

11.3 Surface Area

What is surface area?

Why learn about surface area?

What is a prism?

What is a cylinder?

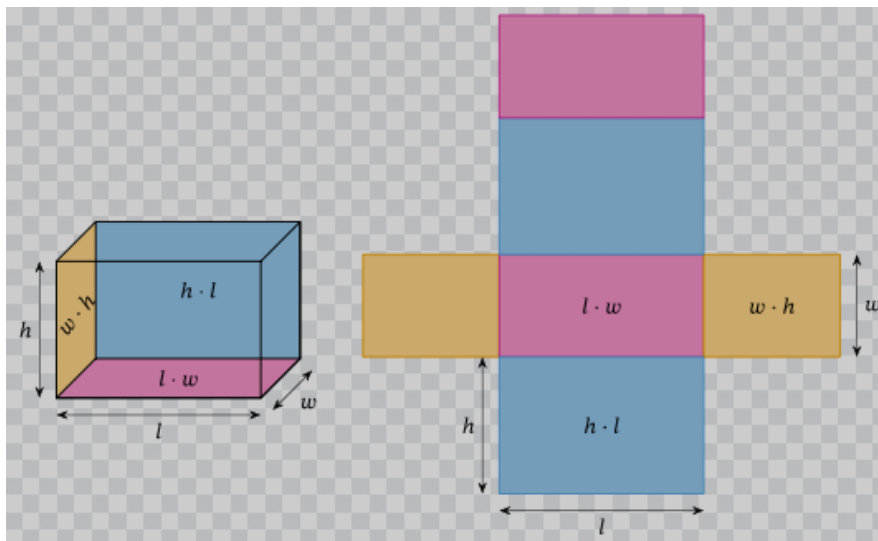
...but first

- Need more practice solving problems
- Those practice problems are going to be worth points
- The points are going to go into the projects category
- Sets of 5 problems worth either 5 or 10 points
- Small test every week or two - directly from the problems
- Tests will have no corrections since tests are open notes

11.3 Surface Area

What is surface area?

Surface area is just what it says. The area of a surface.



11.3 Surface Area

Why learn about surface area?

- Calculate amount of stain/paint to cover a wall/surface
- Calculate amount of fabric for upholstery (furniture seats, etc.)
- Packaging sizing (making boxes)

11.3 Surface Area

What is a prism?

A prism has a top and bottom that are parallel to each other and sides that connect the top and bottom to each other. (We are going to say that those sides are perpendicular or normal to the top and bottom.)



Triangular Prism



Rectangular Prism



Square Prism



Right Prism



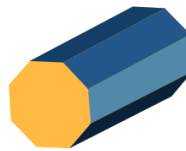
Oblique Prism



Pentagonal Prism



Hexagonal Prism



Octagonal Prism

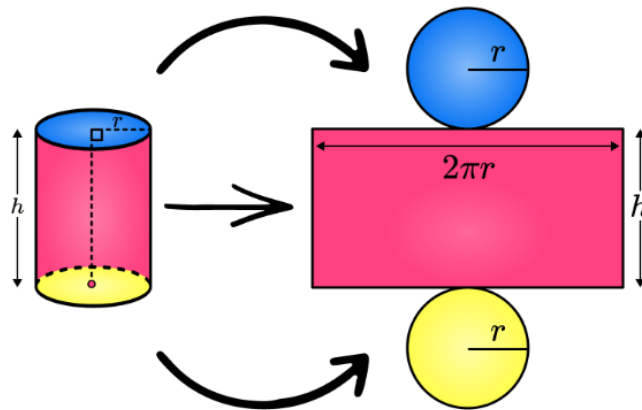


<https://www.geeksforgeeks.org/prism/>

11.3 Surface Area

What is a cylinder?

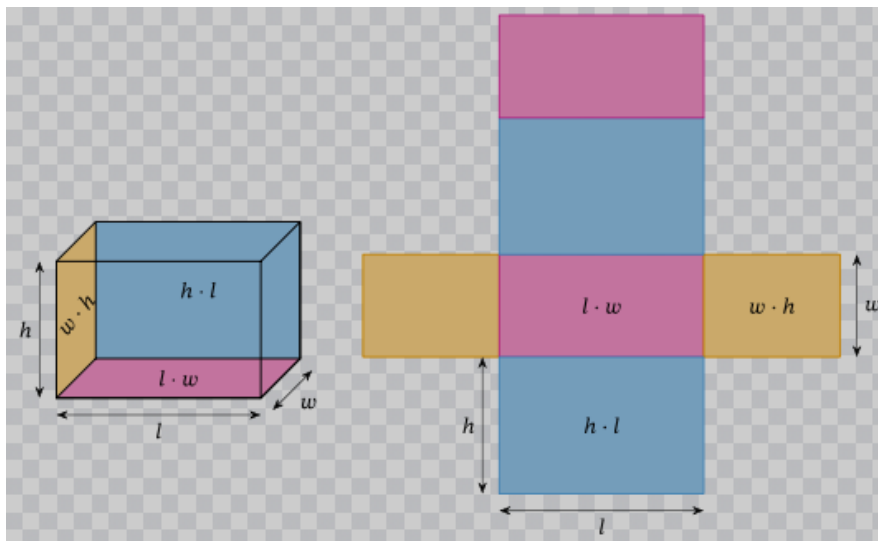
A cylinder is really just a (right) prism with a circular base.



<https://thirdspacelearning.com/gcse-maths/geometry-and-measure/surface-area-of-a-cylinder/>

11.3 Surface Area

How do you calculate Surface area?



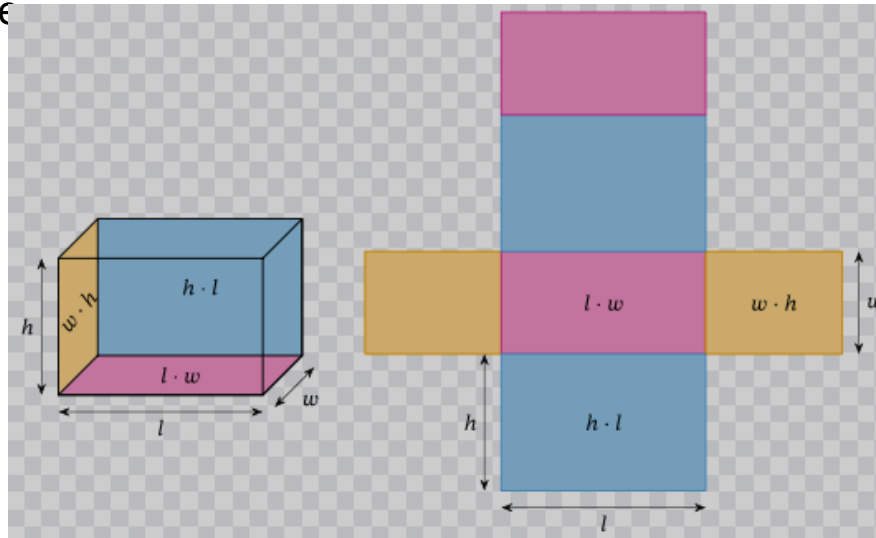
11.3 Surface Area

How do you calculate Surface area?

Two definitions

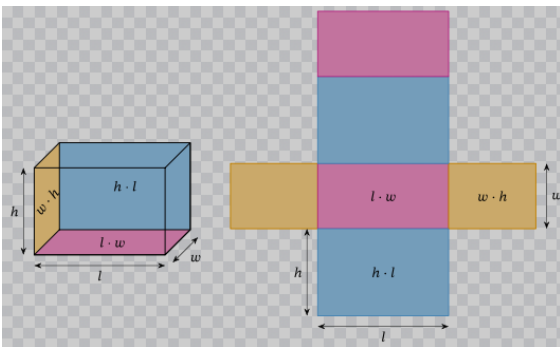
- Lateral Area - Area of the sides of the prism
- Area of the base - Area of the top/bottom

Surface Area is the sum (addition) of the lateral area and the area of the base



11.3 Surface Area

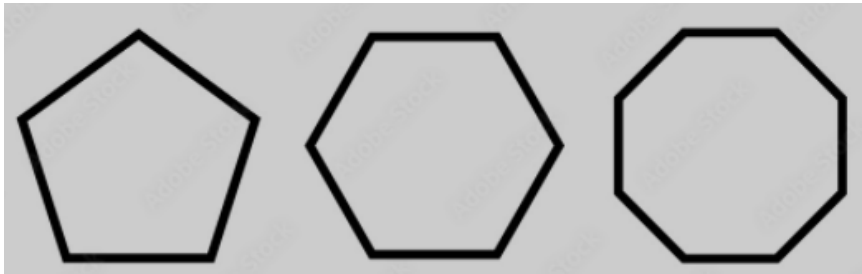
How do you calculate Surface area?



11.3 Surface Area

A couple more definitions

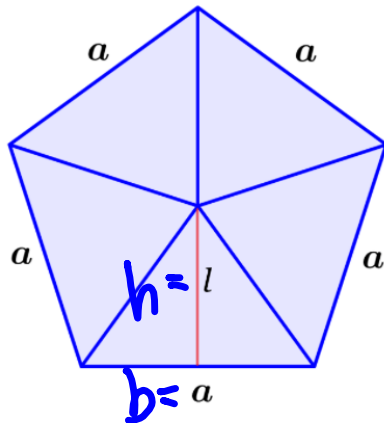
- Polygon - multi-sided figure
- Regular polygon - all sides and angles the same (congruent)



<https://www.istockphoto.com/vector/pentagon-hexagon-octagon-icon-vector-geometry-polygon-gm1057585194-282630518>

11.3 Surface Area

You do not need to remember all the different formulas for areas of regular polygons. All you need to know is the length of the side and the distance from the center of that side to the middle of the polygon. Then, you only need to remember the formula for area of a triangle.



$$A_{\Delta} = \frac{bh}{2}$$

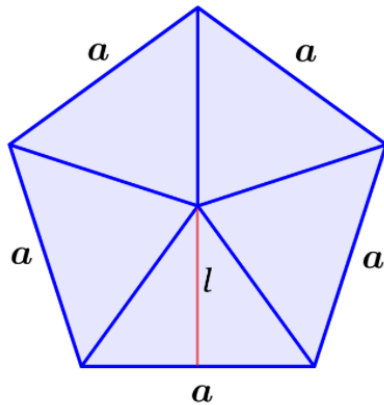
$$A = \frac{5lh}{2}$$

$$p = 5a \quad A = \frac{5}{2} la$$



11.3 Surface Area

The lateral area is always the area of a rectangle. (Even for a cylinder.) So you only need to remember two formulas. Area of a triangle and area of a rectangle.



$$\text{lateral area} = a h \cdot 5$$

$$p = 5a \quad A = \frac{5}{2} l a$$



11.3 Surface Area

Practice (from the book):

11.3 (pp 671-673)

4, 5, 7 9, 10
6, 8, 11, 13, 15

A couple more definitions:

- Compare usually means division or ratio (sometimes subtract)
- Ratio is a fraction

DONE TOGETHER
(LATER PAGES)

11.3 Surface Area

11.3 problems 4, 5, 7, 9, 10

11.3 problems 6, 8, 11, 13, 15

11.3 Surface Area

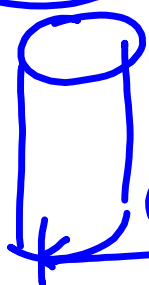
11.3 problems 4

Find lateral and surface area of the figure

Cylinder with radius of 3 cm and height of 16 cm

$$C = \pi d = \pi \cdot 2 \cdot r = \pi \cdot 2 \cdot 3 \text{ cm} = 18.85 \text{ cm}$$

$$L = C \cdot h = 18.85 \text{ cm} \cdot 16 \text{ cm} = 301.6 \text{ cm}^2$$



$$A_B = \pi r^2 = \pi r r$$

$$= \pi \cdot 3 \text{ cm} \cdot 3 \text{ cm} = 28.27 \text{ cm}^2$$

$$h = 16 \text{ cm}$$

$$A = l \cdot w = C \cdot h$$

$$SA = L + 2A_B$$

$$= 301.6 \text{ cm}^2 + 2 \times 28.27 \text{ cm}^2$$

$$= 358.1 \text{ cm}^2$$

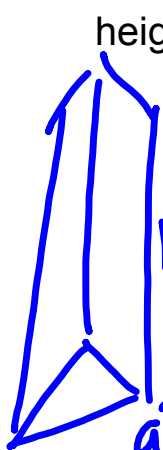
11.3 Surface Area

$$\begin{array}{ccc}
 h & \boxed{A_c} & h & \boxed{A_b} & \boxed{A_a} & h = 10 \text{ in} \\
 & L = 10 \text{ in} & & b = 8 \text{ in} & & a = 6 \text{ in}
 \end{array}$$

11.3 problems 5

Find lateral and surface area of the figure

Triangular based prism - right triangle with legs 6 in. and 8 in.
height of 10 in.



$$\begin{aligned}
 L &= \left[\begin{array}{l} A_a = a \cdot h = 6 \text{ in} \cdot 10 \text{ in} = 60 \text{ in}^2 \\ A_b = b \cdot h = 8 \text{ in} \cdot 10 \text{ in} = 80 \text{ in}^2 \\ A_c = c \cdot h = 10 \text{ in} \cdot 10 \text{ in} = 100 \text{ in}^2 \end{array} \right] \leftarrow \\
 L &= (a+b+c)h = \leftrightarrow L = 240 \text{ in}^2
 \end{aligned}$$

$$\begin{aligned}
 a^2 + b^2 &= c^2 \\
 c &= \sqrt{a^2 + b^2} \\
 b &= 8 \text{ in} \\
 a &= 6 \text{ in} \\
 c &= \sqrt{6^2 + 8^2} = \sqrt{100} = 10 \text{ in}
 \end{aligned}$$

$$\begin{aligned}
 A_B = A_{\Delta} &= \frac{\text{base} \cdot \text{height}}{2} = \frac{a \cdot b}{2} \\
 &= \frac{6 \cdot 8 \text{ in}}{2} = \frac{48 \text{ in}^2}{2} = 24 \text{ in}^2
 \end{aligned}$$

$$\boxed{
 \begin{aligned}
 SA &= L + 2A_{\Delta} \\
 &= 240 \text{ in}^2 + 2 \times 24 \text{ in}^2 \\
 &= 288 \text{ in}^2
 \end{aligned}
 }$$

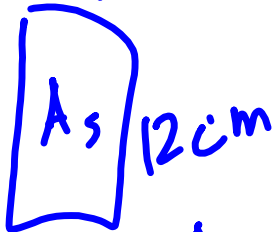
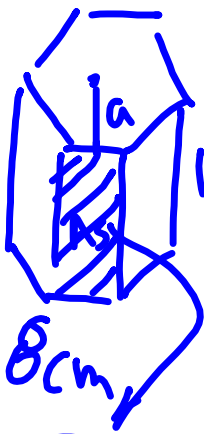
#7

a. hexagonal prism

b. lateral SA = $A_s \times 6$

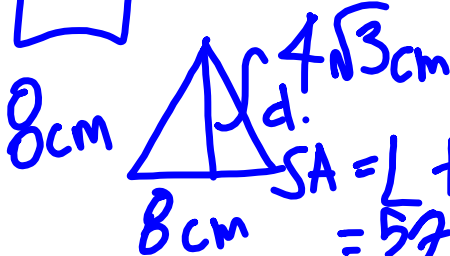
$$a = 4\sqrt{3}\text{ cm} \quad A_s = 8\text{ cm} \times 12\text{ cm} = 96\text{ cm}^2$$

$$L = 6 \cdot A_s = 6 \times 96\text{ cm}^2 = \boxed{576\text{ cm}^2}$$



$$c. A_{\Delta} = \frac{8\text{ cm} \times 4\sqrt{3}\text{ cm}}{2} = 16\sqrt{3}\text{ cm}^2$$

$$A_B = 6 \times A_{\Delta} = 6 \times 16\sqrt{3}\text{ cm}^2 = \boxed{96\sqrt{3}\text{ cm}^2}$$



$$SA = L + 2A_B$$

$$= 576\text{ cm}^2 + 2 \times 96\sqrt{3}\text{ cm}^2 =$$

$$= 576\text{ cm}^2 + 192\sqrt{3}\text{ cm}^2$$

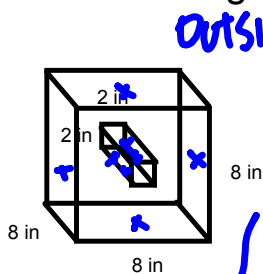
$$576\text{ cm}^2 + 332.6\text{ cm}^2 = \boxed{908.6\text{ cm}^2}$$

11.3 Surface Area

11.3 problem 6

Find lateral and surface area of the figure

Rectangular prism with square hole



$$L = 4(8\text{ in} \times 8\text{ in}) + 4(2\text{ in} \times 2\text{ in})$$

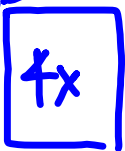
$$4 \times 64\text{ in}^2 + 4 \times 16\text{ in}^2$$

$$256\text{ in}^2 + 64\text{ in}^2$$

$$L = 320\text{ in}^2$$

OUTSIDE

INSIDE



$$A = b \cdot h = 2\text{ in} \times 8\text{ in} = 16\text{ in}^2$$

$$A_{BS} = 64\text{ in}^2$$

$$A = b \cdot h = 8\text{ in} \times 8\text{ in} = 64\text{ in}^2$$



$$\begin{aligned} A_B &= A_{BS} - A_{LS} \\ &= 64\text{ in}^2 - 4\text{ in}^2 \\ &= 60\text{ in}^2 \end{aligned}$$

$$\begin{aligned} A_{LS} &= b \cdot h = 2\text{ in} \cdot 2\text{ in} \\ &= 4\text{ in}^2 \end{aligned}$$

$$SA = L + 2 \cdot A_B$$

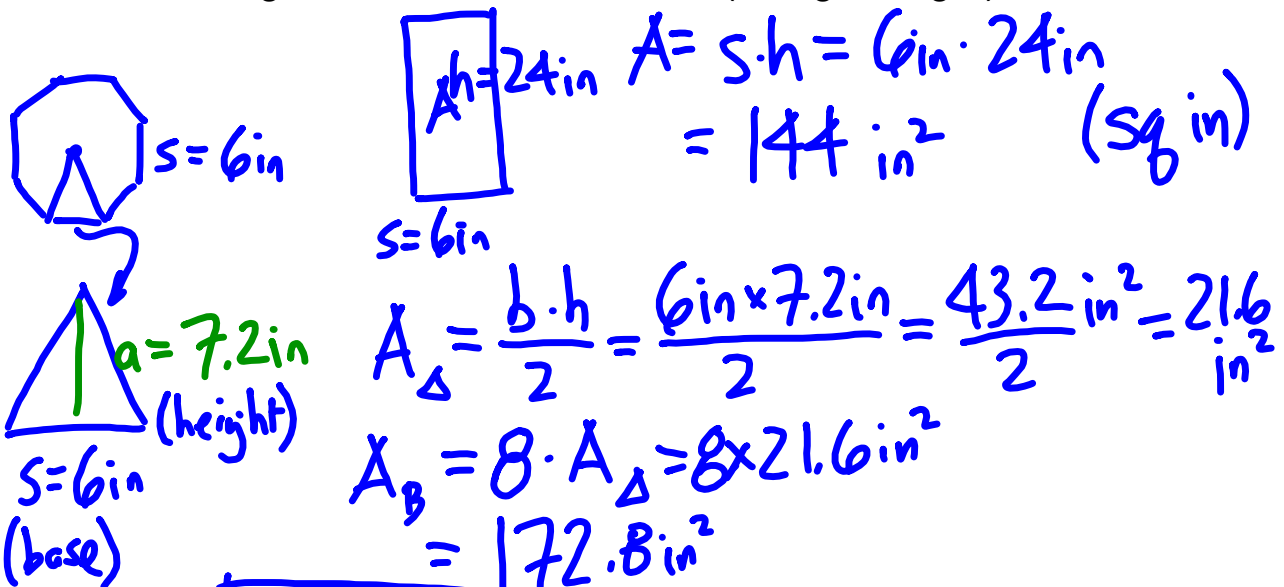
$$\begin{aligned} &= 320\text{ in}^2 + 2 \times 60\text{ in}^2 = 320\text{ in}^2 + 120\text{ in}^2 \\ &= 440\text{ in}^2 \end{aligned}$$

11.3 Surface Area $L = 8 \times A = 8 (144 \text{ in}^2)$

11.3 problem 11 $= 1152 \text{ in}^2$

Aquarium - octagonal prism - find area of base(s), surface area

24 in height, 6 inch side, $a = 7.2 \text{ in}$ (triangle height)



$$\begin{aligned}
 SA &= L + 2 \cdot A_B \\
 &= 1152 \text{ in}^2 + 2 \times 172.8 \text{ in}^2 \\
 &= 1152 \text{ in}^2 + 345.6 \text{ in}^2 \\
 &= 1497.6 \text{ in}^2
 \end{aligned}$$

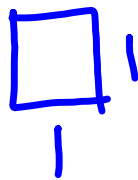
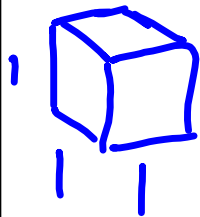
11.3 Surface Area

11.3 problem 15

Suppose the edge of a cube is doubled. What is the ratio of the surface area of the new cube to the surface area of the original cube?

$$SA_2 : SA_1 \quad \frac{SA_2}{SA_1}$$

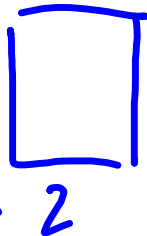
fraction



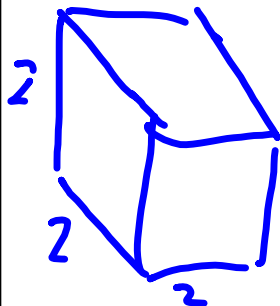
$$A = bh = 1 \times 1 = 1 \text{ sq unit}$$

$$SA_1 = 6 \times A = 6 \times 1 \text{ sq unit} = 6 \text{ sq units}$$

$$A_2 = bh = 2 \times 2 = 4 \text{ sq units}$$



$$SA_2 = 6 \times A_2 = 6 \times 4 = 24 \text{ sq units}$$



$$\frac{SA_2}{SA_1} = \frac{24 \text{ sq units}}{6 \text{ sq units}} = \frac{4}{1} \quad 4:1$$

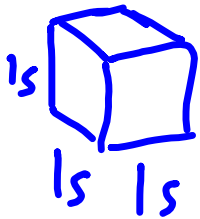
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$$SA_2 : SA_1 \rightarrow \frac{SA_2}{SA_1}$$

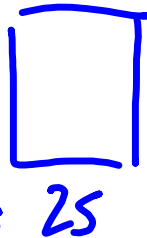
fraction



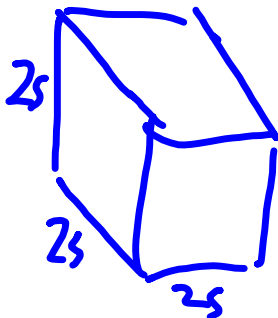
$$\square \quad 1s \quad A = bh = b \times h = 1s \text{ sq unit}$$

$$1s \quad SA_1 = 6 \times A = 6 \times 1s \text{ sq unit} = 6s \text{ sq units}$$

$$A_2 = bh = 2s \times 2s = 4s \text{ sq units}$$



$$2s \quad SA_2 = 6 \times A_2 = 6 \times 4s = 24s \text{ sq units}$$



$$\frac{SA_2}{SA_1} = \frac{24s \text{ sq units}}{6s \text{ sq units}} = \frac{4}{1} \quad 4:1$$

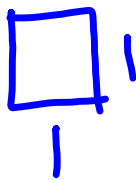
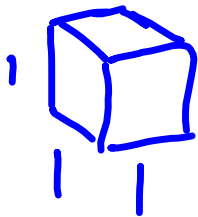
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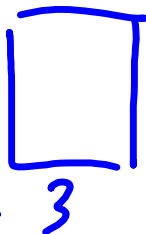
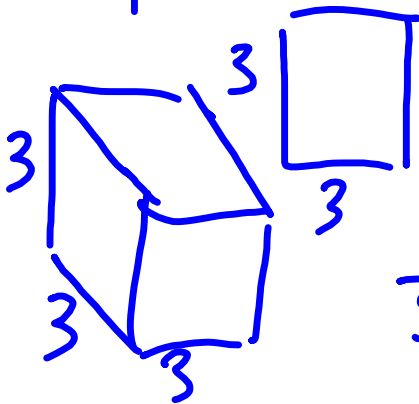
fraction



$$A = bh = 1 \times 1 = 1 \text{ sq unit}$$

$$SA_1 = 6 \times 1 \text{ sq unit} = 6 \text{ sq unit}$$

$$A_2 = 3 \times 3 = 9 \text{ sq units}$$



$$SA_2 = 6 \times 9 \text{ sq units} = 54 \text{ sq units}$$

$$\frac{SA_2}{SA_1} = \frac{54 \text{ sq units}}{6 \text{ sq units}} = \frac{9}{1} \quad 9:1$$