Polyhedron
* 3D figure whose surfaces are ___________________
* each polygon is a _______________.
* an ____________ is a segment where two faces intersect.
* a _____________ is a point where 3 or more edges intersect.

Example 1: List the vertices, edges, and faces of the polyhedron.
There are ___ vertices:
There are ___ edges:
There are ___ faces:

Leonhard Euler (1707-1783), a Swiss mathematician, discovered a relationship among the numbers of faces, vertices, and edges of any polyhedron.

Euler’s Formula: \[ F + V = E + 2 \]
where \( F \) = # of faces \( V \) = # of vertices \( E \) = # of edges

Example 2: Find the number of edges of a polyhedron with 6 faces and 8 vertices.

Note: In two-dimensions, Euler's formula reduces to
\[ F + V = E + 1 \]
where \( F \) is the number of regions formed by \( V \) vertices linked by \( E \) segments.

### Three-Dimensional Figures

<table>
<thead>
<tr>
<th>TERM</th>
<th>EXAMPLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>A <strong>prism</strong> is formed by two parallel congruent polygonal faces called bases connected by faces that are parallelograms.</td>
<td><img src="image1" alt="Prism" /></td>
</tr>
<tr>
<td>A <strong>cylinder</strong> is formed by two parallel congruent circular bases and a curved surface that connects the bases.</td>
<td><img src="image2" alt="Cylinder" /></td>
</tr>
<tr>
<td>A <strong>pyramid</strong> is formed by a polygonal base and triangular faces that meet at a common vertex.</td>
<td><img src="image3" alt="Pyramid" /></td>
</tr>
<tr>
<td>A <strong>cone</strong> is formed by a circular base and a curved surface that connects the base to a vertex.</td>
<td><img src="image4" alt="Cone" /></td>
</tr>
</tbody>
</table>

The faces of a prism are all __________ except for ___ bases that are \( \geq \) and || to each other.

The faces of a pyramid are all __________ except for ___ base.
A cross section is the intersection of a solid and a plane. You can think of a cross section as a very thin slice of a solid.

Describe each cross section. Then name the solid (disregarding the cross section) and, if it is a polyhedron, find the number of faces, vertices, and edges.

1. Cross Section: a triangle
   Solid: Triangular pyramid
   # F: 4
   # V: 4
   # E: 6

2. Cross Section:
   Solid:

3. Cross Section:
   Solid:

4. Cross Section:
   Solid:

5. Cross Section:
   Solid:

6. Cross Section:
   Solid:

7. Cross Section:
   Solid:

8. Cross Section:
   Solid:

9. Cross Section:
   Solid:

10. Cross Section:
    Solid:

11. Cross Section:
    Solid:

12. Cross Section:
    Solid:

13. Cross Section:
    Solid:

14. Cross Section:
    Solid:

15. Cross Section:
    Solid:
Describe the three-dimensional figure that can be made from the given net.

1. ___________________________
2. ___________________________
3. ___________________________
4. ___________________________
5. ___________________________
6. ___________________________
7. ___________________________
8. ___________________________
9. ___________________________
10. ___________________________
11. ___________________________
12. ___________________________
13. ___________________________

14. **Write About It** Which of the following figures is not a net for a cube? Explain.
   
a. ___________________________
b. ___________________________
c. ___________________________
d. ___________________________

15. Which three-dimensional figure does the net represent?
   
a. ___________________________
b. ___________________________
c. ___________________________
d. ___________________________
Visualizing in Three Dimensions

On some aptitude tests you will find questions which ask you to visualize three-dimensional constructions. For instance, you might be asked to “fold” patterns in your mind. In the example below, see if you can guess which pattern, when folded, would produce the box on the left.

The correct answer is A.

Choose the one pattern from each set that could be folded into the box shown.

1. A. B. C. D.
2. A. B. C. D.
3. A. B. C. D.
4. A. B. C. D.
5. A. B. C. D.
What’s my Surface Area?  What’s my Volume?  Name____________________________

Use the ruler on your TAKS Formula Chart to measure to the nearest quarter inch and answer the following questions regarding these nets that will form solids. Please identify the face(s) you are calling the base(s) by lightly shading it(them).

(Hint: the base is not what it is sitting on; it is what gives the solid its name.)

<table>
<thead>
<tr>
<th>Cylinder</th>
<th>Pyramid</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Shape of the base:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Perimeter of Base (P):</strong></td>
<td></td>
</tr>
<tr>
<td>(note that here “P” is really circumference)</td>
<td></td>
</tr>
<tr>
<td><strong>Formula for area of the base:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Area of Base (B):</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Height of solid (h):</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Surface Area (total):</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Formula for Volume:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Volume of Solid:</strong></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cylinder</th>
<th>Pyramid</th>
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<tbody>
<tr>
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<td><strong>Perimeter of Base (P):</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Formula for area of the base:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Area of Base (B):</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Slant height of solid (l):</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Surface Area (total):</strong></td>
<td></td>
</tr>
</tbody>
</table>
Use the ruler on your TAKS Formula Chart to measure to the **nearest tenth of a centimeter** and answer the following questions regarding these nets that will form solids. **Please identify the face(s) you are calling the base(s) by lightly shading it(them).**

(Hint: the base is not what it is sitting on; it is what gives the solid its name.)

<table>
<thead>
<tr>
<th><strong>Cube</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Shape of the base:</strong>  ________</td>
</tr>
<tr>
<td><strong>Perimeter of Base (P):</strong>  ________</td>
</tr>
<tr>
<td><strong>Formula for area of base:</strong>  ________</td>
</tr>
<tr>
<td><strong>Area of Base (B):</strong>  ________</td>
</tr>
<tr>
<td><strong>Height of solid (h):</strong>  ________</td>
</tr>
<tr>
<td><strong>Surface Area (total):</strong>  ________</td>
</tr>
<tr>
<td><strong>Formula for Volume:</strong>  ________</td>
</tr>
<tr>
<td><strong>Volume of Solid:</strong>  ________</td>
</tr>
</tbody>
</table>

(Is your choice of a “base” as crucial in this problem?)

<table>
<thead>
<tr>
<th><strong>Rectangular prism</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Shape of the base:</strong>  ________</td>
</tr>
<tr>
<td><strong>Perimeter of Base (P):</strong>  ________</td>
</tr>
<tr>
<td><strong>Formula for area of base:</strong>  ________</td>
</tr>
<tr>
<td><strong>Area of Base (B):</strong>  ________</td>
</tr>
<tr>
<td><strong>Height of solid (h):</strong>  ________</td>
</tr>
<tr>
<td><strong>Surface Area (total):</strong>  ________</td>
</tr>
<tr>
<td><strong>Formula for Volume:</strong>  ________</td>
</tr>
<tr>
<td><strong>Volume of Solid:</strong>  ________</td>
</tr>
</tbody>
</table>

(Is your choice of a “base” as crucial in this problem?)

What’s my Surface Area?  What’s my Volume?  p. 2
Using a ruler, measure to the nearest $\frac{1}{4}$ inch all sides of the net that are needed to find the areas of all polygons and circles.

### Cone

- **Shape of the base:**
- **Perimeter of Base (P):**
  (note that here “P” is really circumference)
- **Formula for area of the base:**
- **Area of Base (B):**
- **Slant height of solid (l):**
- **Formula- Surface Area (lateral):**
- **Surface Area (lateral):**
- **Formula-Surface Area (total):**
- **Surface Area (total):**

### Pyramid

- **Shape of the base:**
- **Perimeter of Base (P):**
- **Formula for area of the base:**
- **Area of Base (B):**
- **Slant height of solid (l):**
- **Formula- Surface Area (lateral):**
- **Surface Area (lateral):**
- **Formula-Surface Area (total):**
- **Surface Area (total):**
**Sphere**

Shape of the base: __________
Perimeter of Base (P): ________
Formula for area of the base: ________
Area of Base (B): ________
Formula-Surface Area: ________
Surface Area of Solid: ________
Formula for Volume: ________
Volume of Solid: ________

**Name of this solid** __________
Shape of the base: __________
Perimeter of Base (P): ________
Formula for area of the base: ________
Area of Base (B): ________
Height of solid (h): ________
Formula-Surface Area (lateral): ________
Surface Area (lateral): ________
Formula-Surface Area (total): ________
Surface Area (total): ________

Radius = _____ in.
The __________ ________ is the sum of the areas of all the faces of a solid.

11-2 Prisms and Cylinders

1. The two congruent, parallel faces of a prism are called the ___________.

2. The other faces of the prism are called the ___________ faces.

3. A ____________ edge of a prism is an edge that is not one edge of the base.

4. The __________ of a cylinder is the segment joining the centers of the two circular bases.

5. An __________ of a prism or cylinder is a perpendicular segment that joins the planes of the bases.

6. The ________ of a prism or cylinder is the length of an altitude.

7. The ________ area is the sum of the areas of all lateral faces.

8. Therefore, the surface area of a prism or cylinder is the sum of the ________ area and the two ________ areas.

\[
SA = LA + 2B \quad \text{(Prism or Cylinder)}
\]

11-3 Pyramids and Cones

1. A ____________ has one base that is a polygon and ___________ faces that are triangles that meet at a common vertex.

2. A ____________ pyramid has a base that is a regular polygon (All sides and angles of the polygon are congruent).

3. The __________ of a pyramid or cone is the length of the perpendicular segment from the vertex to the plane of the base.

4. The ________ height of a pyramid or cone is the length of the altitude of a lateral face.

5. Since pyramid or cone has only one base, the surface of area of a pyramid or cone is the sum of the ________ area and the ________ area.

\[
SA = LA + B \quad \text{(Pyramid or Cone)}
\]
11-2, 11-3 Surface Areas of Prisms, Cylinders, Pyramids, and Cones

**Formulas for Prism**

Perimeter of base $a + b + c + d$

Lateral Area $= \text{how far apart the bases are}$

Surface Area $= \text{L.A.} + 2B$

- **Lateral Area (LA)**: $a + b + c + d$
- **Substitute with values and solve**
- **Answer with units**

**Formulas for Cylinder**

- **Lateral Area (LA)**: $2\pi rh$
- **Surface Area (SA)**: $\text{LA} + 2B$, or $SA = 2\pi rh + 2\pi r^2$

**Formulas for a Regular Pyramid**

The lateral area of a regular pyramid is half the product of the perimeter of the base and the slant height.

$$\text{L.A.} = \frac{1}{2} P \ell$$

The surface area of a regular pyramid is the sum of the lateral area and the area of the base.

$$\text{S.A.} = \text{L.A.} + B$$

**Formulas for a Cone**

The lateral area of a right cone is half the product of the circumference of the base and the slant height.

$$\text{LA} = \frac{1}{2} P \ell = \frac{1}{2} (2\pi r) \ell = \pi r \ell$$

The surface area of a right cone is the sum of the lateral area and the area of the base.

$$\text{SA} = \frac{1}{2} P \ell + B = \pi r \ell + \pi r^2$$
Answers to Pg 611 # 2-10 evens, 16, 19, 21, 26, 32, 34, 37
Pg 620 # 1, 2, 4, 7, 8, 12, 14, 20, 23, 24, 29, 30, 41, 42

26. a) A(3, 0, 0), B(3, 5,
0), C(0, 5, 0), D(0, 5, 4)  
b) About 54 in²  
c) 84 + 20π in²  
d) ΔPRC, so the lateral altitude PR is shorter than the hypotenuse.  
e) The surface area becomes 4 times as large.

27. a) 94 units²  
b) 376 units²  
c) 4:1  
d) 438 units³, 1752 units², 4:1  
e) The surface area becomes 4 times as large.

28. a) 372/3 π in², b) 686/3 π in³,  
c) 11 in.  
d) about 8.9 in³, b) The answer is less than the actual SA since the dimples on the golf ball add to the SA.  
e) The small ball weighs 75 lb, the large ball weighs 253 lb.

29. 411 in³  
30. 45 m³  
31. 834,308 ft³  
32. 144π cm²  
33. a) Volume of frustum = Volume of whole cone (1/3πR²H) – Volume of missing cone (1/3πr²H).  
b) Use similar Δs to find height of the missing cone. Volume is about 784.6 in³.

Answers to Pg 640 # 2, 6, 8, 12, 17, 18, 23, 24, 27, 28, 32, 37, 38, 40, 42, 43, 58-63 all

2. 400π in²  
6. 578π in²  
8. 62 cm²  
12. 500/3 π ft³ = 524 ft³  
17. 98.784π m³ = 310 m³  
18. 451 in³  
23. Yes; the volume of the frozen yogurt is 85 1/3 π cm³, and the volume of the cone is 64π cm³.
24. C  
27. 1.7 lb  
28. 8 in. sphere; the volume of the three spheres is 13.5π and the large sphere is 85 1/3 π.
32. 500/3 π mm³

37. a) 1372/3 π in³, b) 686/3 π in³,  
c) 11 in.  
d) about 8.9 in³, b) The answer is less than the actual SA since the dimples on the golf ball add to the SA.  
e) The small ball weighs 75 lb, the large ball weighs 253 lb.

38. 58. 16 m³  
59. 19 in³  
60. 19.396 mm³  
61. 10.5 cm  
62. 27 cm  
63. 67.5 cm²

Answers to Pg 648 # 2-14 evens, 17-19 all, 22-29 all (omit # 25), 34-36 all

2. yes, 3 : 2  
4. no  
6. no  
8. 6 : 7  
10. 2 : 5  
12. 180 m³  
14. 175 in²  
17. 6000 toothpicks  
18. 74 oz  
19. a) It is 64 times the smaller prism. b) It is 64 times larger prism.  
22. Yes, 60. Hint: the prisms are rotated. Find the similarity ratio of the largest sides of each prism.

23. About 1000 cm³  
24. No; an increase in the side lengths does not always create proportional ratios.  
26. 27 ft³  
27. a) 3 : 1. b) 9 : 1.  
28. a) 11 : 14, b) 121 : 196.  
29. 864 in³  
34. a) 144 coats. b) 1728 meals.  
35. a) 100 times. b) 1000 times.  
c) His weight is 1000 times but his bones can only support 600 times.
36. a) 384 cm². b) 16 : 1.  
c) SA of Pyramid A is 384 cm², SA of Pyramid B is 24 cm².
11-4, 11-5 Volumes of Prisms, Cylinders, Pyramids, and Cones

Notes
Name: ___________________________  
Date: ________________ Period: _____

11-4 Volumes of Prisms and Cylinders

The _________ is the measure of the amount of space contained in a solid. Units used to measure volume include _________, __________, _________, and __________. The volume of an object is the number of ________ cubes that fill the space within the object.

What is the area of the base of a solid comprised of 2 rows of unit cubes by 3 columns of unit cubes?

How many unit cubes currently fill the space inside the object?

If you place a second layer of cubes on top of the base in the same fashion, how many cubes currently fill the space inside the object?

If you place a third layer of cubes on top of the base in the same fashion, how many cubes currently fill the space inside the object?

If you place a fourth layer of cubes on top of the base in the same fashion, how many cubes currently fill the space inside the object?

The volume of a prism or cylinder is the product of the area of a base and the height of the prism or cylinder.

\[ V = Bh \]

The height (h) is the perpendicular distance between the bases, which is not necessarily vertical. Warning: The formula for the base (B) depends on the SHAPE of the base!

Area of rectangle or parallelogram = __________  Area of triangle = __________

Area of trapezoid = __________  Area of rhombus or kite = __________

Area of circle = __________  Area of regular polygon = __________

The first stack forms a right prism. The second forms an ________ prism. The stacks have the same height. The area of every cross section parallel to a base is the area of one sheet of paper. The stacks have the same volume. These stacks illustrate the following principle:

**Cavalieri's Principle**

If two space figures have the same height and the same cross-sectional area at every level, then they have the same volume.

11-5 Volumes of Pyramids and Cones

The volume of a pyramid or cone is ______ the product of the area of the base and the height.

\[ V = \frac{1}{3} Bh \]
11-6 Surface Areas and Volumes of Spheres

**Notes**

**Date:** ________________ **Period:** _____

**Review:**

- **Area of a circle** = __________
- **Circumference of a circle** = __________

**11-6 Surface Areas and Volumes of Spheres**

A **sphere** is the set of all points in space equidistant from a given point called the **center**. A **radius** is a segment that has one endpoint at the center and the other endpoint on the sphere. A **diameter** is a segment passing through the center with endpoints on the sphere.

If a plane intersects a sphere, the intersection is either a single point or a circle. If the plane contains the center of the sphere, then the intersection is a **great circle** of the sphere. The circumference of a great circle is the circumference of the sphere. Every great circle of a sphere separates the sphere into two congruent halves called **hemispheres**.

A baseball is a model of a sphere. The surface area of a baseball is sewn from two congruent shapes, each of which resembles two joined circles, as shown.

So the entire covering of the baseball consists of four circles, each with radius $r$. The area of a circle with radius $r$ is __________. So, the area of the covering can be approximated by __________.

**Surface Area of a Sphere**

$$ S = 4 \pi r^2 $$

Fill a sphere with a large number ($n$) of small pyramids. The vertex of each pyramid is the **center** of the sphere. The height of each pyramid is the **radius** of the sphere. The sum of the areas of the bases of the $n$ pyramids approximates the **surface area** of the sphere. The sum of the volumes of the $n$ pyramids should approximate the **volume** of the sphere.

**Volume of a Sphere**

$$ V = \frac{4}{3} \pi r^3 $$

**Challenge:**

<table>
<thead>
<tr>
<th>Cylinder</th>
<th>Cone</th>
<th>Sphere</th>
<th>Hemisphere</th>
</tr>
</thead>
<tbody>
<tr>
<td># of bases?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td># of faces?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td># of vertices?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td># of edges?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Has a perimeter?</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Euler’s Formula does not apply since these are not polyhedrons (A polyhedron is a 3D figure whose surfaces are polygons).

**Class Exercises Answer Key:**

1. $144\pi$, or about 452.39 sq ft
2. 121.5\pi, or about 381.70 cubic inches
3. $S = 247.78$ in$^2$
   - $V = 164.22$ in$^3$
4. about 20,944 ft$^3$
5. about 98,321,312 mi$^2$
6. a) 6.99 cm, b) 613.12 cm$^3$ or 613.99 cm$^3$
7. a) about 8.65 in$^3$, b) 29.47 in$^3$ or 29.49 in$^3$
8. a) about 10,306 cm$^3$, b) 82,447.96 cm$^3$.
   - c) 8 : 1
9. a) SA of Torrid Zone is about 80,925,856 mi$^2$. SA of Earth is about 197,359,488 mi$^2$.
   - b) about 41%
11-6 Surface Areas and Volumes of Spheres

**Class Exercises** (from McDougal Littell pages 838-844)

**Show all work on a separate sheet of paper!**

1. In an extreme sport called **sphereing**, a person rolls down a hill inside an inflatable ball surrounded by another ball. The diameter of the outer ball is 12 feet. Find the surface area of the outer ball.

To keep your answer in terms of \( \pi \), input the \#s in the calculator without the \( \pi \), and write \( \pi \) next to your answer at the end.

2. The soccer ball has a radius of 4.5 inches. Find its volume.

There are two ways to type \( 3 \) in the calculator:

\[^{\text{3}}\text{ or MATH 3}\]

3. Find the volume and the surface area of the solid (a cylindrical ice cream container with ice cream scooped out of the top in the shape of a bowl). Round your answer to two decimal places.

First write the strategy, then replace with formulas, then substitute with values.

\[
V = V_{\text{cylinder}} - \frac{1}{2} V_{\text{sphere}} = \pi r^2 h - \frac{1}{2} \left( \frac{4}{3} \pi r^3 \right)
\]

\[
SA = LA_{\text{cyl}} + B_{\text{cyl}} + \frac{1}{2} S_{\text{sph}} = 2\pi rh + \pi r^2 + \frac{1}{2} \left( 4\pi r^2 \right)
\]

4. A grain silo has the dimensions shown. The top of the silo is a hemispherical shape. Find the volume of the grain silo.

5. The circumference of Earth is about 24,855 miles. Find the surface area of the Western Hemisphere of Earth.

Use the circumference formula to solve for \( r \).

\[
C = 2\pi r = 24855
\]

\[
r = \frac{24855}{2\pi}
\]

Make sure you put () around the whole denominator in the calculator. Then instead of rounding the answer for \( r \), use \( \text{ANS} \) by pressing 2nd [(-)]. Type \((1/2)\times4\times\pi\times\text{ANS}^2\)

6. A ball has volume 1427.54 cubic centimeters.

a. Find the radius of the ball. Round your answer to two decimal places.

To get the cube root \( 3 \sqrt{\text{ in the calculator, press MATH 4}} \)

Or press \[^{(1/3)}\]

b. Find the surface area of the ball. Round your answer to two decimal places.

7. Tennis balls are stored in a cylindrical container with height 8.625 inches and radius 1.43 inches.

a. The circumference of a tennis ball is 8 inches. Find the volume of a tennis ball.

b. There are 3 tennis balls in the container. Find the amount of space within the cylinder not taken up by the tennis balls.

8. A partially filled balloon has circumference 27\( \pi \) centimeters. Assume the balloon is a sphere.

a. Find the volume of the balloon.

b. Suppose you double the radius by increasing the air in the balloon. Find the new volume.

c. What is the ratio of this volume to the original volume?

9. The Torrid Zone on Earth is the area between the Tropic of Cancer and the Tropic of Capricorn, as shown. The distance between these two tropics is about 3250 miles. You can think of this distance as the height of a cylindrical belt around Earth at the equator, as shown.

a. Estimate the surface area of the Torrid Zone and the surface area of Earth. (Earth’s radius is about 3963 miles at the equator.)

b. A meteorite is equally likely to hit anywhere on Earth. Estimate the probability that a meteorite will land in the Torrid Zone.
11-7 Areas and Volumes of Similar Solids

Notes and Lab

11-7 Areas and Volumes of Similar Solids

_________ __________ have the same shape and all their corresponding dimensions are proportional. The ratio of corresponding linear dimensions, such as height or radii, of two similar solids is the __________ __________.

Any two cubes are similar, and any two spheres are similar. Why?

Identify Similar Solids:
Tell whether the given right rectangular prism is similar to the right rectangular prism shown at the right.

a) Ratio of lengths: __________ __________ __________
b) Ratio of lengths: __________ __________ __________

Use the following pairs of similar solids to complete the table below.
Pair 1: take 9 cubes to compare 1 unit cube (A) with another cube (B) made by doubling all dimensions.
Pair 2: __________
Pair 3: __________
Pair 4: __________
Pair 5: __________

* Easiest way to find the ratio (most simplified fraction) is to divide the #s in the calculator and press \boxed{\text{MATH} 1}.
If both numbers have π then cancel both π’s and just divide the #s.

<table>
<thead>
<tr>
<th>Pair</th>
<th>Similarity ratio of A to B</th>
<th>Surface Area of A</th>
<th>Surface Area of B</th>
<th>Ratio of Surface Areas</th>
<th>Volume of A</th>
<th>Volume of B</th>
<th>Ratio of Volumes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1 : 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>63π</td>
<td></td>
<td></td>
<td>9 : 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>a : b</td>
<td></td>
<td></td>
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Areas and Volumes of Similar Solids
If the similarity ratio of two similar solids is \(a : b\), then
the ratio of their corresponding areas is ___ : ___ , and the ratio of their volumes is ___ : ___ .
1. Two similar prisms have heights 4 cm and 10 cm.
   a) What is their similarity ratio?
   b) What is the ratio of their surface areas?
   c) What is the ratio of their volumes?

2. The heights of two similar coffee mugs are 3.5 inches and 4 inches. The larger mug holds 12 fluid ounces. What is the capacity of the smaller mug?

3. The cans shown are similar with a scale factor of 87 : 100. \( S = 51.84 \text{ in.}^2 \) and \( V = 28.27 \text{ in.}^3 \) for the smaller can. Find the surface area and volume of the larger can.

4. The pyramids are similar. Pyramid P has a volume of 1000 cubic inches and Pyramid Q has a volume of 216 cubic inches. Find the scale factor of Pyramid P to Pyramid Q.

5. Cube C has a surface area of 54 square units and Cube D has a surface area of 150 square units.
   a) Find the scale factor (similarity ratio) of C to D.
   b) Find the edge length of C.
   c) Use the scale factor to find the volume of D.

6. A store sells balls of yarn in two different sizes. The diameter of the larger ball is twice the diameter of the smaller ball. If the balls of yarn cost $7.50 and $1.50, respectively, which ball of yarn is the better buy?
   b) Calculate the new price for the larger ball of yarn so that neither ball would be a better buy than the other.

7. Solid I is similar to Solid II. Find the surface area and volume of Solid II.

8. Solid I is similar to Solid II. Find the surface area and volume of Solid II.

9. The scale factor of the model car at the right to the actual car is 1 : 18.
   a) The model has length 8 inches. What is the length of the actual car?
   b) Each tire of the model has a surface area of 12.1 square inches. What is the surface area of each tire of the actual car?
   c) The actual car’s engine has volume 8748 cubic inches. Find the volume of the model car’s engine.
Show all work. Give exact answers (in simplest radical form or in terms of $\pi$) unless specifically stated to round. Write the correct units with your answer. Circle your answer.

1. You have a hot tub in the shape of a regular hexagon. Each side of the regular hexagon is 3 ft and the height of the hot tub is 3 ft. What is the maximum volume of the hot tub in gallons? (1 cubic foot = 7.48 gallons)

2. A king-size waterbed mattress measures 5.5 feet by 6.5 feet by 8 inches deep. If the mattress were completely filled with water, how much does the water in the mattress weigh in pounds? (Water weighs 63 pounds per cubic foot).

If the waterbed can be filled at a rate of 20 gal./min, how long will it take to fill the waterbed? (1 cubic foot = 7.48 gallons)

| 10. The floor of the tent is a square. Find the lateral area of the tent. | 11. Find the surface area of the figure. |
| Find the volume of the tent. | Find the volume of the figure. |

| 12. Find the surface area of the figure. | 13. Find the surface area of the figure. |
| Find the volume of the figure. | Find the volume of the figure. |
16. What is the volume of the 3-D figure shown?

17. Calculate the height of the water after the ball is submerged in the cylinder.

18. If Suzie has a rectangular block of wax that is 20 cm by 15 cm by 18 cm, how many candles can she make if each candle is shaped as shown?

19. You have a cube whose sides measure 4 cm. If you quadruple every side of the cube, how do the surface area and volume of the new cube compare with the original cube?

20. You have a balloon with a certain amount of air. If you blow air into the balloon so that the new volume is eight times the original, what happens to the surface area of the balloon? Assume the balloon is a sphere.

21. a) Find the similarity ratio of two spheres with volumes of $32\pi$ m$^3$ and $500\pi$ m$^3$.

b) What is the radius of the smaller sphere?

22. The volumes of two similar solids are 54 ft$^3$ and 250 ft$^3$. The surface area of the smaller solid is 58.5 ft$^2$. Find the surface area of the larger solid.
23. What is the probability of a dart landing in the shaded area? The smallest circle has a radius of 6 cm; the radius of the largest circle is four times the radius of the smallest circle; and the radius of the medium circle is \( \frac{2}{3} \) the radius of the largest circle.

24. Find the probability that a point chosen at random will lie in the shaded area. The diameter of the circle is 14 in.

25. The net of a cylinder is shown below. Use the ruler on the Mathematics Chart to measure the dimensions of the cylinder to the nearest tenth of a centimeter. Calculate the surface area. __________

If this net was folded into a cylinder, which edge would be the height of the cylinder? Mark it on the diagram. Measure it in centimeters (to the nearest tenth) __________ and inches (to the nearest quarter inch) __________.

26. The total surface area of the cylinder is approximately 88 cm\(^2\). The lateral surface area is about 63 cm\(^2\). Find the approximate area of one base and the diameter of the base.

A builder drills a hole through a cube of concrete, as shown in the figure. This cube will be an outlet for a water tap on the side of a house. Complete Exercises to find the surface area of the figure. Round to the nearest tenth if necessary.

Find the surface area of the cube.

Find the lateral area of the cylinder.

Find twice the base area of the cylinder.

The surface area of the figure is the surface area of the prism plus the lateral area of the cylinder minus twice the base area of the cylinder. Find the surface area of the figure.

Answers: 23. 5/9 or 55.556% 24. 31.831% 25. ? 26. Base is 12.5 cm\(^2\), diameter is 3.989 cm. 27. ? 28. SA = 248.538 ft\(^2\), Vol = 50 + 75\(\pi\) ft\(^3\). 29. SA = 123.708 km\(^2\), Vol = 62.575 km\(^3\).
Find the surface area and volume of each composite solid below.

28. SA = ____________  Volume = ____________

29. SA = ____________  Volume = ____________

Rally Table Cards – Effects of changing dimensions on area, surface area and volume.

# 31
A traffic cone has a surface area of $36\pi$. If the height and radius of a traffic cone are both divided by 3, what is the surface area of the new cone?

# 32
A statue has a volume of $54\text{ ft}^3$ and a height of 6 feet. A similar statue is 2 feet tall. What is the volume of the smaller statue?

# 33
The dimensions of a family-size can of soup are 1.5 times the dimensions of a regular can of soup. If the label of the regular can has an area of $45\text{ cm}^2$, what is the area of the label on the family-size can?

# 34
At Johnny’s Pizzeria, they sell a Large pizza with an area of $64\text{ in}^2$. They want to make an Extra Large pizza with a radius that is twice that of the Large pizza. What is the area of the Extra Large pizza?

# 35
Marshall’s rectangular garden has an area of $360\text{ ft}^2$ and he wants to expand its size by tripling the length and the width. What is the area of his expanded garden?

# 36
The height of a pyramid with a volume of $225\text{ ft}^3$ is reduced by a scale factor of $\frac{1}{5}$. What is the volume of the reduced pyramid?

# 37
If the length and width of a rectangular gift box is halved and the height remains the same, by what factor does the volume of the box decrease?

# 38
If the radius of a can of soda is doubled and the height remains the same, how much more soda will the larger can hold than the smaller can?

# 39
If the height of a rectangular gift box is tripled and the other dimensions remain the same, by what factor does the volume of the box increase?

Answers: 31. $4\pi \text{ units}^2$. 32. $2\text{ ft}^3$. 33. $101.25\text{ cm}^2$. 34. $256\text{ in}^2$. 35. $3240\text{ ft}^3$. 36. $45\text{ ft}^3$. 37. $\frac{1}{4}$ times. 38. 4 times. 39. 3 times.