

Building Blocks of Geometry

Geometry 1.1

Points:

Have no size, only represent a location.

.

Named with a capital letter.

Lines:

Have no thickness, but infinite length.

.

.

Named using any two points with a line symbol above them.

Planes:

Have no thickness, but infinite length and width.

P

Named using a script letter.

Line Segments:

Represents a part of a line between two points.

.

.

.

Named using two points and the line segment symbol above them.

Congruent segments have the same length.

There are several ways to represent congruence.

A **midpoint** divides a line segment into two congruent segments.

Rays:

Begin at a point and extends infinitely in one direction.

.

.

.

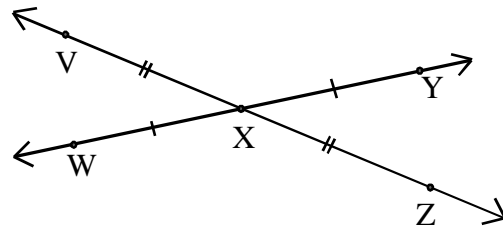
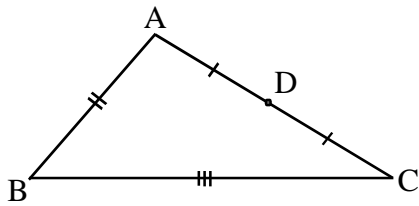
Named using an endpoint and any other point the ray passes through.

Building Blocks of Geometry

Geometry 1.1

Practice:

Use the figures below to answer the following:



1. Name all of the unique line segments in the figure on the left. (5)
2. How many line segments are there in the figure on the right?
Name them.
3. There are two lines in the figure on the right.
How many ways can you name each line?
4. Name the midpoints in each figure, and write a congruence statement describing each pair of congruent line segments.
5. How many *unique* rays can you name in the figure on the right?
Name them all.

Practice:

Draw each figure described below:

1. Lines AE and BD intersect at point C where C is the midpoint of segments AE and BD. Point B is the midpoint of segment AF.
2. Point B is the midpoint of segment AC. $AE = CE$. Point D is the midpoint of BE.
3. Segments $AB = AC = BC = BD = CD$. The midpoint of AD is point E.

Building Blocks of Geometry

Geometry 1.1

Coordinate Geometry:

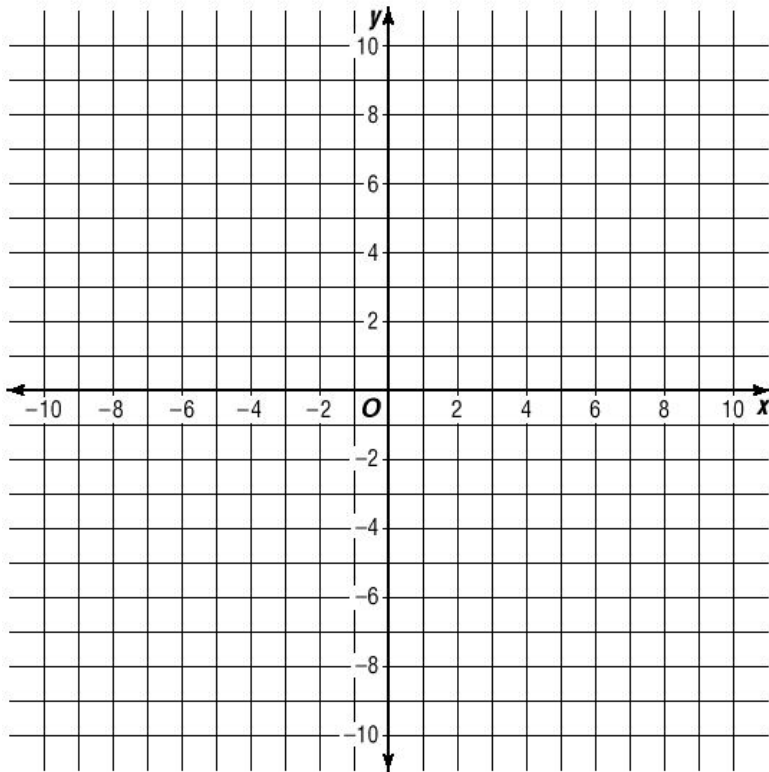
Finding the midpoint of a line graphed on the coordinate plane is easy.

The Formula:

For points: (x_1, y_1) and (x_2, y_2)

The midpoint is at: $\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)$

Explain why this works. Look at the graph below.



Practice:

Find the midpoint for each pair of points below without graphing.

1. $(3, -4)$ $(-1, -8)$

2. $(-1, 9)$ $(0, -3)$

3. $(5, 6)$ $(-2, -3)$

4. $(2, 11)$ $(-2, 3)$

5. The midpoint of a line is at $(3, -2)$. One endpoint is at $(6, 3)$.
Where is the other endpoint?

Angles

Angles:

Formed by two rays with a common endpoint.
The endpoint is called the **vertex**.

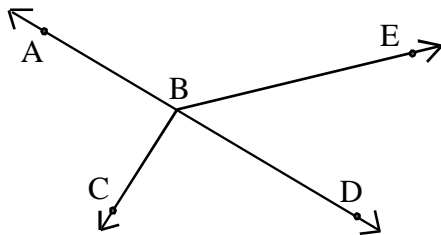
Named using three points with the vertex in the center.
Measure *between* 0 and 180 degrees.

Congruent Angles have the same measure.

An **angle bisector** divides an angle into two congruent angles starting from the angle's vertex.

Practice:

Name all of the angles in the figure below.

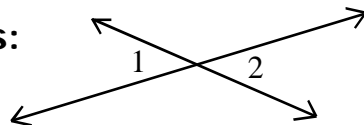


Acute:

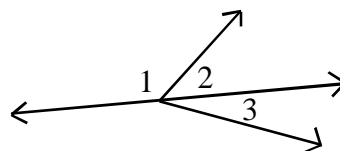
Obtuse:

Right:

Vertical Angles:



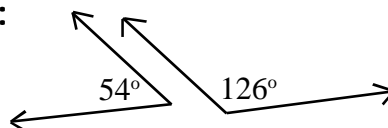
Linear/Adjacent Angles:



Complementary Angles:



Supplementary Angles:



Visual Thinking

Geometry 1.3

Practice:

Draw the following figures wherever possible, and answer the questions that follow.

1. Lines AB and DE intersect at point C. Ray CF is an angle bisector of angle BCE and angle BCF equals 20 degrees.
What is the measure of angle ACD?
What is the measure of angle BCD?

2. Angles ABC and CBD form a pair of complementary angles.
B is the midpoint of line CF. Angle CBD measures 18 degrees.
What is the measure of angle ABF?
What is the measure of angle DBF?

3. Angles ABC and BDE are supplementary. B is the midpoint of line DC.
Angle ABD measures 80 degrees.
Ray BF bisects angle ABC.
What is the measure of angle FBC?
What is the measure of angle BDE?

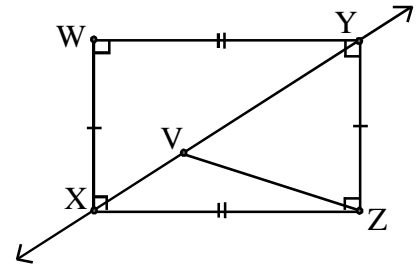
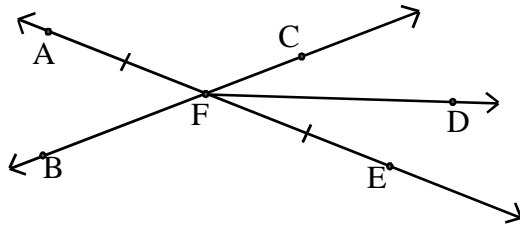
4. Four congruent line segments: AB, AC, AD, and AE form six *pairs* of congruent angles each with vertex A.
Draw and label how (if) this is possible and name all pairs of congruent angles.

5. Show how (if) it is possible for two angles to intersect at (share):
One point
Two points
Three points
Four points
Five points
Infinite Points

Practice Quiz

Geometry 1.3

Use the figures below to answer the questions that follow:



1. F is the _____ of line segment AE. 1. _____
2. \overrightarrow{FD} is called a _____. 2. _____
3. If angle $\angle CFD \cong \angle EFD$, then ray FD is a(n) _____. 3. _____
4. How many unique angles are there in the figure on the left? 4. _____
5. How many line segments are there in the figure on the left? 5. _____
6. If the measure of angle AFC is 120 degrees, what is the measure of angle AFB? 6. _____
7. Angles AFC and BFE are called _____ angles. 7. _____
8. How many acute angles are there in the figure on the left? 8. _____
9. Angles WXV and VXZ are _____ angles. 9. _____
10. Ray YV is the same as ray _____. 10. _____
11. Name a pair of linear angles in the figure on the right. 11. _____ and _____

Practice Quiz

Geometry 1.3

Use a straight edge to draw each of the following figures described below:
Mark everything you know about each figure described and answer any questions that follow. BE NEAT!

12. Angles ABD and DBC are complementary angles.
Point E is the midpoint of segment \overline{AB} ,
and $\overline{DE} \cong \overline{DC}$.

$\overset{\bullet}{B}$ $\overset{\bullet}{C}$

13. Angles XYA and ZYA are both right angles.
C is the midpoint of \overline{YZ} , and
B is the midpoint of \overline{AZ} .
 $XY = YC$.

$\overset{\bullet}{A}$ $\overset{\bullet}{Y}$

14. Angles LMN and OMP are obtuse vertical angles (points L, M, and P are collinear).
K is the midpoint of segment OP.
Ray MK bisects angle PMO.
Angle NMP measures 72 degrees.
Label the measure of angles LMN, OMK, and KMP.

Polygons

Polygon:

A closed figure in a plane.

Segments are called sides, endpoints are called vertices.

A **diagonal** connects nonconsecutive vertices.

In a **convex** polygon, all diagonals are within the figure.

In a **concave** polygon, one or more diagonals is outside the polygon.

Challenge:

How many diagonals are there on a square? A hexagon? An octagon?

Can you find a way to count the number of diagonals on a 20-sided figure without drawing it?

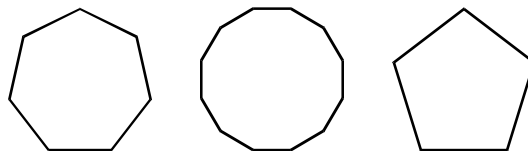
Each vertex can connect to all other vertices except itself and the two adjacent vertices (n-3). This is true for every vertex: $n(n-3)$

Since each vertex is counted twice (AB=BA) we divide by 2: $\frac{n(n-3)}{2}$

Equilateral means all sides are equal.

Equiangular means all angles are equal.

Regular polygons are equilateral and equiangular.



Answer:

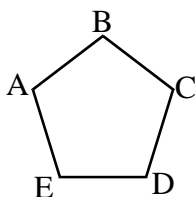
Can a triangle be concave? If not, offer a simple proof.

Can an equilateral hexagon be concave?

Can an equiangular hexagon be concave?

Can any regular polygon be concave?

How many ways can the polygon below be named?



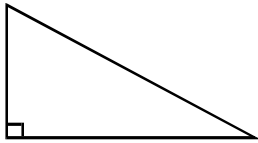
1. Pentagon ABCDE
- 2.

Triangles and Quadrilaterals

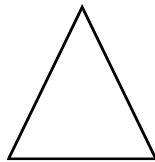
Triangles:

Classified by their sides and their angles.

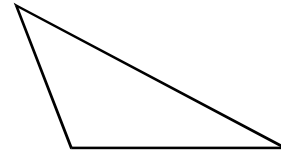
Right



Acute

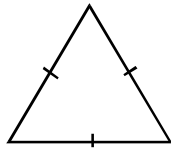


Obtuse



Also classified by their sides

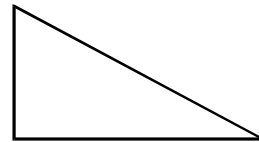
Equilateral



Isosceles



Scalene



Practice:

Try to draw each of the nine triangles below. Which are impossible?

Equilateral Right

Isosceles Right

Scalene Right

Equilateral Acute

Isosceles Acute

Scalene Acute

Equilateral Obtuse

Isosceles Obtuse

Scalene Obtuse

Drawing a triangle given three sides:

Using a ruler and a compass, how could you draw a triangle with sides measuring 4cm, 5cm, and 7cm?

Is this triangle obtuse, right, or acute?

Practice:

1. Construct a triangle whose sides measure 5, 12, and 13cm.

What kind of triangle is this?

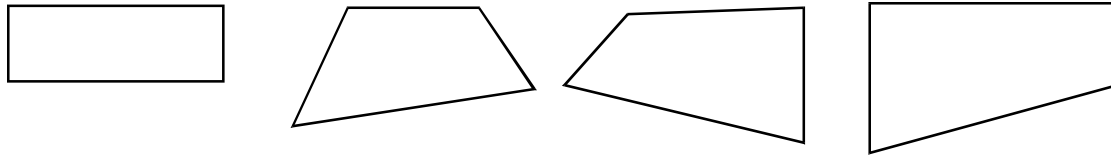
2. Draw a straight line on your paper of any length.

Construct an equilateral triangle whose sides are all the same length as the line you drew.

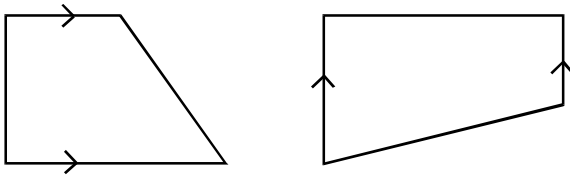
Quadrilaterals

Quadrilaterals:

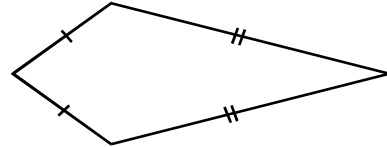
Have four sides.



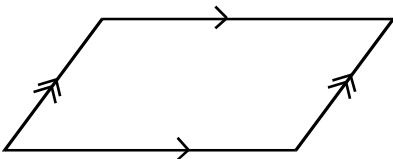
Trapezoids have exactly one pair of parallel sides:



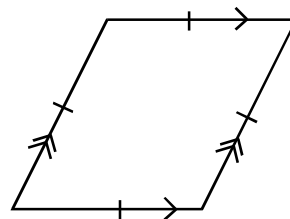
Kites have two distinct pairs of consecutive congruent sides.



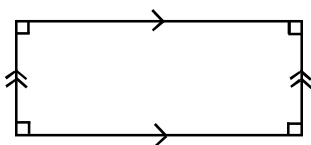
Parallelograms have two pairs of parallel sides:



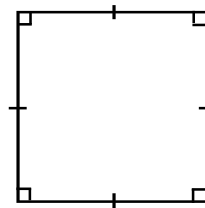
A **Rhombus** is an equilateral parallelogram.



A **Rectangle** is a parallelogram with four right angles.



A **Square** is a regular quadrilateral (equal sides and angles).



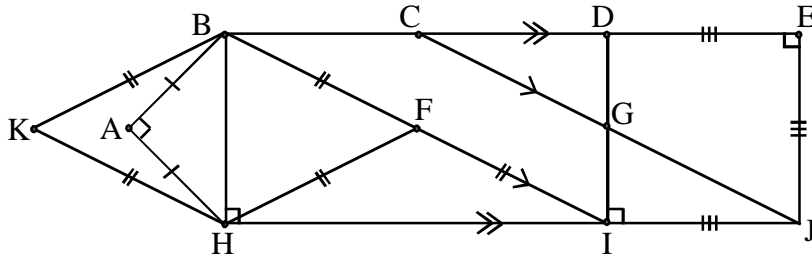
Answer:

1. What is an equiangular rhombus more typically called?
2. Are all squares rectangles?
3. Are all rectangles squares?
4. Can a quadrilateral have exactly three right angles? If so, draw it.
5. Can a trapezoid have exactly one right angle? Two? Four?
6. Can a kite have exactly one right angle? Two? Four?
7. How many right angles can a rhombus have? 0 1 2 3 4

Geometry 1.5

Practice Quiz

Use the figure below to answer the questions that follow:



note: angle measures are drawn to scale.

1. Name a pair of complementary angles.

1. _____

2. Name a parallelogram that is not a rectangle.

2. _____

3. Name a rhombus that is not a square.

3. _____

4. Name a kite.

4. _____

5. Name a pair of obtuse vertical angles.

5. _____

6. Name an isosceles right triangle.

6. _____

7. Name an isosceles obtuse triangle.

7. _____

8. Name a concave pentagon.

8. _____

9. Name a trapezoid with no right angles.

9. _____

10. On the back of this paper, construct a triangle whose sides measure 6, 7, and 8cm. Classify this triangle by its sides and angles.

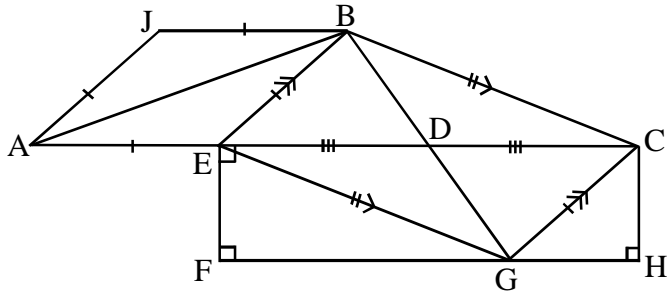
10. _____

Pledge: Write-out and sign.

Geometry 1.5

Practice Quiz

Use the figure below to answer the questions that follow:



note: figure drawn to scale.

- | | |
|---|------------------|
| <p>1. Triangle EFG is a(n) _____ right triangle.</p> | <p>1. _____</p> |
| <p>2. Angles EDG and BDC are _____ angles.</p> | <p>2. _____</p> |
| <p>3. Name a pair of complementary angles.</p> | <p>3. _____</p> |
| <p>4. Name a rectangle.</p> | <p>4. _____</p> |
| <p>5. Name a rhombus.</p> | <p>5. _____</p> |
| <p>6. Name a parallelogram that is not a rhombus or a rectangle.</p> | <p>6. _____</p> |
| <p>7. Name a concave pentagon.</p> | <p>7. _____</p> |
| <p>8. Name a concave quadrilateral.</p> | <p>8. _____</p> |
| <p>9. Name a trapezoid.</p> | <p>9. _____</p> |
| <p>10. Name an isosceles triangle.</p> | <p>10. _____</p> |
| <p>11. If $BG=BC$ and $GH=CH$ then BCHG is a _____.</p> | <p>11. _____</p> |

Practice Quiz

Geometry

Use a straight edge to draw each of the following figures described below:

Mark everything you know about each figure described and answer any questions that follow. BE NEAT!

12. Line WZ includes points X and Y so that X is the midpoint of segment WY and Y is the midpoint of XZ.
Angles WXA and BXY are obtuse vertical angles.
Angles AXY and YXC are complementary.
BXC is a right angle.

W[•]Z[•]

13. Triangle ABC is Scalene Right with right angle B and $BC > AB$.
D is the midpoint of AC.
BDCF is a rhombus.

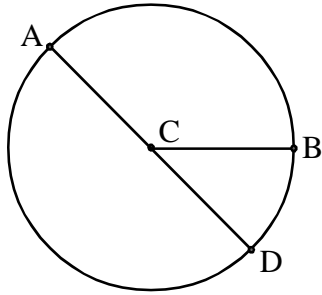
A[•]C[•]

14. Construct a triangle (you may use a separate sheet) with sides measuring 3, 3, and 5cm.
Classify this triangle by its sides and angles.

Circles

Circles:

A circle is the set of points that are a certain distance from a point (center).

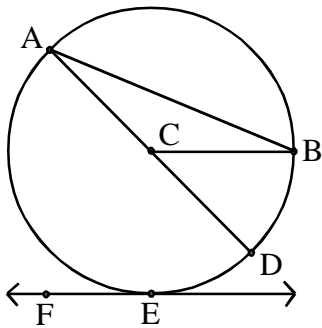


Circles are named by their center. (Circle C)

The **radius** of a circle is the distance from center to edge. Segment \overline{CB} is a radius of circle C. The **diameter** of a circle is the distance from edge to edge through the center. \overline{AD} is a diameter.

What makes two circles congruent?

What makes two circles **concentric**?



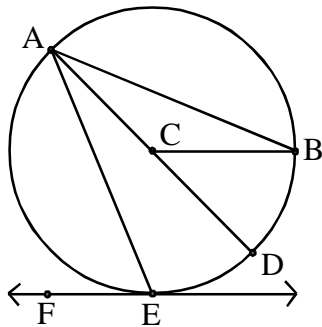
An **arc** of a circle is defined by two points on the circle and the part of the circle between them.

Arc AB is a **minor arc**.

Arc ABE is a **major arc**.

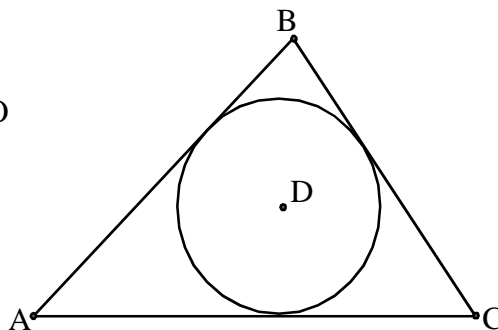
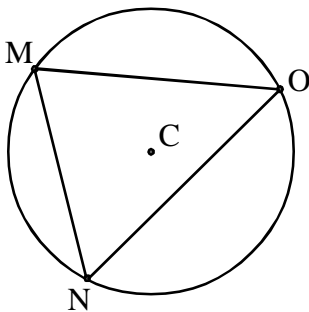
Arc ABD is a **semicircle**.

The **measure of an arc** is the same as the measure of the central angle of the circle. If angle ACB is 120° , then arc AB is 120° .



A **chord** is a segment with endpoints on the circle. Name three segments that are chords of circle C.

A **tangent** is a line that intersects the circle once. Name a tangent of circle C.



Triangle MNO is **inscribed** in circle C.

Triangle ABC is **circumscribed** about circle D.

Circles

Circles:

On your paper, construct circle A with a radius of 5cm.

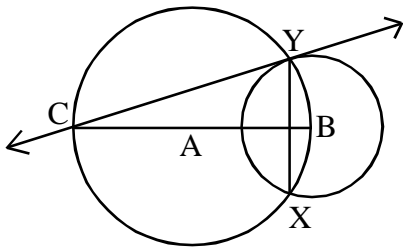
Place point B on the circle and draw circle B with a radius of 3cm. Label the points where circles A and B cross X and Y.

Draw diameter CB (on the larger circle).

Connect points to create line \overleftrightarrow{CY} , and ray \overrightarrow{YX} .

Answer the following:

1. Name two radii of circle A.
2. Name a chord of circle B.
3. Name three chords for circle A.
4. Name as many minor arcs on circle A as you can find.
5. Name two semicircles on circle A.
6. Name five unique major arcs on circle A.
7. Name a tangent on circle B.



Construct circle A in the center of a page with a radius of 5cm. Label any point on the circle X.

Construct circle X with a 2cm radius and label points W and Y where the circles intersect. Construct circles W and Y, also with a 2cm radius.

Create triangles WAX and YAX.

1. What kind of triangles are WAX and YAX?
2. What is the measure of angle WAX?

Continue the above diagram. Label the point where circles W and A intersect with point V and construct circle V. Label the point where circles Y and A intersect with point T and construct circle T. Circles V, A, and T should intersect, label this point U. Your diagram should look like a daisy.

3. What kind of quadrilateral is VWXY?
4. What kind of triangle is TAX?
5. What kind of triangle is TWX?

Stop Thinking and Draw!

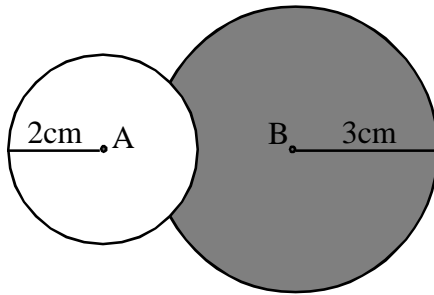
Geometry 1.6

Sketching is an important tool for problem solving in geometry.

One new term for this unit:

A **locus** of points is a set of points which satisfy a set of conditions.

For example, a point is at least 2cm from point A and no more than 3cm from point B. A and B are 4cm apart. Below is the locus of points.



Sketch-out your work to solve each:

1. A man wearing red pants has on red shoes. A man with blue pants has on blue shoes. A man with green pants has on green shoes. For whatever reason, they exchange shoes so that each man is wearing one shoe from each of the other two men. After they leave, you only remember that The man in red pants had a green shoe on his right foot. What shoe was on the left foot of the man in blue pants?

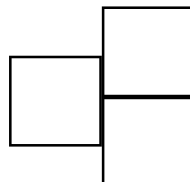
2. A man is riding his bike on the trails at Umstead. He rides his bike two miles north, then eight miles west, and finally four more miles north and arrives at the ranger station. From here there is a shortcut that takes him straight back to his starting point, which he uses to get back to where he started. How many miles did he ride altogether?

Hint: Pythagoras could solve it.

3. A circle has a square inscribed within, and one circumscribed about it. The area of the larger square is 18 square centimeters. What is the area of the smaller one?

4. What is the fewest number of non-overlapping squares that can be drawn so that each square touches exactly three other squares?

Example: In this diagram each square touches two others.



Try with:

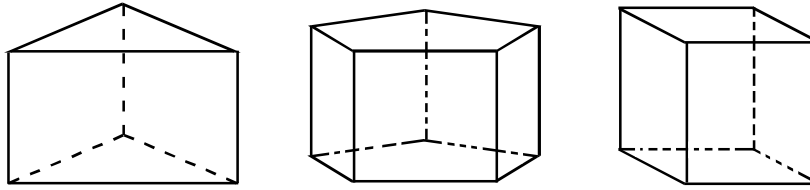
Squares of different sizes.

Same sized squares.

The 3rd Dimension

You will need to be able to sketch and reconize several basic shapes and their nets:

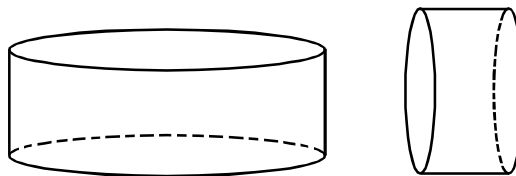
Prisms:



Nets:

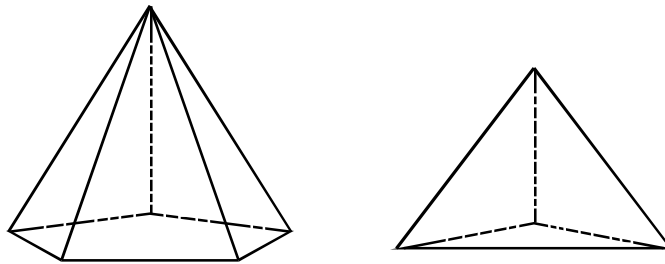
Flat top and base can be any shape. Rectangular sides.

Cylinders:



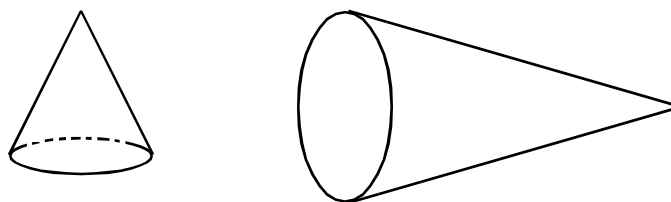
Round top and base, rectangular 'wrap'.

Pyramids:



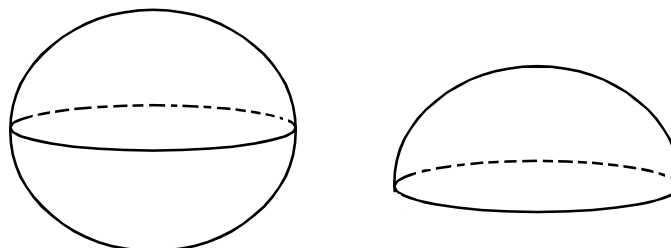
Flat base can be any shape, triangular sides.

Cones:



Circular base, comes to a point at the top.

Spheres and Hemispheres:



Test Review

Geometry 1.8

Complete the following tasks and answer the questions that follow for the points shown:

Part 1:

Segment AC has midpoint B . Angles ABD and CBE are obtuse vertical angles. Triangle ABE is equilateral. Angle DCE is a right angle.

- 100 What is the measure of angle ABE ?
- 100 What is the measure of angle CBE ?
- 200 Name two complementary angles.
- 200 Name a pair of acute vertical angles.
- 200 Classify triangle CBE .
- 300 What is the measure of angle BCE ?
- 300 What is the measure of angle BCD ?
- 400 Classify triangle BCD .
- 500 If $AE=3\text{cm}$, what is the length of EC ?

Part 2:

Circle B has a 3cm radius. Point A is on circle B . Circle A also has a radius of 3cm . Point D is on circle A , and point C is on circle B so that line CD is tangent to both circles. Point X occurs where circles A and B intersect nearest the tangent line, and point Y occurs where circles A and B intersect farthest from the tangent line.

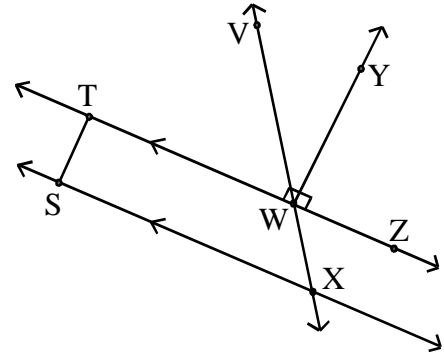
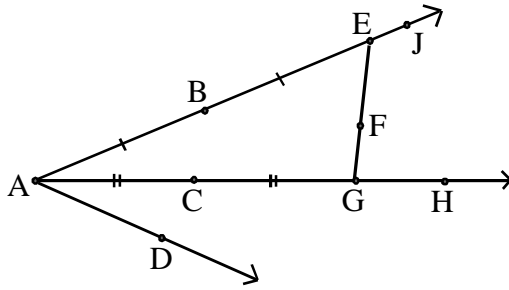
Connect all points necessary to answer each question below:

- 100 Classify quadrilateral $ABCD$. (It is exactly what it looks like.)
- 100 Classify triangle ABY .
- 100 Classify pentagon $AYBCD$
(concave? convex? equilateral? equiangular? regular?)
- 200 What is the measure of arc XB ?
- 200 What is the measure of arc XCY ?
- 200 Classify triangle CBA .
- 300 What is the measure of arc XD ?
- 300 Classify Quadrilateral $DAYX$. (this requires some assumptions)
- 400 How many unique arcs are there on circle A (major and minor)?
- 500 What is the measure of angle BYD ?

Practice Test

Geometry 1.8

Use the figures below to answer the questions that follow:



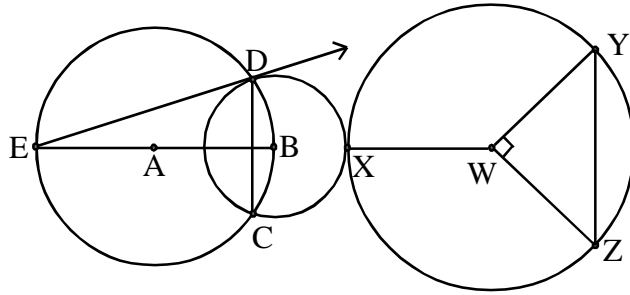
Give the BEST, MOST SPECIFIC answer possible.

1. Angles FGA and FGH are _____ angles. 1. _____
2. Ray CG is the same as ray _____. 2. _____
3. Name a pair of complementary angles. 3. _____
4. Triangle AGE is classified as _____ _____. 4. _____
5. Using correct notation, label a pair of congruent segments. 5. _____
6. How many obtuse angles are there in the figure on the left? 6. _____
7. Angles TWV and _____ are vertical angles. 7. _____
8. Quadrilateral STWX is a _____. 8. _____
9. If the $m\angle TWX$ is 133° , what is the $m\angle VWY$? 9. _____
10. Ray TW is the same as ray _____. 10. _____

Practice Test

Geometry 1.8

Use the figures below to answer the questions that follow:



Give the **BEST, MOST SPECIFIC** answer possible.

11. Name a point of tangency. 11. _____
12. What is the measure of arc \widehat{XY} if $\angle XWZ$ and $\angle XWY$ are congruent angles? 12. _____
13. Name two semicircles. 13. _____
14. How many arcs are there on circle W? 14. _____
15. Name three chords on circle A. 15. _____
16. A field is shaped like a regular hexagon, each side 15 meters long. How many posts will it take to enclose the field if they are spaced 5m apart? 16. _____
17. In regular octagon ABCDEFGH, are segments AB and EF parallel, perpendicular, or neither? 17. _____
18. How many **sides** (faces) are there on a triangular prism? 18. _____
19. How many **edges** are there on a pentagonal prism? 19. _____
20. Name the figure that will be formed by folding the net below: 20. _____

