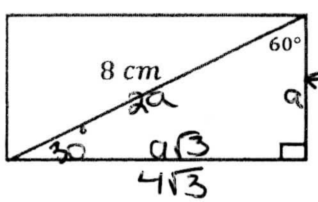
Notes 11.4

Effects of Changing Dimensions on Area & Volume

EXAMPLE 1: Find the area of the rectangle below.



$\frac{2a}{2} = \frac{8}{2}$

$a = 4$

$A = lw = 4(4\sqrt{3})$

$= 16\sqrt{3}\ cm^2$

A = $16\sqrt{3}\ cm^2$

What would happen if we changed one or both dimensions in this rectangle?

Original Area	Change in Width	Change in Length	New Area	$\frac{\text{New Area}}{\text{Orig. Area}}$
$16\sqrt{3}$	*Twice* as long $4 \cdot 2 = 8$	*Twice* as long $4\sqrt{3} \cdot 2 = 8\sqrt{3}$	$8 \cdot 8\sqrt{3} =$ $64\sqrt{3}\ cm^2$	$\frac{64\sqrt{3}}{16\sqrt{3}} = 4$
$16\sqrt{3}$	*Twice* as long $4 \cdot 2 = 8$	*Three times* as long $4\sqrt{3} \cdot 3 = 12\sqrt{3}$	$8 \cdot 12\sqrt{3} =$ $96\sqrt{3}\ cm^2$	$\frac{96\sqrt{3}}{16\sqrt{3}} = 6$
$16\sqrt{3}$	*Four times* as long $4 \cdot 4 = 16$	*Half* as long $4\sqrt{3} \cdot \frac{1}{2} = 2\sqrt{3}$	$16 \cdot 2\sqrt{3} =$ $32\sqrt{3}$	$\frac{32\sqrt{3}}{16\sqrt{3}} = 2$
$16\sqrt{3}$	*One – fourth* as long $4 \cdot \frac{1}{4} = 1$	*Twice* as long $4\sqrt{3} \cdot 2 = 8\sqrt{3}$	$1 \cdot 8\sqrt{3} =$ $8\sqrt{3}$	$\frac{8\sqrt{3}}{16\sqrt{3}} = \frac{1}{2}$

What conjecture can you make regarding the changing of dimension(s) in a two dimensional figure?

When you multiply the original area by the product of the factors you are changing the dimensions, you get the new area.

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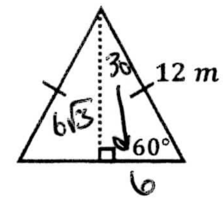
EXAMPLE 2: Find the area of the isosceles triangle below, if its base were *doubled* and height were *tripled.*



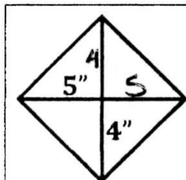
Original Area: $\frac{12(6\sqrt{3})}{2} = 36\sqrt{3}$

Product of Factors: $2 \cdot 3 = 6$

New Area: $36\sqrt{3}(6) = 216\sqrt{3}$

A("*changed*" *triangle*) = $216\sqrt{3}\ m^2$

EXAMPLE 3: Find the area of the rhombus below if one diagonal was *halved* and the other diagonal were *doubled.*



Original Area: $\frac{10(8)}{2} = 40$

Product of the Factors: $\frac{1}{2}(2) = 1$

New Area: $40(1) = 40$

A("*changed*" *rhombus*) = $40\ in^2$

EXAMPLE 4:

The area of a triangle is 36 *square millimeters.* Suppose the height was *three times* as long, and the base was *four times* as long. Find the area of the new triangle.

Original Area: $36\ mm^2$

Product of Factors: $3 \cdot 4 = 12$

New Area: $36(12) = 432$

A("*changed*" *triangle*) = $432\ mm^2$

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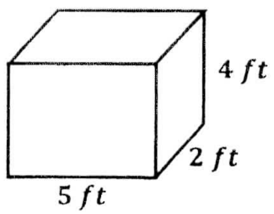
EXAMPLE 5: Find the volume of the prism below.



$V = Bh$
$= 10(4)$
$= 40$

B = area of base (rectangle)
$B = LW = 5(2)$
$= 10 ft^2$

V = $40\ ft^3$ ← volume cubed

What would happen if we changed the dimensions in this prism?

Original Volume	Change in length	Change in width	Change in height	New Volume	New Vol. / Orig. Vol.
40	*Twice* as long $5 \cdot 2 = 10$	*Twice* as long $2 \cdot 2 = 4$	*Three times* as long $4 \cdot 3 = 12$	$10 \cdot 4 \cdot 12 = 480 ft^3$	$\frac{480}{40} = 12$
40	*Three times* as long $5 \cdot 3 = 15$	No Change $2 \cdot 1 = 2$	*Twice* as long $4 \cdot 2 = 8$	$15 \cdot 2 \cdot 8 = 240 ft^3$	$\frac{240}{40} = 6$
40	*4 times* as long $5 \cdot 4 = 20$	*Half* as long $2 \cdot \frac{1}{2} = 1$	*Three times* as long $4 \cdot 3 = 12$	$20 \cdot 1 \cdot 12 = 240 ft^3$	$\frac{240}{40} = 6$

What conjecture can you make regarding the effect of changing dimensions on volume?

When you multiply the original volume by the product of the factors you are changing the dimensions, you get the new volume.

EXAMPLE 6:

Suppose the volume of a right triangular prism is 360 *cubic units*. What would its new volume be if one of its dimensions was *twice* as long, a second dimension was *three times* as long, and the third dimension was *half* as long?

Original Volume: $360\ u^3$

Product of Factors: $2 \cdot 3 \cdot \frac{1}{2} = 3$

New volume: $360 \cdot 3 = 1080$

V("*changed*" *prism*) = $1080\ u^3$

EXAMPLE 7:

Suppose the volume of a cube is $4\sqrt{3}$ *cubic centimeters*. What would its new volume be if one of its dimensions was *halved*, a second dimension was *doubled*, and a third dimension did not change?

Original Volume: $4\sqrt{3}\ cm^3$

Product of Factors: $\frac{1}{2} \cdot 2 \cdot 1 = 1$

No change

New Volume: $4\sqrt{3} \cdot 1 = 4\sqrt{3}$

V("*changed*" *cube*) = $4\sqrt{3}\ cm^3$