

Compass and Straightedge Constructions

Grade 10 – Geometry math · Worksheet · Standards: G-CO.D.12, G-CO.D.13

Name: _____ Date: _____ Class: _____

These problems cover G-CO.D.12 and G-CO.D.13: constructions with a compass and straightedge, including copying segments and angles, bisecting, perpendicular and parallel lines, and regular polygons inscribed in a circle.

Early problems order the steps and find measures. Later problems justify why each construction works and use coordinates and areas.

Standards: G-CO.D.12, G-CO.D.13 · **Level:** Grade 10 Geometry

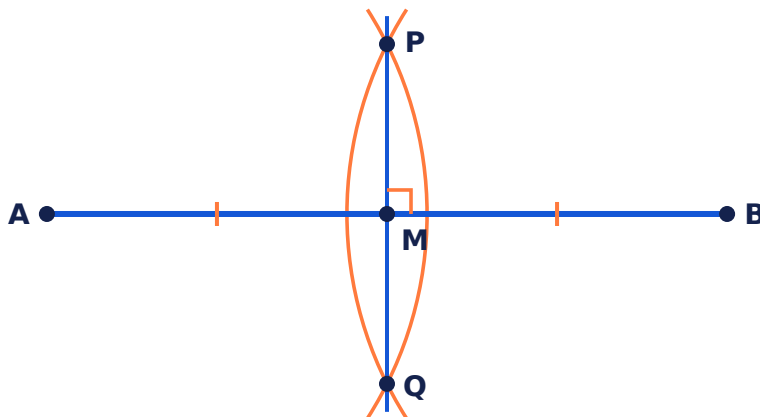
Problem 1 Order the steps to copy a segment (easy)

The steps for copying segment AB onto a ray are listed out of order. Put them in the correct order.

1. Without changing the opening, place the compass point on C and draw an arc that crosses the ray at D .
2. Draw a ray and mark its endpoint C .
3. Label the arc's crossing point D ; then CD is congruent to AB .
4. Place the compass point on A and open it until the pencil is on B .

Problem 2 Perpendicular bisector of a segment (easy)

Segment AB is 12 centimeters long. A perpendicular bisector is constructed with arcs that meet at P and Q , crossing AB at M . Find AM , MB and $m\angle AMP$. What must the compass opening exceed?



Problem 3 Bisect an angle (easy)

Ray OZ is built by the angle bisector construction for $\angle XOY = 74^\circ$. Find $m\angle XOZ$ and $m\angle ZOY$.

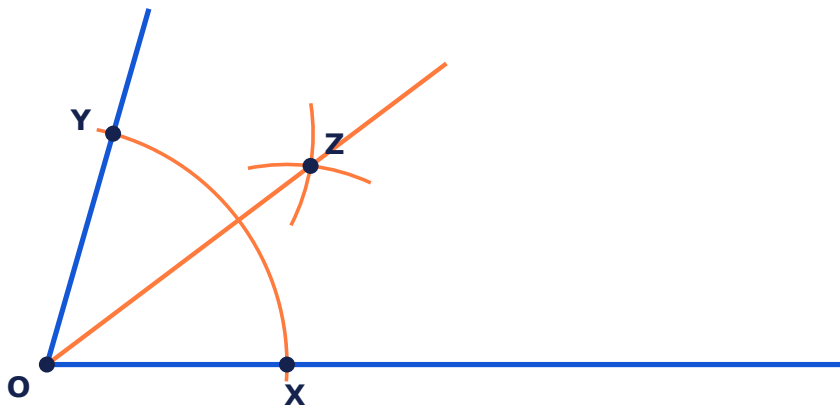


Figure for Problem 3.

Problem 4 Copy an angle (easy)

$\angle ABC$ measures 48° . It is copied onto a new ray from point D by drawing an arc, copying the chord, and drawing the second side. What is the measure of the new angle $\angle EDF$? Which two lengths must be equal for the copy to be exact?

Problem 5 Equilateral triangle on a segment (easy)

Arcs of radius AB are drawn from A and from B and meet at C . If $AB = 6.5$ centimeters, find the perimeter and each angle of $\triangle ABC$.

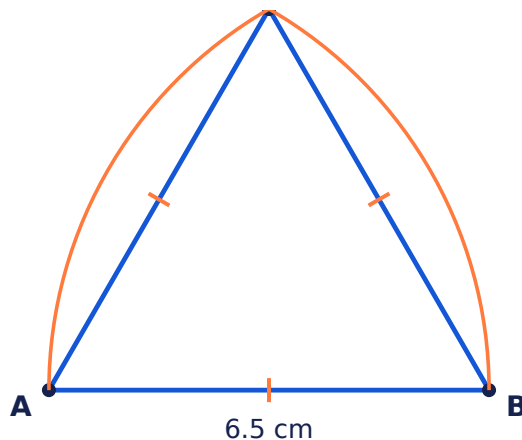


Figure for Problem 5.

Problem 6 Hexagon in a circle (medium)

A regular hexagon is inscribed in a circle of radius 5 centimeters by stepping the radius around the circle. Find the side length, the perimeter and the central angle for one side.

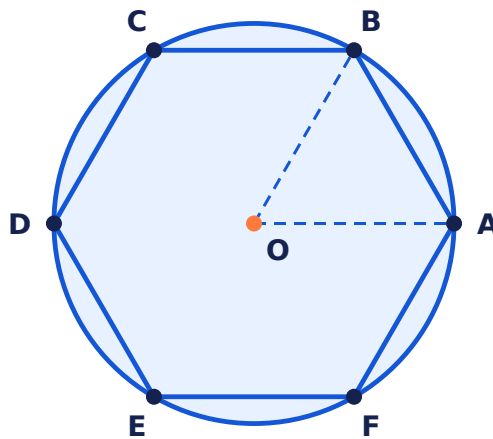


Figure for Problem 6.

Problem 7 Why the hexagon construction works (medium)

Explain why stepping the radius around a circle produces a central angle of 60° at each step. Name the type of triangle formed by the center and two neighboring marks.

Problem 8 Square in a circle (medium)

A square is inscribed in a circle of radius 8 by drawing two perpendicular diameters. Find the diagonal, the side length (to the nearest hundredth) and the area of the square.

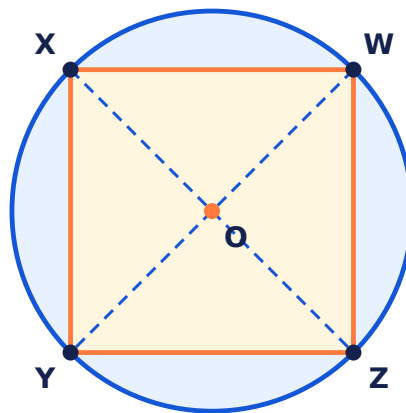


Figure for Problem 8.

Problem 9 Triangle in a circle (medium)

An equilateral triangle is inscribed in a circle of radius 6 by joining every second vertex of the inscribed hexagon. Find its side length to the nearest hundredth and its area.

Problem 10 Parallel line through a point (medium)

A line is drawn through point P crossing line m , making a 65° angle with m . A student copies this 65° corresponding angle at P to build a new line n . Why is n parallel to m ? Find the measure of the alternate interior angle.

Problem 11 Perpendicular through a point on a line (medium)

To build a perpendicular to line l through point P on l , a student draws an arc centered at P that crosses l at X and Y , then builds the perpendicular bisector of XY . Why does this line pass through P and form a right angle with l ?

Problem 12 Perpendicular from a point off the line (medium)

Point P is not on line l . An arc centered at P crosses l at X and Y . Then equal arcs from X and Y meet at Q on the other side of l . Explain why line PQ is perpendicular to l .

Problem 13 Spot the mistake (medium)

A student bisects a segment AB of length 10 centimeters but sets the compass to 4 centimeters for both arcs. What goes wrong? Give the smallest whole number of centimeters that would work.

Problem 14 Perpendicular bisector on a grid (medium)

Segment AB has endpoints $A(-4, 1)$ and $B(6, 5)$. Find its midpoint and the equation of its perpendicular bisector in slope-intercept form. Then show that $P(3, -2)$ is on that bisector and is equidistant from A and B .

Problem 15 Equidistant meeting point (hard)

Three friends live at $A(0, 0)$, $B(8, 0)$ and $C(8, 6)$, measured in blocks. They want to meet at a spot the same distance from all three homes. Construct the perpendicular bisectors of AB and BC and find where they meet and the distance to each home.

Problem 16 Hexagonal tile (hard)

A tile designer inscribes a regular hexagon in a circle of radius 9 inches by stepping the radius around the circle. Find the perimeter, the distance from the center to a side (the apothem) to the nearest hundredth, and the hexagon's area to the nearest tenth.

Problem 17 Square patio around a fountain (hard)

A circular fountain has a radius of 6.5 meters. A square patio is inscribed in the circle with its corners on the circle. Find the side length of the patio to the nearest hundredth, its area, and the percent of the circle's area the patio covers (nearest tenth).

Problem 18 Prove the angle bisector construction (hard)

In the angle bisector construction, the arc centered at O crosses the sides at X and Y , and equal arcs from X and Y meet at Z . Prove that $\angle XOZ \cong \angle YOZ$.

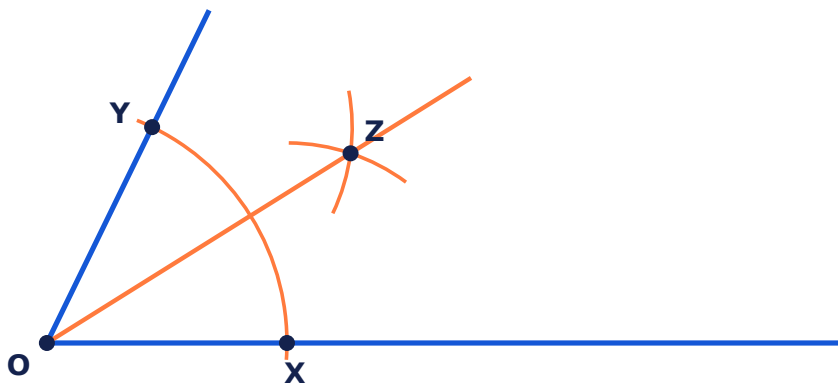


Figure for Problem 18.

Problem 19 Prove the perpendicular bisector construction (hard)

Arcs of equal radius centered at A and B meet at P and Q . Line PQ meets AB at M . Prove that PQ is the perpendicular bisector of AB .

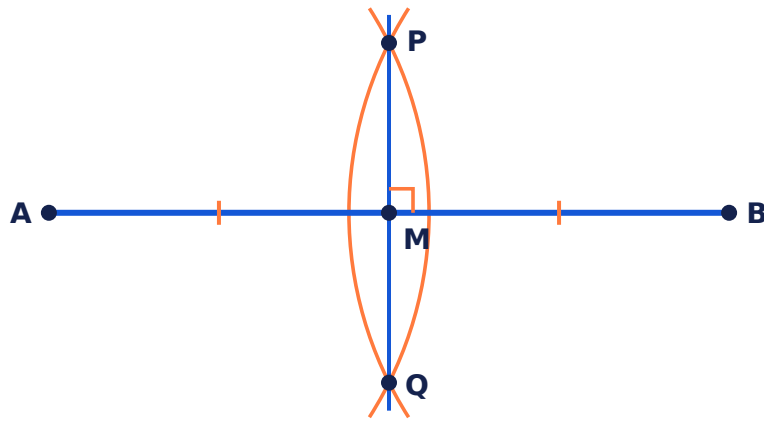


Figure for Problem 19.

Problem 20 Prove the radius steps around a circle (hard)

Circle O has radius r . Point A is on the circle, and an arc centered at A with radius r crosses the circle at B . Prove that $\angle AOB = 60^\circ$ and explain why the radius fits around the circle exactly six times.