Math 9 – Unit 4: Measurement

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Lesson 4.2: Rectangular and Triangular Prisms and Cylinders

Date: March 19, 2025

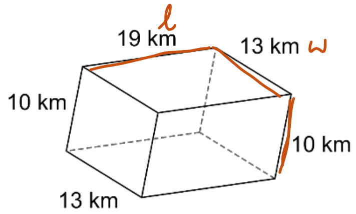
Learning Goal: We are learning to calculate the surface area and volume for common 3D shapes.

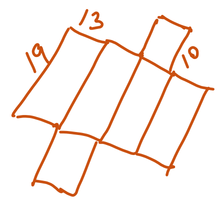
Surface Area: find the area of each 2D shape by itself, using yesterday's formulas, then add all of them together
Volume: always the "area of the base" × "the height"

A NET IS THE OUTSIDE OF A 3D SOLID.

For each new solid shape, draw the net, then calculate the surface area and the volume.

1.



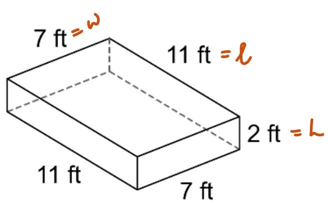


Given: $l = 19\text{km}, w = 13\text{km}, h = 10\text{ km}$

$$\begin{aligned}S.A. &= 2lw + 2wh + 2hl\\ &= 2(19)(13) + 2(13)(10) + 2(10)(19)\\ &= 494 + 260 + 380\\ &= 1134 \text{ sq. km. (or) } \boxed{1134\text{ km}^2}\end{aligned}$$

$$\begin{aligned}V. &= lwh\\ &= (19)(13)(10)\\ &= 2470 \text{ cubic km (or) } \boxed{2470\text{ km}^3}\end{aligned}$$

2.



$$\boxed{\begin{aligned}S.A &= 226\text{ ft}^2\\ V &= 154\text{ ft}^3\end{aligned}}$$

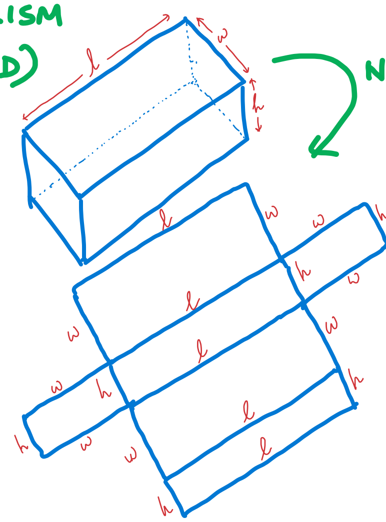
$$\begin{aligned}S.A. &= 2lw + 2wh + 2hl\\ &= 2(11)(7) + 2(7)(2) + 2(2)(11)\\ &= 154 + 28 + 44\\ &= 226\text{ ft}^2\end{aligned}$$

$$\begin{aligned}V &= lwh\\ &= (11)(7)(2)\\ &= 154\text{ ft}^3\end{aligned}$$

$$\boxed{S.A. = 2lw + 2wh + 2lh}$$
$$\boxed{V = lwh}$$

RECTANGULAR PRISM (CUBOID) → It has 6 rectangular faces.

NET



SURFACE AREA (S.A.)
(TOTAL AREA OF ALL 2D FACES THAT MAKE THE 3D SOLID)

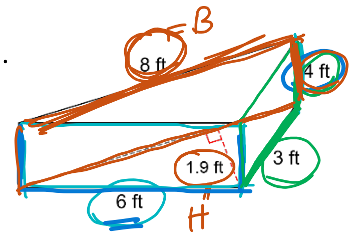
$$S.A. = lw + lh + lw + lh + hw + hw$$
$$S.A. = 2lw + 2lh + 2wh$$
$$S.A. = 2(lw + lh + wh)$$

VOLUME (V)
(THE SPACE INSIDE THE OUTSIDE COVER OF THE SOLID)

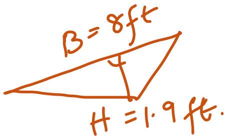
$V = (\text{Area of Rectangular base})\text{height}$

$V = (lw)h = lwh$

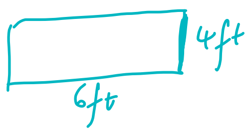
3.



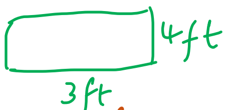
* REFER TO THE NET ON THE RIGHT TO VISUALIZE ☺



$$\text{area of } \Delta s = \cancel{2}\left(\frac{BH}{\cancel{2}}\right) = BH = (8)(1.9) = 15.2\,ft^2$$



$$\text{area} = (6)(4) = 24\,ft^2$$



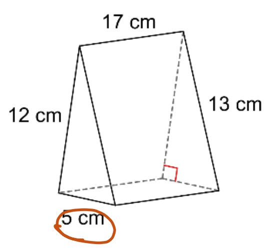
$$\text{area} = (3)(4) = 12\,ft^2$$

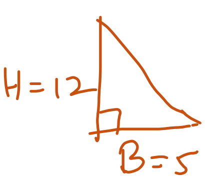
$$\text{Area} = (8)(4) = 32\,ft^2$$

$$\therefore SA = 15.2 + 24 + 12 + 32 = \boxed{83.2\,ft^2}$$

$$V = \frac{(8)(1.9)(4)}{2} = \boxed{30.4\,ft^3}$$

4.





$$\text{Area of } 2\,\Delta s = 2\left(\frac{BH}{2}\right) = BH = (5)(12) = 60\,cm^2$$

$$V = \frac{(5)(12)(17)}{2} = 510\,cm^3$$

17 / 13: $A = (17)(13) = 221\,cm^2$

17 / 12: $A = (17)(12) = 204\,cm^2$

17 / 5: $A = (17)(5) = 85\,cm^2$

$$\boxed{\begin{array}{l} S.A. = 570\,cm^2 \\ V = 510\,cm^3 \end{array}}$$

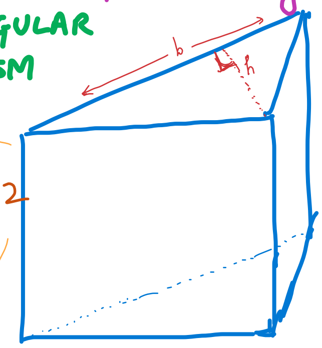
$$\therefore S.A. = 60 + 221 + 204 + 85 = 570\,cm^2$$

$$\boxed{S.A. = 3\square + 2\Delta}$$

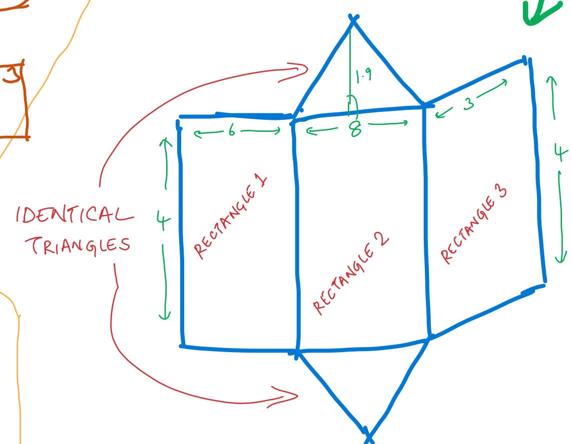
$$\boxed{V = \frac{lbh}{2}}$$

TRIANGULAR PRISM

It has 2 identical triangular faces and 3 rectangular faces.



NET



SURFACE AREA

= AREA (RECTANGLE 1) + AREA (RECTANGLE 2) + AREA (RECTANGLE 3) + 2 (AREA OF THE TRIANGLE)

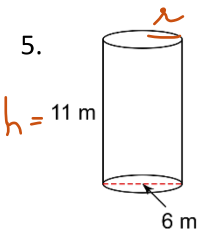
S.A. = AREA of 3 $\square$ + AREA of 2 identical Δ

VOLUME

= (AREA of Δ BASE) (LENGTH OF PRISM (or height))

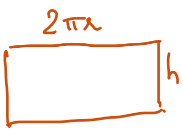
$$V = \left(\frac{bh}{2}\right)l = \frac{lbh}{2}$$

5.



Given: $r = \frac{6}{2} = 3m$; $h = 11m$

Area of 2 circles $= 2\pi r^2$
$= 2(3.14)(3)(3)$
$= 56.52\ m^2$



Area $= 2\pi r h$
$= 2(3.14)(3)(11)$
$= 207.24\ m^2$

$V = \pi r^2 h$

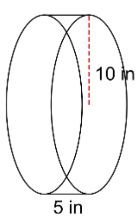
$V = (3.14)(3)(3)(11)$

$\boxed{V = 310.86\ m^3}$

$\therefore$ S.A. $= 56.52 + 207.24$

$\boxed{SA = 263.76\ m^2}$

6.



$r = 10$ in.
$h = 5$ in.

$\boxed{\begin{array}{l} S.A = 942\ in^2 \\ V = 1570\ in^3 \end{array}}$

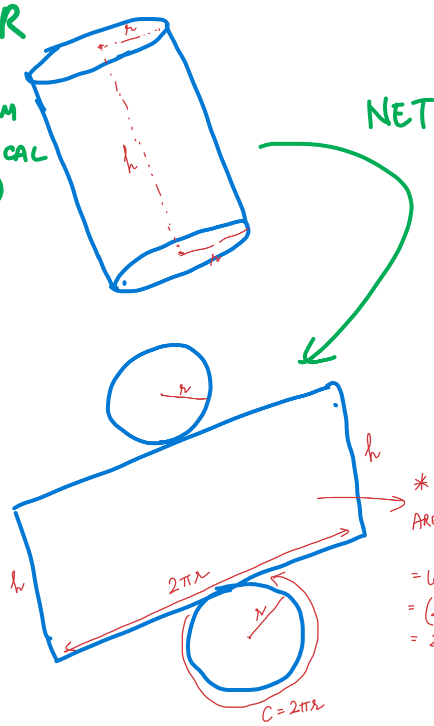
$S.A. = 2\pi r h + 2\pi r^2$
$= 2(3.14)(10)(5) + 2(3.14)(10)(10)$
$= 314 + 628$
$= 942\ in^2$

$V = \pi r^2 h = (3.14)(10)(10)(5) = 1570\ in^3.$

$\boxed{S.A. = 2\pi r^2 + 2\pi r h}$

$\boxed{V = \pi r^2 h}$

CYLINDER
(VISUALIZE AS A CIRCULAR PRISM WITH TWO IDENTICAL CIRCLE BASES)



* NOTE
AREA OF CURVED RECTANGLE
= length x width
= $(2\pi r)(h)$
= $2\pi r h$

SURFACE AREA
= AREA OF 2 IDENTICAL CIRCLES
+ AREA OF THE RECTANGLE
(which is the curved surface)

$S.A. = 2(\pi r^2) + (2\pi r)h$

$S.A. = 2\pi r^2 + 2\pi r h$

$S.A. = 2\pi r(r + h)$

VOLUME = (AREA OF CIRCULAR BASE)(LENGTH (or height) OF CYLINDER)

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

Use the appropriate formula to solve for the missing measurement.

7. A rectangular prism has a volume of 5940cm^3 with a height of 15cm and a length of 33cm. What is the width of the box?

Given: $V = 5940\,cm^3$, $h = 15\,cm$, $l = 33\,cm$, $w = ?$

$$V = lwh = (lh)w$$

$$\Rightarrow \frac{V}{lh} = w$$

Ans - $w = \frac{V}{lh} = \frac{5940}{(33)(15)} = \frac{5940}{495} = 12\,cm$

$\therefore$ The width of the prism is 12 cm.

8. A cylinder has a surface area of 439.82 cm^2 with a diameter of 10cm. Determine the height of the cylinder.

Given: $S.A. = 439.82\,cm^2$, $d = 10\,cm$ $\therefore r = \frac{10}{2} = 5\,cm$, $h = ?$

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

$$SA - 2\pi r^2 = (2\pi r)h$$

$$\frac{SA - (2\pi r^2)}{(2\pi r)} = h$$

Ans

$$h = \frac{439.82 - [(2)(3.14)(5)(5)]}{2(3.14)(5)} =$$

$$= \frac{439.82 - 157}{31.4}$$

$$= \frac{282.82}{31.4} \approx 9\,cm$$

$\therefore$ The height of cylinder is approx. 9cm.

Success Criteria:

- I can find the surface area of prisms and cylinders by adding up the areas of each side
- I can find the volume of prisms and cylinders by using the appropriate formula (area of the base × height)