Welding (48.0508) T-Chart

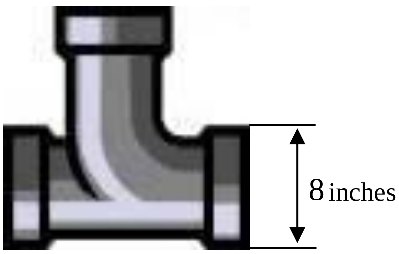
Calculate welding surface area for attaching fittings	=	Apply geometric concepts to model and solve real world problems

Program Task: Calculate welding surface area for attaching fittings**.**

Program Associated Vocabulary:
AREA, CIRCUMFERENCE, DIAMETER, RADIUS

Program Formulas and Procedures:
Formula for Circumference:

$C = \pi d$ or $C = 2\pi r$



Example 1:
If an experienced welder was going to attach two of the fittings pictured above using the stick weld method with 16" "sticks", and could get 10" of coverage from one stick, how many sticks would be needed to attach the fittings?

$C = \pi d \quad C = \pi 8" \quad C = 25.13"$

$\frac{25.13"}{10} = 2.5 \text{ sticks}$

The welder would need to buy three 16" welding sticks.

Example 2:
Find the surface area of the cylinder to determine the welding material needed for entire surface of a cylinder. ($\pi = 3.14$)

Formula for Surface Area: $SA = 2\pi r^2 + 2\pi rh$

$SA = 2\pi r^2 + 2\pi rh$

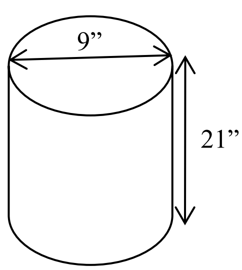
$SA = 2\pi(4.5^2) + 2\pi(4.5 \times 21)$

$SA = 2\pi(20.25) + 2\pi(94.5)$

$SA = 40.5\pi + 189\pi$

$SA = 229.5\pi$

$SA \approx 720.63 \text{ in.}^2$



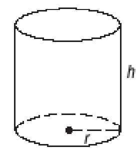
PA Core Standard: CC.2.3.HS.A.14

Description: Apply geometric concepts to model and solve real world problems.

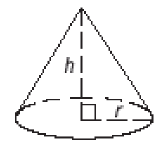
Math Associated Vocabulary:
AREA, CROSS SECTION, LENGTH, WIDTH, ROUND, BASE, HEIGHT, RADIUS, RECTANGULAR PRISM

Formulas and Procedures:
Surface Area:

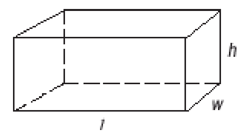
Cylinder:
$SA = 2\pi r^2 + 2\pi rh$



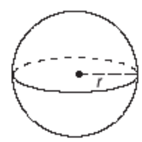
Cone:
$SA = \pi r^2 + \pi r\sqrt{(r^2+h^2)}$



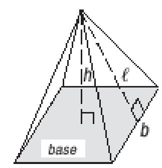
Rectangular Prism:
$SA = 2lw + 2wh + 2hl$



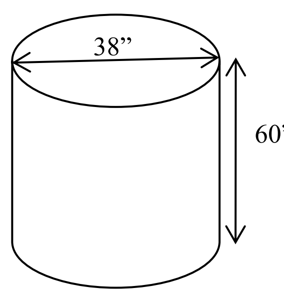
Sphere:
$SA = 4\pi r^2$



Pyramid:
SA = (area of the base) + ½ ℓ (perimeter of base)
b = base, h = height, ℓ = slant length



Example: Find the surface area of the cylinder below.



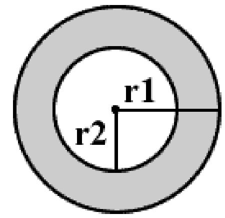
r = ½ • 38" = 19" h = 60"
Cylinder $SA = 2\pi r^2 + 2\pi rh$
$SA = 2\pi(19)^2 + 2\pi(19)(60)$
$SA = 722\pi + 2{,}280\pi$
$SA = 3{,}002\pi$
$SA \approx 9{,}426.28$ in

Welding (48.0508) T-Chart

Instructor's Script – Comparing and Contrasting

Surface Area is the total area of all surfaces of a solid object. Unlike lateral area, it includes the area of the bases(s) of the figure. The surface area formulas used in technical trades are the same as in mathematics. The formulas correspond to the areas of the individual surfaces of the objects as noted on the right side of the T-Chart.

One additional surface area formula useful in some everyday applications (e.g., brakes) is the **annulus**:



Annulus**:** $SA = \pi(r_2 + r_1)(r_1 - r_2)$ or $SA = \pi \div 4(d^2 - f^2)$

Where d = the OUTER diameter & f = the INNER diameter (d = 12 and f = 3)

$$SA = \pi(r_2 + r_1)(r_1 - r_2) \text{ or } SA = \pi \div 4(d^2 - f^2)$$

$$SA = \pi(1.5 + 6)(6 - 1.5) \text{ or } SA = .7854(12^2 - 3^2)$$

$$SA = 106.3 \text{ sq.ft.}$$

** Use the annulus formula for problem #2 on page 3.

When using these surface area formulas for technical applications, the student must identify which parts of the formulas to use, as many applications will not be concerned with ALL surfaces of an object.

For example, cylinders include a top and bottom **(**$2\pi rh$**)**, but if you are calculating a hemi-cylinder, you will want to remove the top out of the formula and replace it with a specialized formula for the cap.

Common Mistakes Made By Students

Using incorrect formula: Students may use an incorrect formula to solve a problem. To rectify these errors have the students correctly identify the type of object they are dealing with and use the appropriate formula. Frequently two formulas may be needed for complex problems.

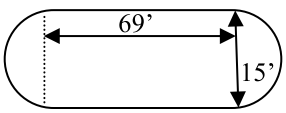
Using consistent units: If the problem asks for the answer in square feet instead of square inches, be sure to either convert your given measurements into feet first (inches ÷ 12 = feet) or convert your square inch answer into square feet (sq. inches ÷ 144 = sq. feet).

Not "removing" unnecessary surface areas from calculations: Depending on the problem, not all surface areas included in formula may be needed. Identify the areas that are required for the calculation and remove from formula as needed.

CTE Instructor's Extended Discussion

Technical tasks are usually not presented using this model. Therefore, it is important that technical instructors demonstrate to students how these math concepts link to and are relevant in their technical training and that the math is presented in a way which shows a relationship to math that CTE students use in their academic school settings.

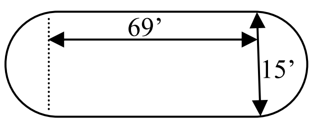
Welding (48.0508) T-Chart

Problems Career and Technical Math Concepts	Solutions
1. Calculate the area of scrap remaining after cutting a 42” diameter hole (Circle 1) and a 49” diameter hole (Circle 2) from a piece of sheet metal 54” W X 95” L.	
2. What is the working (surface) area of a 14’diameter round welding worktable? What is the working (surface) area if the same table has a 3’diameter hole in the middle for a trash receptacle? Use the formula: $SA = \pi(r_2 + r_1)(r_1 - r_2)$ or $SA = \pi \div 4(d^2 - f^2)$	
3. If a welder must weld around the perimeter (P) of the semi-circular shaped table, what is the linear measurement he/she needs to weld? 	

Problems Related, Generic Math Concepts	Solutions
4. 4. You need fabric to cover a 4-sided pyramid with base sides of 12’ & slant length of 20’. How many square feet of fabric will you need to cover all sides of the pyramid? How many square yards? Note: $1yd^2 = 9\ ft^2$.	
5. 5. One soup can has a radius = 3” and height = 4”; another soup can has a radius = 4” and a height = 3”. Which can has a greater total surface area?	
6. 6. A size 7 regulation basketball has a d = 9.39”. A size 6 regulation basketball has a d = 9.07”. What is the surface area of each basketball?	

Problems PA Core Math Look	Solutions
7. 7. Find the surface area of a cylinder with a diameter of 13.75’ and a height of 28.45’.	
8. 8. Find the surface area of a sphere that has a diameter of 27.75”.	
9. 9. Find the total surface area of a cone with a base diameter of 15.5” and a height of 22”.	

Welding (48.0508) T-Chart

Problems	Career and Technical Math Concepts Solutions
1. Calculate the area of scrap remaining after cutting a 42" diameter hole (Circle 1) and a 49" diameter hole (Circle 2) from a piece of sheet metal 54" W X 95" L.	$A(\text{Circle1}) = \pi 21^2$, $A(\text{Circle2}) = \pi 24.5^2$ $A(\text{Circle1}) = 1385.4$, $A(\text{Circle2}) = 1885.7$ (All in^2) $A(\text{Sheet Metal}) = 54 \times 95$, $A = 5130$ $A(\text{Scrap}) = 5130 - (1385.4 + 1885.7)$, $A = 1858.9 \text{ in.}^2$
2. What is the working (surface) area of a 14'diameter round welding worktable? What is the working (surface) area if the same table has a 3'diameter hole in the middle for a trash receptacle? Use the formula: $SA = \pi(r_2 + r_1)(r_1 - r_2)$ or $SA = \pi \div 4(d^2 - f^2)$	$SA = \pi r^2$ $SA = \pi 7^2$ $SA = 153.9$ sq.in. area of the worktable $SA = \pi(1.5 + 7)(7 - 1.5)$ or $SA = \pi \div 4(14^2 - 3^2)$ $SA = \pi(8.5)(5.5)$ or $.7854(196 - 9)$ $SA = 146.89$ sq.ft. area of the worktable less the hole
3. If a welder must weld around the perimeter (P) of the semi-circular shaped table, what is the linear measurement he/she needs to weld?  	$P = \text{Circumference} + (2)\text{Length}$ $P = 15\pi + (2 \times 69)$, $P = 47.12 + 138$, $185.1'$
Problems	**Related, Generic Math Concepts Solutions**
4. You need fabric to cover a 4-sided pyramid with base sides of 12' & slant length of 20'. How many square feet of fabric will you need to cover all sides of the pyramid? How many square yards? Note: 1yd^2 = 27 ft^2.	Pyramid: SA = (base area) + ½ ℓ(number of base sides)(b) SA = 144 + ½ (20)(4)(12) SA = 144 + 480 SA = 624 ft^2 SA = 624 ft^2 ÷ 9 ≈ 69.3 yd^2.
5. One soup can has a radius = 3" and height = 4"; another soup can has a radius = 4" and a height = 3". Which can has a greater total surface area?	Can 1: Can 2: (Greater surface Area) $SA = 2\pi(3^2) + 2\pi(3)(4)$ $SA = 2\pi(4^2) + 2\pi(4)(3)$ $SA \approx 57 + 75$ $SA \approx 101 + 75$ $SA \approx 132$ in^2 $SA \approx 176$ in^2
6. A size 7 regulation basketball has a d = 9.39". A size 6 regulation basketball has a d=9.07". What is the approx. surface area of each basketball?	Ball 1: r = 4.695 Ball 2: r = 4.535 $SA = 4\pi(4.695^2)$ $SA = 4\pi(4.535^2)$ $SA = 4\pi(22.04)$ $SA = 4\pi(20.57)$ $SA \approx 277$ in^2 $SA \approx 259$ in^2
Problems	**PA Core Math Look Solutions**
7. Find the surface area of a cylinder with a diameter of 13.75' and a height of 28.45'.	Cylinder $SA = 2\pi r^2 + 2\pi rh$ Radius = ½ d = 6.875' $SA = 2\pi(6.875)^2 + 2\pi(6.875)(28.45)$ $SA = 94.53125\pi + 391.1875\pi$ $SA = 485.71875\pi$ SA = 1525.9 ft^2.
8. Find the surface area of a sphere that has a diameter of 27.75".	Sphere $SA = 4\pi r^2$ Radius = r = 27.75/2 = 13.875" $SA = 4\pi(13.875)^2$ $SA = 770.0625\pi$ $SA \approx 2419.2$ in^2
9. Find the total surface area of a cone with a base diameter of 15.5" and a height of 22".	Cone: $SA = \pi r^2 + \pi r\sqrt{(r^2+h^2)}$ $SA = \pi(7.75)^2 + \pi(7.75)\sqrt{((7.75)^2 + 22^2)}$ $SA = 60.0625\pi + \pi(7.75)\sqrt{60.0625 + 484}$ $SA = 60.0625\pi + \pi(7.75)\sqrt{544.0625}$ $SA = 60.0625\pi + \pi(7.75)(23.325)$ $SA = 60.0625\pi + \pi(180.769)$ $SA = 240.83\pi$ $SA \approx 756.2$ in^2.