Benchmark:  MA.912.G.1.1 Find the lengths and midpoints of line segments in two-dimensional coordinate systems.

Problem 1:  The circle shown below is centered at the origin and contains the point (-4, -2).

Which of the following is closest to the length of the diameter of the circle?

A. 13.41  
B. 11.66  
C. 8.94   
D. 4.47

Problem 2: On a coordinate grid, $AB$ has end point $B$ at (24, 16). The midpoint of $AB$ is $P(4, -3)$. What is the $y$-coordinate of Point $A$?

Problem 3:  Calculate the distance between $G$ (12, 4) and $H$ (12, 2).

**Benchmark:** MA.912.G.1.3 Identify and use the relationships between special pairs of angles formed by parallel lines and transversals.

**Problem 1:** In the figure below, $AB$ is parallel to $DC$. Which of the following statements about the figure must be true?

![Diagram of parallelogram with angles]

- A. $m \angle DAB + m \angle ABC = 180^\circ$
- B. $m \angle DAB + m \angle CDA = 180^\circ$
- C. $\angle BAD$ is congruent to $\angle ADC$
- D. $\angle ADC$ is congruent to $\angle ABC$

**Problem 2:** Highlands Park is located between two parallel streets, Walker Street and James Avenue. The park faces Walker Street and is bordered by two brick walls that intersect James Avenue at point $C$, as shown below.

What is the measure, in degrees, of $\angle ACB$, the angle formed by the park's two brick walls?

What is the measure, in degrees, of $\angle ACB$, the angle formed by the park's two brick walls?

Benchmark: MA.912.G.2.2 Determine the measures of interior and exterior angles of polygons, justifying the method used.

Problem 1: A regular hexagon and a regular heptagon share one side, as shown in the diagram below.

Which of the following is closest to the measure of \( x \), the angle formed by one side of the hexagon and one side of the heptagon?

A. 102.9°  
B. 111.4°  
C. 120.0°  
D. 124.5°

Problem 2: Claire is drawing a regular polygon. She has drawn two of the sides with an interior angle of 140°, as shown below.

When Claire completes the regular polygon, what should be the sum, in degrees, of the measures of the interior angles?
Benchmark: MA.912.G.2.3 Use properties of congruent and similar polygons to solve mathematical or real-world problems.

**Problem 1:** The owners of a water park want to build a scaled-down version of a popular tubular water slide for the children’s section of the park. The side view of the water slide, labeled $ABC$, is shown below.

![Water Slide Diagram](image)

Points $A'$, $B'$ and $C'$, shown above, are the corresponding points of the scaled-down slide. Which of the following would be closest to the coordinates of a new point $C'$ that will make slide $A'B'C'$ similar to slide $ABC$?

A. $(90, 20)$  
B. $(77, 20)$  
C. $(50, 20)$  
D. $(47, 20)$

**Problem 2:** Standard sizes of photo enlargements are not similar. Assume that all sizes are similar to the 5in. x 7in. size, where 5in is the width. What would be the corresponding length of an 8in. wide enlargement? (Note: 8in. x 10in. is the standard offering)
Benchmark: MA.912.G.2.4 Apply transformations (translations, reflections, rotations, dilations, and scale factors) to polygons to determine congruence, similarity, and symmetry. Know that images formed by translations, reflections, and rotations are congruent to the original shape. Create and verify tessellations of the plane using polygons.

**Problem 1:** Pentagon ABCDE is shown below on a coordinate grid. The coordinates for A, B, C, D, and E all have integer values.

If pentagon ABCDE is rotated 90° about point A clockwise to create pentagon A’B’C’D’E’, what will be the X-coordinate of E’?

**Problem 2:** The vertices of ΔRST are R(3,1), S(0,4), and T(-2,2). Use scalar multiplication to find the image of the triangle after a dilation centered at the origin with scale factor 9/2. Which of the following would be the coordinates of R’?

A.  \((27/2, 9/2)\)
B.  \((0, 18)\)
C.  \((-9, 9)\)
D.  \((26/2, 8/2)\)
**Problem 1:** Marisol is creating a custom window frame that is in the shape of a regular hexagon. She wants to find the area of the hexagon to determine the amount of glass needed. She measured diagonal $d$ and determined it was 40 inches. A diagram of the window frame is shown below.

Which of the following is the closest to the area, in square inches, of the hexagon?

A. 600  
B. 849  
C. 1,039  
D. 1,200

**Problem 2:** The FFA students want to plant a garden. The garden will be in the shape of a regular pentagon with an apothem of 4.1ft and side length of 6ft. How many feet of fence will they need to enclose the garden area shown below?
Benchmark: MA.912.G.3.3 Use coordinate geometry to prove properties of congruent, regular, and similar quadrilaterals.

**Problem 1:** On the coordinate grid below, quadrilateral \(ABCD\) has vertices with integer coordinates.

Quadrilateral \(QRST\) is similar to quadrilateral \(ABCD\) with point \(S\) located at \((5, -1)\) and point \(T\) located at \((-1, -1)\). Which of the following could be possible coordinates for point \(Q\)?

A. \((6, -4)\)
B. \((7, -7)\)
C. \((-3, -7)\)
D. \((-2, -4)\)
Problem 2: On the coordinate grid below, quadrilateral $WXYZ$ has vertices with integer coordinates. Quadrilateral $QRST$ is congruent to quadrilateral $WXYZ$ with point $S$ located at (-6, 6) and point $T$ located at (0, 6). Which of the following could be possible coordinates of point $Q$?

A. (0, 1)  
B. (0, 0)  
C. (-6, 1)  
D. (-6, 0)

Benchmark: MA.912.G.3.4 Prove theorems involving quadrilaterals.

**Problem 1:** Figure $ABCD$ is a rhombus. The length of $AE$ is $(x + 5)$ units, and the length of $EC$ is $(2x - 3)$ units.

Which statement best explains why the equation $x + 5 = 2x - 3$ can be used to solve for $x$?

- **A.** All four sides of a rhombus are equal.
- **B.** Opposite sides of a rhombus are parallel.
- **C.** Diagonals of a rhombus are perpendicular.
- **D.** Diagonals of a rhombus bisect each other.
Problem 2: Four students are choreographing their dance routine for the high school talent show. The stage is rectangular and measures 15 yards by 10 yards. The stage is represented by the coordinate grid below. Three of the students—Riley (R), Krista (K), and Julian (J)—graphed their starting positions, as shown below.

Let $H$ represent Hannah's starting position on the stage. What should be the $x$-coordinate of point $H$ so that $RKJH$ is a parallelogram?
Benchmark: MA.912.G.4.6 Prove that triangles are congruent or similar and use the concept of corresponding parts of congruent triangles.

Problem 1: Nancy wrote a proof about the figure shown below.

In the proof below, Nancy started with the fact that $XZ$ is a perpendicular bisector of $WY$ and proved that $\triangle WYZ$ is isosceles.

Which of the following correctly replaces the question mark in Nancy’s proof?

A. ASA
B. SAA
C. SAS
D. SSS
Problem 2: Samuel wrote a proof about the figure below.

In Samuel's proof below he started with angle B being congruent to angle D and proved that \( \triangle ABC \) is congruent to \( \triangle EDC \).

It is given that angle B is congruent to angle D. By the converse of the Base Angle Theorem, AC is congruent to EC. By the Vertical Angle Theorem, angle BCA is congruent to angle DCE. \( \triangle ABC \) is congruent to \( \triangle EDC \) by the ? Congruence Theorem.

Which of the following correctly replaces the question mark in Samuel's proof?

A. SSS  
B. AAS  
C. SAS  
D. ASA
Benchmark: MA.912.G.4.7 Apply the inequality theorems: triangle inequality, inequality in one triangle, and the Hinge Theorem.

Problem 1: A surveyor took some measurements across a river, as shown below. In the diagram, \( AC = DF \) and \( AB = DE \).

The surveyor determined that \( \angle BAC = 29 \) and \( \angle EDF = 32 \). Which of the following can he conclude?

A. \( BC > EF \)
B. \( BC < EF \)
C. \( AC > DE \)
D. \( AC < DF \)
Problem 2: Kristin has two dogs, Buddy and Socks. She stands at point $K$ in the diagram and throws two disks. Buddy catches one at point $B$, which is 11 meters (m) from Kristin. Socks catches the other at point $S$, which is 6 m from Kristin.

If $KSB$ forms a triangle, which could be the length, in meters, of segment $SB$?

A. 5 m  
B. 8 m  
C. 17 m  
D. 22 m
Benchmark: MA.912.G.5.4 Solve real-world problems involving right triangles.

Problem 1: In $\triangle ABC$, $BD$ is an altitude.

What is the length, in units, of $BD$?

A. 1  
B. 2  
C. $\sqrt{3}$  
D. $2\sqrt{3}$

Problem 2: Nara created two right triangles. She started with $\triangle JKL$ and drew an altitude from point $K$ to side $JL$. The diagram below shows $\triangle JKL$ and some of its measurements, in centimeters (cm).

Based on the information in the diagram, what is the measure of $x$ to the nearest tenth of a centimeter?
Benchmark: MA.912.G.6.5 Solve real-world problems using measures of circumference, arc length, and areas of circles and sectors.

**Problem 1:** Kayla inscribed kite $ABCD$ in a circle, as shown below.

If the measure of arc $ADC$ is 255° in Kayla’s design, what is the measure, in degrees, of angle $ADC$?

**Problem 2:** You focus your camera on a fountain. Your camera is at the vertex of the angle formed by the tangent to the fountain. You estimate that this angle is 40°. What is the measure, in degrees, of the arc of the circular basin of the fountain that will be in the photograph?
Benchmark: MA.912.G.6.6 Given the center and the radius, find the equation of a circle in the coordinate plane or given the equation of a circle in center-radius form, state the center and the radius of the circle.

**Problem 1:** Circle Q has a radius of 5 units with center Q(3.7, -2). Which of the following equations defines circle Q?

A. \((x + 3.7)^2 + (y - 2)^2 = 5\)
B. \((x + 3.7)^2 + (y - 2)^2 = 25\)
C. \((x - 3.7)^2 + (y + 2)^2 = 5\)
D. \((x - 3.7)^2 + (y + 2)^2 = 25\)

**Problem 2:** Given the equation, \((x + 3)^2 + (y - 5)^2 = 256\), find the length of the radius.

Benchmark: MA.912.G.7.1 Describe and make regular, non-regular, and oblique polyhedra, and sketch the net for a given polyhedron and vice versa.

**Problem 1:** Below is a net of a polyhedron.

![Net of a Polyhedron](image)

How many edges does the polyhedron have?

A. 6
B. 8
C. 12
D. 24

**Problem 2:** How many faces does a dodecahedron have?

Benchmark: MA.912.G.7.5 Explain and use formulas for lateral area, surface area, and volume of solids.

Problem 1: What is the surface area in square meters of a sphere whose radius is 7.5 m? Round to the nearest hundredth.

Problem 2: One gallon fills about 231 cubic inches. A right cylindrical carton is 12 inches tall and holds 9 gallons when full. Find the radius of the carton to the nearest tenth of an inch.

Benchmark: MA.912.G.7.7 Determine how changes in dimensions affect the surface area and volume of common geometric solids.

Problem 1: Kendra has a compost box that has the shape of a cube. She wants to increase the size of the box by extending every edge of the box by half of its original length. After the box is increased in size, which of the following statements is true?

A. The volume of the new compost box is exactly 112.5% of the volume of the original box.
B. The volume of the new compost box is exactly 150% of the volume of the original box.
C. The volume of the new compost box is exactly 337.5% of the volume of the original box.
D. The volume of the new compost box is exactly 450% of the volume of the original box.

Problem 2: A city is planning to replace one of its water storage tanks with a larger one. The city’s old tank is a right circular cylinder with a radius of 12 feet and a volume of 10,000 cubic feet. The new tank is a right circular cylinder with a radius of 15 feet and the same height as the old tank. What is the maximum number of cubic feet of water the new storage tank will hold?
Benchmark: MA.912.G.8.4 Make conjectures with justifications about geometric ideas. Distinguish between information that supports a conjecture and the proof of a conjecture.

**Problem 1:** For his mathematics assignment, Armando must determine the conditions that will make quadrilateral $ABCD$, shown below, a parallelogram.

![Parallelogram Diagram]

Given that the $m \angle DAB = 40^\circ$, which of the following statements will guarantee that $ABCD$ is a parallelogram?

A. $m \angle ADC + m \angle DCB + m \angle ABC + 40^\circ = 360^\circ$
B. $m \angle DCB = 40^\circ; m \angle ABC = 140^\circ$
C. $m \angle ABC + 40^\circ = 180^\circ$
D. $m \angle DCB = 40^\circ$

**Problem 2:**

![Diagram with angles]

What can you conclude from the information in the diagram?

A. $\angle 1 \equiv \angle 2$
B. $\angle 2$ and $\angle 4$ form a linear pair.
C. $\angle 3$ and $\angle 5$ are vertical angles.
D. $\angle 2$ and $\angle 4$ are complimentary angles.
Benchmark: MA.912.T.2.1 Define and use the trigonometric ratios (sine, cosine, tangent, cotangent, secant, cosecant) in terms of angles of right triangles.

Problem 1: A tackle shop and restaurant are located on the shore of a lake and are 32 meters (m) apart. A boat on the lake heading toward the tackle shop is a distance of 77 meters from the tackle shop. This situation is shown in the diagram below, where point $T$ represents the location of the tackle shop, point $R$ represents the location of the restaurant, and point $B$ represents the location of the boat.

The driver of the boat wants to change direction to sail toward the restaurant. Which of the following is closest to the value of $x$?

A. 23  
B. 25  
C. 65  
D. 67

Problem 2: Mr. Rose is remodeling his house by adding a room to one side, as shown in the diagram below. In order to determine the length of the boards he needs for the roof of the room, he must calculate the distance from point $A$ to point $D$.

What is the length, to the nearest tenth of a foot, of $AD$?

**Benchmark:** MA.912.D.6.2 Find the converse, inverse, and contrapositive of a statement. (Also assesses MA.912.D.6.3 Determine whether two propositions are logically equivalent.)

**Problem 1:** Which of the following is the **converse** of the following statement?

“If today is Sunday, then tomorrow is Monday.”

A. If tomorrow is Monday, then today is Sunday.
B. If tomorrow is not Monday, then today is Sunday.
C. If today is not Sunday, then tomorrow is not Monday.
D. If tomorrow is not Monday, then today is not Sunday.

**Problem 2:** Which of the following is the **inverse** of the following statement?

“For two lines that are cut by a transversal, if the lines are parallel, then the same-side interior angles are congruent.”

A. For two lines that are cut by a transversal, if the same-side interior angles are congruent, then the lines are parallel.
B. For two lines that are cut by a transversal, if the lines are not parallel, then the same-side interior angles are not congruent.
C. For two lines that are cut by a transversal, if the same-side interior angles are not congruent, then the lines are not parallel.
D. For two lines that are cut by a transversal, if the lines are parallel, then the same-side interior angles are not congruent.