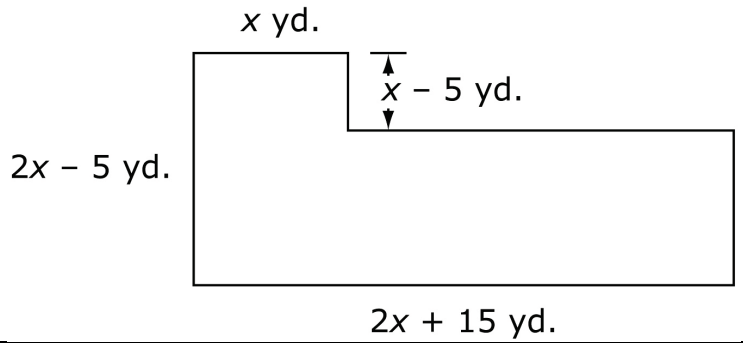
MAT.HS.ER.3.0AAPR.F.045

Sample Item ID:	MAT.HS.ER.3.0AAPR.F.045
Grade:	HS
Claim:	**Claim 3. Communicating Reasoning** Students can clearly and precisely construct viable arguments to support their own reasoning and to critique the reasoning of others.
Secondary Claim(s):	Claim 1: Concepts and Procedures Students can explain and apply mathematical concepts and carry out mathematical procedures with precision and fluency.
Content Domain:	Algebra
Assessment Target(s):	3 F: Base arguments on concrete referents such as objects, drawings, diagrams, and actions. 3 B: Construct, autonomously, chains of reasoning that will justify or refute propositions or conjectures. 1 F: Perform arithmetic operations on polynomials.
Standard(s):	A-APR.1
Mathematical Practice(s):	1, 2, 3, 6
DOK:	3
Item Type:	ER
Score Points:	3
Difficulty:	H
Key:	See Sample Top-Score Response.
Stimulus/Source:	
Target-specific attributes (e.g., accessibility issues):	
Notes:	Multi-part item – Part of PT set

Part A

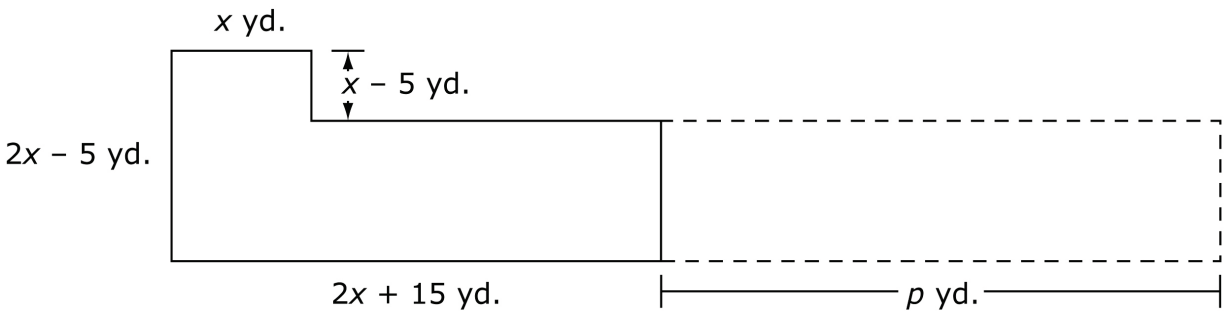
A town council plans to build a public parking lot. The outline below represents the proposed shape of the parking lot.



Write an expression for the area, in square feet, of this proposed parking lot. Explain the reasoning you used to find the expression.

Part B

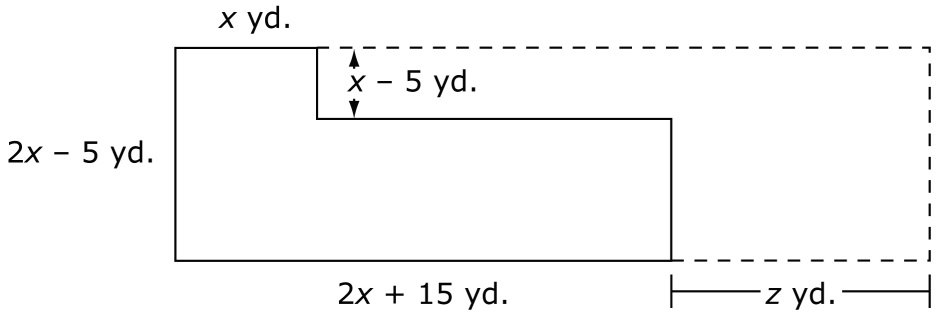
The town council has plans to double the area of the parking lot in a few years. They create two plans to do this. The first plan increases the length of the base of the parking lot by p yards, as shown in the diagram below.



Write an expression in terms of x to represent the value of p, in feet. Explain the reasoning you used to find the value of p.

Part C

The town council's second plan to double the area changes the shape of the parking lot to a rectangle, as shown in the diagram below.



Can the value of z be represented as a polynomial with integer coefficients? Justify your reasoning.

Sample Top-Score Response:

Part A

Missing vertical dimension is $2x - 5 - (x - 5) = x$.
Area $= x(x - 5) + x(2x + 15)$
$= x^2 - 5x + 2x^2 + 15x$
$= 3x^2 + 10x$ square yards

Part B

Doubled area $= 6x^2 + 20x$ square yards.
Area of top left corner $= x^2 - 5x$ square yards.
Area of lower portion with doubled area $= 6x^2 + 20x - (x^2 - 5x)$
$= 5x^2 + 25x$ square yards

Since the width remains x yards, the longest length must be
$(5x^2 + 25x) \div x = 5x + 25$ yards long.
So, $y = 5x + 25 - (2x + 15) = 5x + 25 - 2x - 15 = 3x + 10$ yards.

Part C
If z is a polynomial with integer coefficients, the length of the rectangle, $2x + 15 + z$, would be a factor of the doubled area. Likewise, $2x - 5$ would be a factor of the doubled area. But $2x - 5$ is not a factor of $6x^2 + 20x$. So $2x + 15 + z$ is not a factor either. Therefore, z cannot be represented as a polynomial with integer coefficients.

Scoring Rubric:

Responses to this item will receive 0-3 points, based on the following:

3 points: The student has a solid understanding of how to articulate reasoning with viable arguments associated with adding, subtracting, and multiplying polynomials. The student answers *parts A* and *B* correctly, showing all relevant work or reasoning. The student also clearly explains assumptions made in *Part C* as well as showing how they lead to a refutation of the conjecture that a given polynomial has integer coefficients.

2 points: The student understands how to add, subtract, and multiply polynomials but cannot clearly articulate reasoning with viable arguments associated with these tasks. The student answers *parts A* and *B* correctly, showing all relevant work or reasoning. However, the student has flawed or incomplete reasoning associated with assumptions made in *Part C* that lead to a refutation of the conjecture that a given polynomial has integer coefficients.

1 point: The student has only a basic understanding of how to articulate reasoning with viable arguments associated with adding, subtracting, and multiplying polynomials. The student makes one or two computational errors in *parts A* and *B*. The student also has flawed or incomplete reasoning associated with assumptions made in *Part C* that lead to a refutation of the conjecture that a given polynomial has integer coefficients.

0 points: The student demonstrates inconsistent understanding of how to articulate reasoning with viable arguments associated with adding, subtracting, and multiplying polynomials. The student makes three or more computational errors in *parts A* and *B*. The student also has missing or flawed reasoning related to determining whether a given polynomial has integer coefficients.