



Math 1030 #17E

Scaling:
Starting with Area and Volume

If there are two proportionately identical objects, the scale factor is the number that you multiply the lengths of the original object by to get the lengths of the new object.

Scaling Laws:

- Lengths scale with the scaling factor;
- Areas scale with the square of the scaling factor;
- Volumes scale with the cube of the scaling factor.

Variation on Terminology		When length doubles	When length is scaled by $\frac{1}{3}$
1 Length Scale Factor	a	$2^1 = 2$	$\left(\frac{1}{3}\right)^1 = \frac{1}{3}$
2 Area Scale Factor	a^2	$2^2 = 4$	$\left(\frac{1}{3}\right)^2 = \frac{1}{9}$
3 Volume Scale Factor	a^3	$2^3 = 8$	$\left(\frac{1}{3}\right)^3 = \frac{1}{27}$

EX 1: A squeezable stress toy has a smaller and larger version, which are proportional to each other. The smaller toy has surface area of 0.8 square feet and the larger toy has surface area of 2.5 square feet.

a) Find the length, area, and volume scale factors.

	Sm	La
Area	0.8 ft ²	2.5 ft ²

$$\sqrt{a^2} = \sqrt{3.125}$$

$$a \approx 1.768 \quad \text{lsf}$$

$$0.8a^2 = 2.5$$

$$a^2 = \frac{2.5}{0.8}$$

$$\text{a.s.f.} \quad a^2 = 3.125$$

$$a^3 \approx (1.768)^3$$

$$a^3 \approx 5.524 \quad \text{vsf}$$

b) If the length of the small toy is 5.0 inches, find the length of the larger toy in inches.

	Sm	La
Length	5.0 in	?

$$5.0 \cdot a = ?$$

$$5.0 (1.768) \approx 8.84 \text{ in}$$

$$\text{Length} \approx 8.8 \text{ in}$$

c) The larger toy is filled with 260 cubic inches of foam. How much foam is in the smaller version?

	Sm	La
Volume	?	260 in ³

$$? a^3 = 260 \text{ in}^3$$

$$? (5.524) \approx 260 \text{ in}^3$$

$$? \approx \frac{260 \text{ in}^3}{5.524}$$

$$\approx 47.067$$

$$\text{Vol of small is about } 47 \text{ in}^3$$

EX 2: A candy maker makes chocolates in the shape of lady bugs. A small ladybug is solid chocolate, has a length of 4.0 cm, a width of 3.0 cm, and a height of 1.5 cm. It has a weight of 18 grams.

- a) They want to make a larger version that weighs 10 times as much and is still solid. What will the dimensions of the larger version be?

	sm	la
l	4 cm	?
w	3 cm	?
h	1.5 cm	?
weight	18 gm	$10 \cdot 18 \text{ gm} = 180 \text{ gm}$

$$18 \text{ g} \cdot a^3 = 180 \text{ g}$$

$$a^3 = \frac{180 \text{ g}}{18 \text{ g}}$$

$$a^3 = 10$$

$$\sqrt[3]{a^3} = \sqrt[3]{10}$$

$$a \approx 2.154$$

l:

$$4 \text{ cm} \cdot 2.154$$

$$\approx \underline{8.6 \text{ cm}}$$

w

$$3 \text{ cm} \cdot 2.154$$

$$\approx \underline{6.5 \text{ cm}}$$

h

$$1.5 \text{ cm} \cdot 2.154$$

$$\approx \underline{3.2 \text{ cm}}$$

- b) A new version of the small lady bug is covered with 5 grams of red sprinkles. How many grams of sprinkles would be needed to cover the large lady bug?

	Sm.	la
area	5 gm	?

$$5 \text{ gm} \cdot a^2 \approx ?$$

$$5 \text{ gm} (2.154)^2 \approx 23.199 \text{ gm}$$

23 grams of red sprinkles for the larger version.