

104 - Volume and Vol Unit Conversions

Data Sheet - Measurement Conversion Charts

S.I. to S.I.		Exact?
1 km	1000 m	✓
1 m	100 cm	✓
1 cm	10 mm	✓

Imperial to Imperial		Exact?
1 mi.	1760 yd.	✓
1 yd.	3 ft.	✓
1 ft.	12 in.	✓

Imperial to S.I.		Exact?
1 mi.	1.609 km	×
1 yd.	0.9144 m	×
1 ft.	30.48 cm	✓
1 in.	2.54 cm	✓

Data Sheet - Geometric Formulas

Area

Circle $A = \pi r^2$

Triangle $A = \frac{b \times h}{2}$

Parallelogram $A = b \times h$

Trapezoid $A = h \left(\frac{b_1 + b_2}{2} \right)$

Surface Area

Sphere $SA = 4\pi r^2$

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

Cone $SA = \pi r^2 + \pi rs$

Prism $SA = 2lw + 2lh + 2wh$

Volume

Sphere $V = \frac{4}{3}\pi r^3$

Cylinder $V = \pi r^2 h$

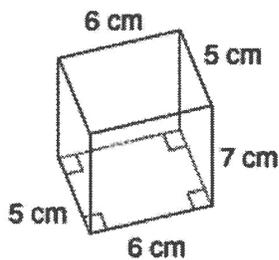
Prism $V = B \times h$

Cone $V = \frac{1}{3}\pi r^2 h$

Pyramid $V = \frac{B \times h}{3}$

Part 1 - Surface Area versus Volume Unit Conversions

Q1: Calculate the Surface Area and Volume of the shape:



Surface Area	Volume
<p>Top = $5 \times 6 = 30$ Bottom = 30 Left = $5 \times 7 = 35$ Right = 35 Front = $6 \times 7 = 42$ Back = 42 <u>214 cm²</u></p>	<p>VOL = (Area of Base) \times Height = $(5 \times 6) \times 7$ = $(30) \times 7$ = 210 cm^3</p>

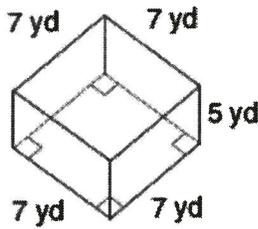
Q2: Convert the Surface Area to in². How many times do we need to apply the conversion? *Twice!*

$$\frac{214 \cancel{\text{cm}} \cdot \cancel{\text{cm}}}{1} \times \frac{1 \cancel{\text{in}}}{2.54 \cancel{\text{cm}}} \times \frac{1 \cancel{\text{in}}}{2.54 \cancel{\text{cm}}} = \frac{214 \text{ in}^2}{6.4516} = \boxed{33.17 \text{ cm}^2}$$

Q3: Convert the Volume to in³. How many times do we need to apply the conversion? *Three Times!*

$$\frac{210 \cancel{\text{cm}} \cdot \cancel{\text{cm}} \cdot \cancel{\text{cm}}}{1} \times \frac{1 \cancel{\text{in}}}{2.54 \cancel{\text{cm}}} \times \frac{1 \cancel{\text{in}}}{2.54 \cancel{\text{cm}}} \times \frac{1 \cancel{\text{in}}}{2.54 \cancel{\text{cm}}} = \frac{210 \text{ in}^3}{16.387064} = \boxed{12.81 \text{ in}^3}$$

Q4: Calculate the Surface Area and Volume of the shape:



Surface Area	Volume
$\begin{aligned} \text{Top} &= 7 \times 7 = 49 \\ \text{Bottom} &= 49 \\ \text{Front} &= 7 \times 5 = 35 \\ \text{Back} &= 35 \\ \text{Right} &= 7 \times 5 = 35 \\ \text{Left} &= 35 \\ \hline &= 238 \text{ yd}^2 \end{aligned}$	$\begin{aligned} \text{Vol} &= (\text{Area of Base}) \times \text{Height} \\ &= (7 \times 7) \times 5 \\ &= (49) \times 5 \\ &= 245 \text{ yd}^3 \end{aligned}$

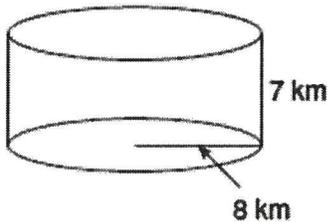
Q5: Convert the Surface Area to m^2 . How many times do we need to apply the conversion? *Twice!*

$$\frac{238 \cancel{\text{yd}} \cdot \cancel{\text{yd}}}{1} \times \frac{0.9144 \text{ m}}{1 \cancel{\text{yd}}} \times \frac{0.9144 \text{ m}}{1 \cancel{\text{yd}}} = \boxed{198.998 \text{ m}^2}$$

Q6: Convert the Volume to m^3 . How many times do we need to apply the conversion? *Three Times!*

$$\frac{245 \cancel{\text{yd}} \cdot \cancel{\text{yd}} \cdot \cancel{\text{yd}}}{1} \times \frac{0.9144 \text{ m}}{1 \cancel{\text{yd}}} \times \frac{0.9144 \text{ m}}{1 \cancel{\text{yd}}} \times \frac{0.9144 \text{ m}}{1 \cancel{\text{yd}}} = \boxed{187.32 \text{ m}^3}$$

Q7: Calculate the Surface Area and Volume of the shape:



Surface Area	Volume
$\begin{aligned} \text{Top} &= \pi r^2 = (3.14)(8)^2 = 200.96 \\ \text{Bottom} &= 200.96 \\ \text{Side} &= 2\pi rh = 2(3.14)(8)(7) = 351.68 \\ \hline &= 753.6 \text{ km}^2 \end{aligned}$	$\begin{aligned} \text{Vol} &= (\text{Area of Base}) \times \text{Height} \\ &= (\pi r^2) \times h \\ &= (3.14)(8)^2 \times 7 \\ &= 200.96 \times 7 \\ &= 1406.72 \text{ km}^3 \end{aligned}$

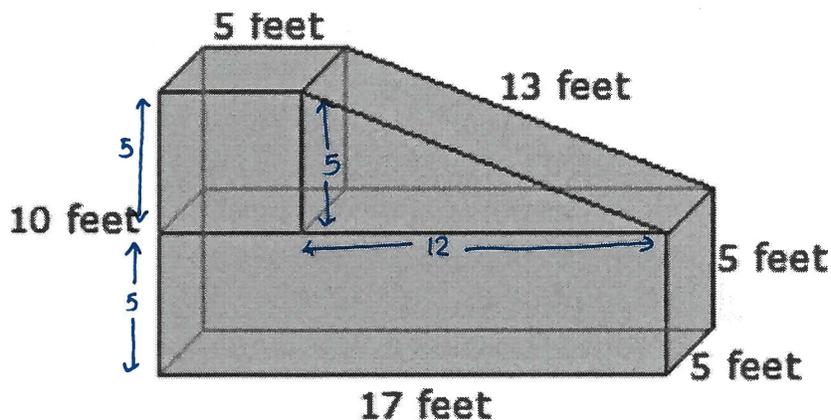
Q8: Convert the Surface Area to mi^2 . How many times do we need to apply the conversion? *Twice!*

$$\frac{753.6 \cancel{\text{km}} \cdot \cancel{\text{km}}}{1} \times \frac{1 \text{ mi}}{1.609 \cancel{\text{km}}} \times \frac{1 \text{ mi}}{1.609 \cancel{\text{km}}} = \frac{753.6}{2.58881} = \boxed{291.09 \text{ mi}^2}$$

Q9: Convert the Volume to mi^3 . How many times do we need to apply the conversion? *Three Times*

$$\frac{1406.72 \cancel{\text{km}} \cdot \cancel{\text{km}} \cdot \cancel{\text{km}}}{1} \times \frac{1 \text{ mi}}{1.609 \cancel{\text{km}}} \times \frac{1 \text{ mi}}{1.609 \cancel{\text{km}}} \times \frac{1 \text{ mi}}{1.609 \cancel{\text{km}}} = \frac{1406.72 \text{ mi}^3}{4.165509529} = \boxed{337.71 \text{ mi}^3}$$

Q10: Calculate the Volume of the shape in yd^3 .



$$\begin{aligned} \text{Top Left} &= (\text{Area of Base}) \times \text{Height} \\ &= (5 \times 5) \times 5 \\ &= 125 \text{ ft}^3 \end{aligned}$$

$$\begin{aligned} \text{Top Right} &= (\text{Area of Base}) \times \text{Height} \\ &= \left(\frac{1}{2} \times 5 \times 12\right) \times 5 \\ &= (30) \times 5 \\ &= 150 \text{ ft}^3 \end{aligned}$$

$$\begin{aligned} \text{Bottom} &= (\text{Area of Base}) \times \text{Height} \\ &= (17 \times 5) \times 5 \\ &= (85) \times 5 \\ &= 425 \text{ ft}^3 \end{aligned}$$

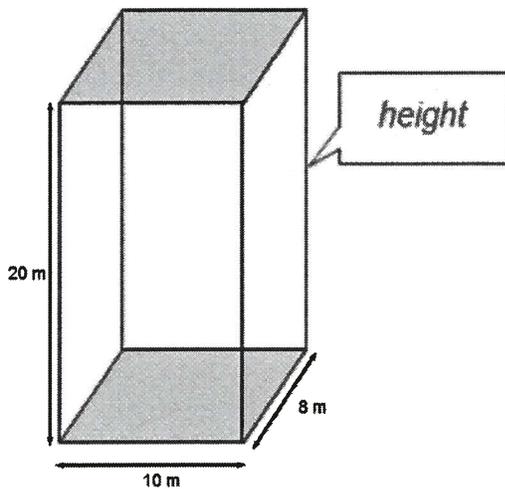
$$\begin{aligned} \text{TOTAL VOL} &= 125 + 150 + 425 \\ &= 700 \text{ ft}^3 \end{aligned}$$

$$\frac{700 \cancel{\text{ft}} \cdot \cancel{\text{ft}} \cdot \cancel{\text{ft}}}{1} \times \frac{1 \text{ yd}}{3 \cancel{\text{ft}}} \times \frac{1 \text{ yd}}{3 \cancel{\text{ft}}} \times \frac{1 \text{ yd}}{3 \cancel{\text{ft}}} = \frac{700 \text{ yd}^3}{27} = \boxed{25.93 \text{ yd}^3}$$

Part 2 – Volume of Prisms and Cylinders versus Pyramids and Cones (i.e. “Pointy Things”)
Q11: Calculate the volume of a Rectangular Prism (left) and a Rectangular Pyramid (right), in cubic yards.

Rectangular Prism

$$\text{Prism } V = B \times h$$



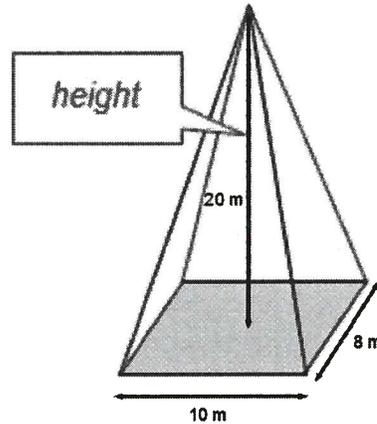
$$\begin{aligned} \text{Vol} &= (\text{Area of Base}) \times \text{Height} \\ &= (10 \times 8) \times 20 \\ &= 80 \times 20 \\ &= 1600 \text{ m}^3 \end{aligned}$$

$$\frac{1600 \text{ m}^3}{1} \times \frac{1 \text{ yd}}{0.9144 \text{ m}} \times \frac{1 \text{ yd}}{0.9144 \text{ m}} \times \frac{1 \text{ yd}}{0.9144 \text{ m}} = \frac{1600 \text{ yd}^3}{0.76455\dots}$$

$$= 2092.72 \text{ yd}^3$$

Rectangular Pyramid (“Pointy”)

$$\text{Pyramid } V = \frac{B \times h}{3}$$



$$\begin{aligned} \text{Vol} &= \frac{(\text{Area of Base}) \times \text{Height}}{3} \\ &= \frac{(10 \times 8) \times 20}{3} \\ &= \frac{80 \times 20}{3} \\ &= \frac{1600}{3} \\ &= 533.\bar{3} \text{ m}^3 \end{aligned}$$

$$\frac{533.\bar{3} \text{ m}^3}{1} \times \frac{1 \text{ yd}}{0.9144 \text{ m}} \times \frac{1 \text{ yd}}{0.9144 \text{ m}} \times \frac{1 \text{ yd}}{0.9144 \text{ m}} = \frac{533.\bar{3} \text{ yd}^3}{0.76455\dots}$$

$$= 697.57 \text{ yd}^3$$

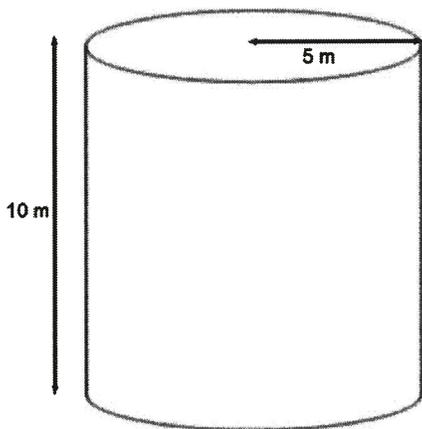
Q12: Calculate the volume of a Cylinder (left) and a Rectangular Pyramid (right), in cubic yards.

Cylinder

Cylinder $V = \pi r^2 h$

$$\text{Vol} = (\text{Area of Base}) \times \text{Height}$$

$$= (\pi r^2) \times h$$



$$\text{Vol} = (\text{Area of Base}) \times \text{Height}$$

$$= (\pi r^2) \times h$$

$$= (3.14)(5)^2 \times 10$$

$$= (78.5) \times 10$$

$$= 785 \text{ m}^3$$

$$\frac{785 \cancel{\text{m}} \cdot \cancel{\text{m}} \cdot \cancel{\text{m}}}{1} \times \frac{1 \text{ yd}}{0.9144 \cancel{\text{m}}} \cdot \frac{1 \text{ yd}}{0.9144 \cancel{\text{m}}} \cdot \frac{1 \text{ yd}}{0.9144 \cancel{\text{m}}} = \frac{785}{0.76455}$$

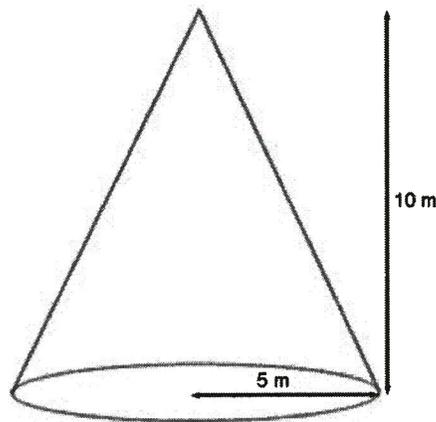
$$= 1026.74 \text{ yd}^3$$

Cone ("Pointy")

Cone $V = \frac{1}{3} \pi r^2 h$

$$\text{Vol} = \frac{(\text{Area of Base}) \times \text{Height}}{3}$$

$$= \frac{(\pi r^2) \times h}{3}$$



$$\text{Vol} = \frac{(\text{Area of Base}) \times \text{Height}}{3}$$

$$= \frac{(\pi r^2) \times h}{3}$$

$$= \frac{(3.14)(5)^2 \times 10}{3}$$

$$= \frac{785}{3}$$

$$= 261.6 \text{ m}^3$$

$$\frac{261.6 \cancel{\text{m}} \cdot \cancel{\text{m}} \cdot \cancel{\text{m}}}{1} \times \frac{1 \text{ yd}}{0.9144 \cancel{\text{m}}} \cdot \frac{1 \text{ yd}}{0.9144 \cancel{\text{m}}} \cdot \frac{1 \text{ yd}}{0.9144 \cancel{\text{m}}} = \frac{261.6}{0.76455}$$

$$= 342.25 \text{ yd}^3$$