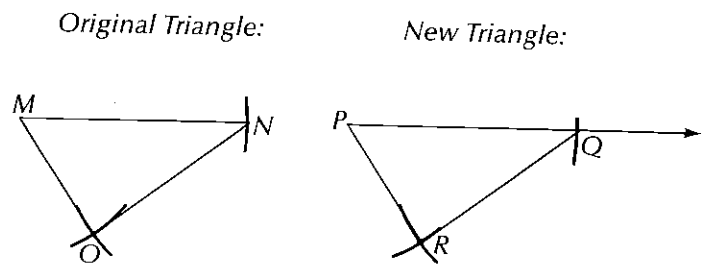
Angle-Side-Angle (ASA) Method of Copying a Triangle:

1. Copy $\angle D$.
2. Construct \overline{GH} so that $GH = DE$.
3. Copy angle E at H .
Extend the sides of angles G and H to intersect at point J .
 $\triangle GHJ \cong \triangle DEF$



Side-Side-Side (SSS) Method of Copying a Triangle:

1. Construct \overline{PQ} so that $PQ = MN$
2. With radius MO and centre P , draw an arc. With radius NO and centre Q draw a second arc. Let R be the point where the arcs intersect.
3. Draw \overline{PR} and \overline{QR} .
 $\triangle PQR \cong \triangle MNO$



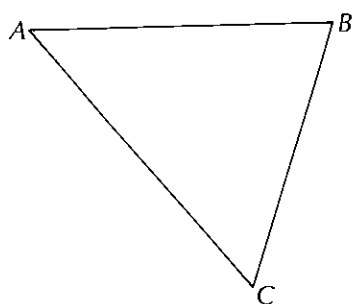
EXERCISES

1. Draw a large scalene triangle.
Draw three congruent triangles using:
a. SAS b. ASA c. SSS
2. Draw an isosceles right triangle.
Use the method of your choice to draw a congruent triangle.

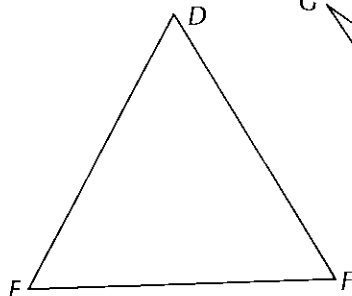
PRACTICE

1. Trace the given triangle. Then construct a congruent triangle.

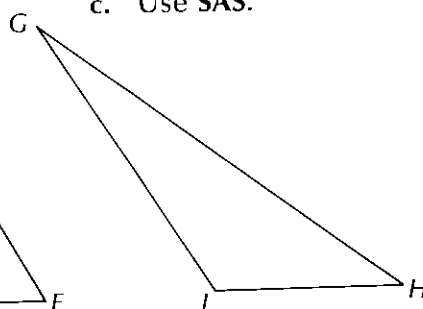
a. Use SSS.



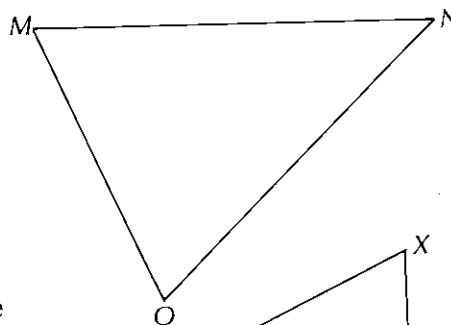
b. Use ASA.



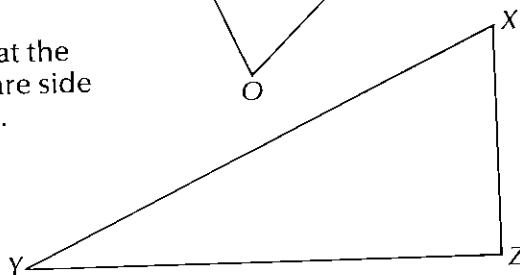
c. Use SAS.



2. Trace $\triangle MNO$. Construct $\triangle PNO$ so that the two triangles are congruent and share side ON . Identify the figure constructed. (There are 2 possible answers.)



3. Trace $\triangle XYZ$. Construct $\triangle XOZ$ so that the two triangles are congruent and share side XZ . Identify the figure constructed. (There are 2 possible answers.)



REVIEW

1. Which quadrilaterals have the following properties?

a. 4 congruent angles

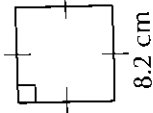
b. opposite sides parallel

c. opposite sides congruent

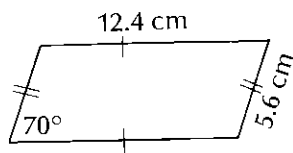
d. 2 lines of symmetry

2. Draw each polygon.

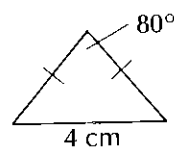
a.



b.



c.



3. Draw each kind of triangle.

Then construct a triangle congruent to each.

a. equilateral triangle

b. scalene triangle

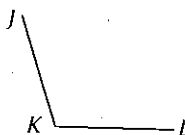
c. acute triangle

1. Use a straightedge and compass to construct an angle congruent to each.

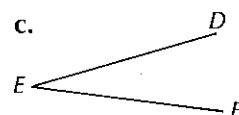
a.



b.



c.



2. Find the missing lengths. Use $\pi \approx 3.14$.

Use a compass to draw a circle with the given dimensions

a. radius = \blacksquare cm

diameter = 13 cm

circumference = \blacksquare cm

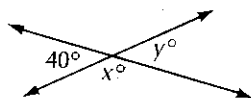
b. radius = \blacksquare cm

diameter = \blacksquare cm

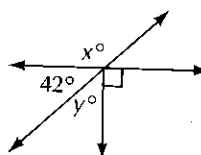
circumference = 18.84 cm

3. Find the unknown angle.

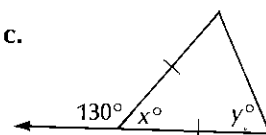
a.



b.



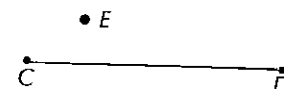
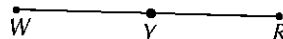
c.



4. Draw segments and points similar to those shown.

a. Construct $\overline{XY} \perp \overline{WR}$

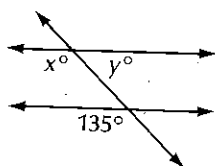
b. Construct $\overline{FE} \perp \overline{CD}$



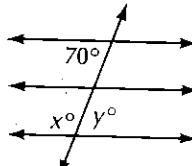
5. Find the unknown angles.

Assume all horizontal lines are parallel.

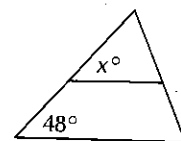
a.



b.



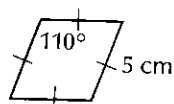
c.



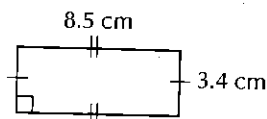
6. a. Explain why a square is also a rhombus.
b. Explain why a kite is not a parallelogram.

7. Draw each polygon.

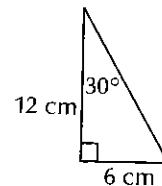
a.



b.



c.



8. Draw an example of each kind of triangle.
Then construct a triangle congruent to each.

a. scalene triangle

b. isosceles right triangle

c. obtuse triangle

1. Draw and label a figure to represent each.

- | | | |
|----------------------|-----------------------|-------------------------|
| a. line FG | b. polygon $ABRS$ | c. point K |
| d. segment MN | e. ray JL | f. right angle WRS |
| g. acute angle DEF | h. obtuse angle GHI | i. straight angle BVD |

2. What kind of triangle has the given angle sizes?

- | | | |
|-------------------------|-------------------------|-------------------------|
| a. $48^\circ, 75^\circ$ | b. $22^\circ, 68^\circ$ | c. $35^\circ, 45^\circ$ |
|-------------------------|-------------------------|-------------------------|

3. Copy and complete the congruency statement.

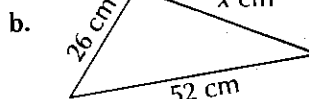
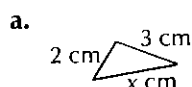
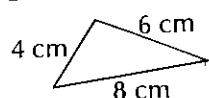
Given: $\triangle BXA \cong \triangle FTR$ a. $\angle X \cong \blacksquare$ b. $\overline{XA} \cong \blacksquare$

4. Are the triangles congruent? If so, state the rule which establishes the congruence: **SSS**, **SAS**, **ASA**, or **AAS**.



5. Both triangles are similar to the given triangle. Find the length of the third side of each triangle.

Given:



6. A 1.8 m man casts a 3 m shadow at the same time a tower casts a 38.5 m shadow. How tall is the tower?

7. Simplify.

a. $\sqrt{10\,000}$

b. $\sqrt{1.44}$

c. $\sqrt{\frac{16}{81}}$

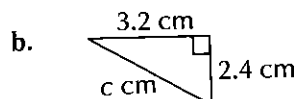
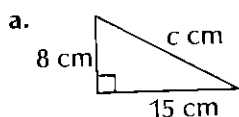
8. Approximate the square root to the nearest tenth.

a. $\sqrt{5}$

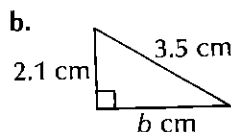
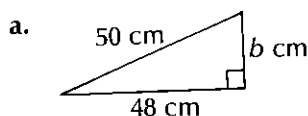
b. $\sqrt{10}$

c. $\sqrt{15}$

9. The length of the hypotenuse is c cm. Solve for c .



10. The length of the side is b cm. Solve for b .



11. Find the missing number in each Pythagorean triple.

a. $\blacksquare, 12, 13$

b. $30, \blacksquare, 50$

c. $45, 200, \blacksquare$