Sales, Distribution, and Marketing Operations (52.1801) T-Chart

Calculate selling space = Apply geometric concepts to solve real-world problems

Program Task: Store Operations, calculate selling space.	**PA Core Standard:** CC.2.3.HS.A.14

Description: Apply geometric concepts to solve real-world problems.

Program Associated Vocabulary:
AREA, SELLING SPACE, SALES PER SQUARE FOOT, GROSS SALES, NET SALES, SQUARE FOOTAGE

Math Associated Vocabulary:
LENGTH, HEIGHT, BASE, WIDTH, DIAMETER, RADIUS, HYPOTENUSE, AREA, PERIMETER, CIRCUMFERENCE

Program Formulas and Procedures:
When establishing a business and selecting a location, one needs to know how to calculate selling space. Selling space includes areas in which merchandise is kept but does not include bathrooms, stockrooms, offices, etc. Look at the floor plan below: What is the selling space of the store?
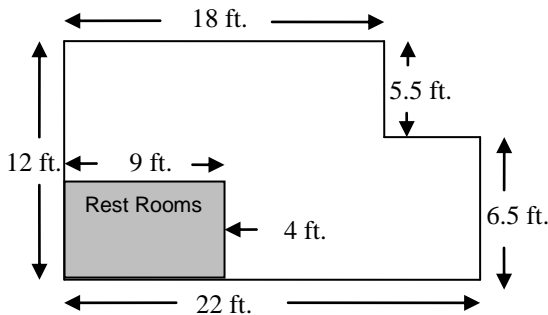
Formulas and Procedures:
Rectangle: $A = lw$ $P = 2l + 2w$

Trapezoid: $A = \dfrac{h(a+b)}{2}$

Circle: $A = \pi r^2$ $C = 2\pi r$ or πd
        (Circumference = circle perimeter)

Triangle: $A = \dfrac{1}{2} bh$ $P = a + b + c$

Pythagorean Theorem: $c^2 = a^2 + b^2$

One method of calculating the selling area, is to partition the figure into two rectangles, one measuring 18' x 12' and the other measuring 4' x 6.5'. (22' − 18' = 4')

Then find the total area of both rectangles.

18' x 12' = 216 sq. feet

4' x 6.5' = 26 sq. feet

Total area = 216 sq. feet + 26 sq. feet = 242 sq. feet.

Next subtract the area lost to restroom space.

Restroom space = 9' x 4' = 36 sq. feet.

Selling space = 242' − 36' = 206 sq. feet.

An irregular figure can be broken down into two or more regular shapes, such as triangles, circles, trapezoids or rectangles.

To find the **perimeter** around irregular figures, add the lengths of the sides. If the sides of the figures include circles, use the circumference formula to calculate the length of that portion of the figure and add it to the total of the other sides.

Example 1: To find the **area** of an irregular figure, separate the figure into shapes for which you can calculate the area. The sum of the areas of each smaller figure is the area of the irregular figure.
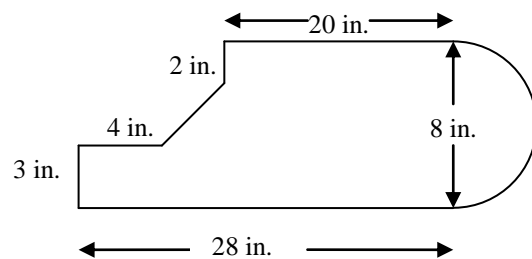
To find the **perimeter** of the figure above, use the Pythagorean theorem and circumference formula to find the missing lengths:
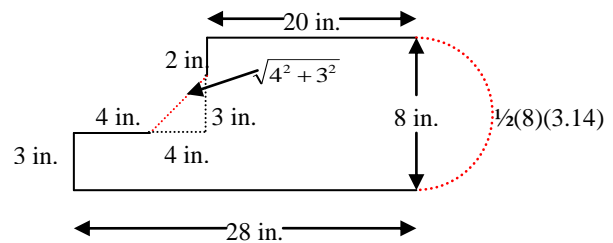
To find the **area** of the same figure, divide the figure into one triangle, two rectangles, and one semi-circle.

Instructor's Script - Comparing and Contrasting
Persons employed in Marketing and Sales are required to determine the area of irregular figures represented in architectural drawings. Most floor plans are not represented by basic rectangles. The complexity of the architectural design involves multiple shapes forming the irregular figure.

Common Mistakes Made By Students
Mixing perimeter and area formulas or calculations: Perimeter formulas calculate the length of the outside edge of an object, while area formulas calculate the space taken up by the shape. Areas and perimeters should not be compared (apples and oranges) because perimeter is measured as a unit length while area is that same unit squared.

Perimeter calculations should <u>not</u> include inner edges: The perimeter of an irregular object should follow the outer edge of the figure. If you find the perimeter for basic shapes constructed within the irregularly shaped object, be sure to eliminate the auxiliary lines (inner edges) that don't follow the outside edge.

Finding basic shapes within irregular objects can be frustrating: Some irregular objects can be broken into basic shapes with only a couple of extra lines, while others seem to take a lot more. Don't feel locked in to your first attempt if it is too messy.

Empty shapes in the figure require subtracting the area of the "hole": If your plan includes areas that create holes in the object, you will be subtracting out that area to get a final answer (e.g., a deck plan that has a spot for a hot tub).
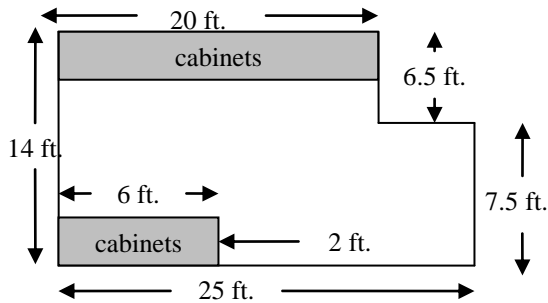
Final answer may include multiple parts: Don't forget to total all the various areas or perimeters to get your final answer.

**Be sure to find all missing lengths before calculating the perimeter.**

CTE Instructor's Extended Discussion
Having a strong understanding of the area of irregular shapes is important for anyone who is looking to open a retail storefront, set up fixtures for a retail store, arrange display areas in store and window displays, utilize the selling space available in the store, or organize the distribution center. Store managers have to create displays and place fixtures in a manner that makes the shopping experience pleasant for the customers and functional for the store employees.
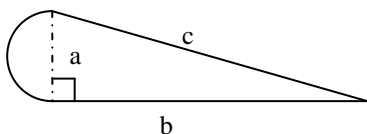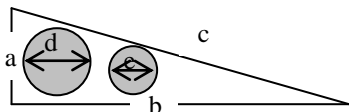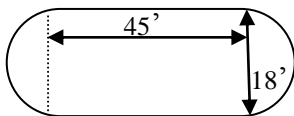
Federal and state laws also mandate codes on businesses to allow for restrooms, ramps, wider aisles, and additional accessibility for customers and employees. This information must be configured into to the layout and design of the store or business.
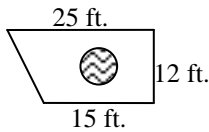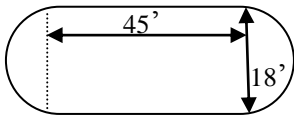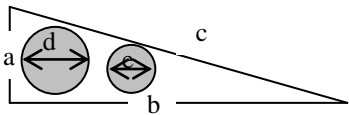
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Problems	Career and Technical Math Concepts	Solutions
1. Find the area of the floor plan shown on the right.		
2. Find the total perimeter of the retail space shown to the right.		
3. Each cabinet unit is 2 feet deep. How much open floor area is available for displays?		

Problems	Related, Generic Math Concepts	Solutions
4. A health club has a circular jogging track with an outside diameter of 200 feet and the track is 15 feet wide. What is the area of the track?		
5. Your goal is to paint a mural that depicts a large yellow image of the Sun, risen half-way above the eastern horizon. You buy a gallon of yellow paint and read that the manufacturer claims it will cover a 200 square foot wall. What is the diameter of the largest sun you can paint?		
6. The installer plans to build a new patio with a 6 ft. (d) round hot tub in the center. What is the area of material needed around the hot tub pictured in the patio below?		
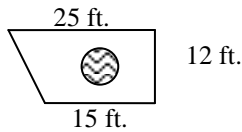
Problems	PA Core Math Look	Solutions
7. Find the area of the figure pictured.		
8. Find the area of the unshaded area if a = 5, b = 18, d = 3, and e = 1.		
9. Find the perimeter of the figure if c = 37 and b = 24.		

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Problems	Career and Technical Math Concepts	Solutions
1. Find the area of the floor plan shown on the right.		14 x 20 = 280 7.5 x 5 = 37.5 Total square footage = 317.5 sq. ft.
2. Find the total perimeter of the retail space shown to the right.		20 + 6.5 + 7.5 + 25 + 14 = 73ft.
3. Each cabinet unit is 2 feet deep. How much open floor area is available for displays?		Total sq. ft. = 317.5 Cabinet 1: 6 x 2 = 12 sq. ft., cabinet 2: 20 x 2 = 40 sq. ft. 40 + 12 = 52 sq. ft. 317.5 – 52 = 265.5 sq. ft.

Problems	Related, Generic Math Concepts	Solutions
4. A health club has a circular jogging track with an outside diameter of 200 feet and the track is 15 feet wide. What is the area of the track?		The diameter of the smaller circle is (200 - (15+15)) feet Large circle area = Pi (100 * 100) Large circle area = 3.14 * 10,000, or 31,400 ft^2 Small circle area = 3.14 * 85 * 85, or 22,687 ft^2 Area of the track = Large Circle Area (31,400) - Small Circle Area (22,687), or 8,718 ft^2.
5. Your goal is to paint a mural that depicts a large yellow image of the Sun, risen half-way above the eastern horizon. You buy a gallon of yellow paint and read that the manufacturer claims it will cover a 200 square foot wall. What is the diameter of the largest sun you can paint?		You base your estimations on a semi-circle whose area is 200 sq. ft. (full circle size would be 400 sq. ft.) Formula to use: Diameter = (Sqrt(Area/π)) • 2 Diameter = (Sqrt(400/3.14)) • 2 Diameter = Sqrt 127 • 2 Diameter = 11.27 • 2 Diameter = 22.5 feet
6. The installer plans to build a new patio with a 6 ft. (d) round hot tub in the center. What is the area of material needed around the hot tub pictured in the patio below? 25 ft. 12 ft. 15 ft.		Area of patio = area of a trapezoid (patio shape) – area of the circle (hot tub shape) Area = $\frac{h(a+b)}{2}$ - πr^2 A = $\frac{12(15+25)}{2}$ - $\pi 3^2$ A= 240 – 28.26 = 211.74 ft.^{2}

Problems	PA Core Math Look	Solutions

7. Find the area of the figure pictured.
 	
45'
18'
		Area = Area Rectangle + Area one full circle
		   = lw + πr^2 (l=45, w=18, r = radius = ½ × 18 = 9')
		   = (45)(18) + $\pi(9)^2$
		   = 810 + 254.5
		   = 1064.5 ft.^{2}

8. Find the area of the unshaded area if a = 5, b = 18, d = 3, and e = 1.
 	
d   c
a
b
		Area = Area triangle – Area circle 1 – Area circle 2
		   = ½ bh – πr^2 - πr^2 (radius circle 1 = ½ × 3 = 1.5 radius -
		                          circle 2 = ½ × 1 = 0.5)
		   = ½ (18)(5) – $\pi(1.5)^2$ $\pi(0.5)^2$
		   = 45 – 7.1 - .8
		   = 37.1 units^2

9. Find the perimeter of the figure if c = 37 and b = 24. c a b		Perimeter = c + b + semicircle with diameter a. $a^2 + b^2 = c^2$ $a^2 + 24^2 = 37^2$ $a^2 + 576 = 1369$ $a^2 + 576 - 576 = 1369 - 576$ $a^2 = 793$ $\sqrt{a^2} = \sqrt{793}$ a = 28.2 = diameter of semicircle circumference of semicircle =1/2 dπ = ½ (28.2)(3.14) = 44.27 Total perimeter = 37 + 24 + 44.27 = 105.27 units