

Topic C:

Perimeters and Areas of Polygonal Regions in the Cartesian Plane

G-GPE.B.7

Focus Standard: G-GPE.B.7 Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.*

Instructional Days: 3

Lesson 9: Perimeter and Area of Triangles in the Cartesian Plane (P)¹

Lesson 10: Perimeter and Area of Polygonal Regions in the Cartesian Plane (S)

Lesson 11: Perimeters and Areas of Polygonal Regions Defined by Systems of Inequalities (P)

Lesson 9 begins Topic C with students finding the perimeter of triangular regions using the distance formula and deriving the formula for the area of a triangle with vertices $(0, 0)$, (x_1, y_1) , (x_2, y_2) as

$A = \frac{1}{2}|x_1y_2 - x_2y_1|$ (**G-GPE.B.7**). Students are introduced to the “shoelace” formula for area and

understand that this formula is useful because only the coordinates of the vertices of a triangle are needed.

In Lesson 10, students extend the “shoelace” formula to quadrilaterals, showing that the traditional formulas are verified with general cases of the “shoelace” formula and even extend this work to other polygons (pentagons and hexagons). Students compare the traditional formula for area and area by decomposition of figures and see that the “shoelace” formula is much more efficient in some cases. This work with the “shoelace” formula is the high school Geometry version of Green’s theorem and subtly exposes students to elementary ideas of vector and integral calculus. Lesson 11 concludes this work as the regions are described by a system of inequalities. Students sketch the regions, determine points of intersection (vertices), and use the distance formula to calculate perimeter and the “shoelace” formula to determine area of these regions. Students return to the real-world application of programming a robot and extend this work to robots not just confined to straight line motion but also motion bound by regions described by inequalities and defined areas.

¹ Lesson Structure Key: **P**-Problem Set Lesson, **M**-Modeling Cycle Lesson, **E**-Exploration Lesson, **S**-Socratic Lesson