Essential Question: When the dimensions of a solid increase by a factor of \( k \), how does the surface area change?

How does the volume change?

**Questions:**

**Notes:** Similar solids are solids that have the same shape and proportional corresponding dimensions.

**EXAMPLE 1:** Identifying Similar Solids

Which cylinder is similar to Cylinder A?

- Check to see if corresponding dimensions are proportional.
- Cylinder A and Cylinder B
  - Height of A: 4 m
  - Height of B: 3 m
  - Radius of A: 5 m
  - Radius of B: 6 m

- Cylinder A and Cylinder C
  - Height of A: 4 m
  - Height of C: 5 m
  - Radius of A: 6 m
  - Radius of C: 7.5 m

So, Cylinder C is similar to Cylinder A.

Cylinder D has a radius of 7.5 meters and a height of 4.5 meters. Which cylinder in Example 1 is similar to Cylinder D?

- Cylinder A: \( \frac{4}{4.5} = \frac{6}{7.5} \) No
- Cylinder B: \( \frac{3}{4.5} = \frac{5}{7.5} \) Yes
- Cylinder C: \( \frac{5}{4.5} = \frac{7.5}{7.5} \) No

Cylinder D and Cylinder B are similar because they have proportional corresponding dimensions.

Determine whether the solids are similar.
### Key Ideas

#### Linear Measures

#### Surface Areas of Similar Solids

When two solids are similar, the ratio of their surface areas is equal to the square of the ratio of their corresponding linear measures.

\[
\frac{\text{Surface Area of } A}{\text{Surface Area of } B} = \left( \frac{a}{b} \right)^2
\]
### Questions:

How do you find the surface area of a similar solid?

### Notes:

#### Example 3: Finding Surface Area

The pyramids are similar. What is the surface area of Pyramid A?

**Diagram:**

- **Pyramid A:** 6 ft base, 10 ft slant height.
- **Pyramid B:** 5 ft base, 8 ft slant height.

**Surface Area of A**

\[
S = \frac{6}{10} \times 36 = 216
\]

**Surface Area of B**

\[
S = \frac{5}{8} \times 36 = 216
\]

**Surface Area of Pyramid B:** 110 ft²

\[
S = \frac{5}{8} \times 36
\]

\[
S = 216
\]

The surface area of Pyramid A is 216 square feet.

#### Example 4: Finding Surface Area

The solids are similar. Find the surface area of the red solid. Round your answer to the nearest tenth.

**Diagram:**

- **Solid A:** 8 m base, 5 m height.
- **Solid B:** 4 cm base, 5 cm height.

**Surface Area of Solid A**

\[
S = 608 \text{ m}^2
\]

**Surface Area of Solid B**

\[
S = 110 \text{ cm}^2
\]

\[
S = \frac{608}{5} \times \left(\frac{5}{8}\right)^2
\]

\[
S = 237.5 \text{ m}^2
\]

**Surface Area of Solid B**

\[
S = \frac{110}{4} \times \left(\frac{5}{8}\right)
\]

\[
S = 171.9 \text{ cm}^2
\]

#### Key Idea

**Volumes of Similar Solids**

When two solids are similar, the ratio of their volumes is equal to the cube of the ratio of their corresponding linear measures.

\[
\frac{\text{Volume of A}}{\text{Volume of B}} = \left(\frac{a}{b}\right)
\]

#### Example 5: Finding Volume

The dimensions of the touch tank at an aquarium are doubled. What is the volume of the new touch tank?

- **Options:**
  - (A) 150 ft³
  - (B) 1600 ft³
  - (C) 8000 ft³
  - (D) 16,000 ft³

The dimensions are doubled, so the ratio of the dimensions of the original tank to the dimensions of the new tank is 1 : 2.

\[
\frac{\text{Original volume}}{\text{New volume}} = \left(\frac{1}{2}\right)^3
\]

\[
\frac{2000}{V} = \left(\frac{1}{2}\right)^3
\]

\[
2000 = V 	imes \frac{1}{8}
\]

\[
V = 16,000
\]

\[
16,000 = V
\]

The volume of the new tank is 16,000 cubic feet. So, the correct answer is (D).

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**Study Tip:**

When the dimensions of a solid are multiplied by \(k\), the surface area is multiplied by \(k^2\) and the volume is multiplied by \(k^3\).
<table>
<thead>
<tr>
<th>Questions:</th>
<th>Notes: The solids are similar. Find the volume of the red solid. Round your answer to the nearest tenth.</th>
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<table>
<thead>
<tr>
<th>5 cm</th>
<th>12 cm</th>
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<tbody>
<tr>
<td><img src="image" alt="Cone" /></td>
<td><img src="image" alt="Cone" /></td>
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<tr>
<td>Volume = 288 cm³</td>
<td>Volume = 9 in³</td>
</tr>
<tr>
<td>3 in.</td>
<td>4 in.</td>
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\[
\frac{V}{288} = \left(\frac{5}{12}\right)^3 \\
\frac{9}{V} = \left(\frac{9}{4}\right)^3 \\
\frac{V}{288} = \frac{125}{1728} \\
\frac{9}{V} = \frac{27}{64} \\
V = 20.8 \text{ cm}^3 \\
V = 21.3 \text{ in}^3
\]

The solids are similar. Find the surface area \( S \) or volume \( V \) of the shaded solid.

<table>
<thead>
<tr>
<th>3 mm</th>
<th>3 mm</th>
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<tbody>
<tr>
<td><img src="image" alt="Pyramid" /></td>
<td><img src="image" alt="Cube" /></td>
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\[
S = 198 \text{ m}^2 \\
\frac{198}{S} = \left(\frac{6}{8}\right)^2 \\
\frac{V}{54} = \left(\frac{8}{3}\right)^3 \\
\frac{198}{S} = \frac{36}{64} \\
\frac{V}{54} = \frac{512}{27} \\
SA = 352 \text{ m}^2 \\
V = 1024 \text{ mm}^3
\]

**SUMMARY:** To determine if solids are similar, set up a proportion of corresponding dimensions. If equal, they are similar. To find the missing measure of similar solids, set up a proportion of corresponding dimensions. Then, cross multiply and divide. To find the surface area of similar solids, set up a ratio of surface area equal to the squared ratio of given linear measures. Then cross multiply and divide. You can find the missing Volume of similar solids the same way, except cube the ratio instead of squaring it.