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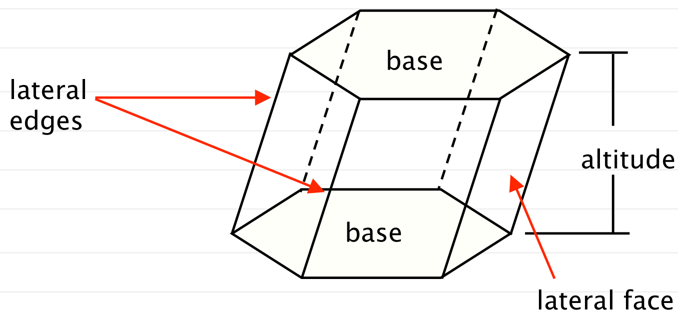
**Definition**

A **prism** is a solid with two congruent bases that are parallel, and lateral edges are parallel.





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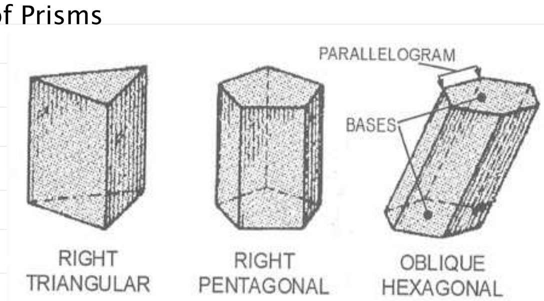
Some Types of Prisms




What is the difference between right prism and oblique prism?

**Theorem 12.1**

The lateral area of a right prism equals the perimeter, p, of a base times the height, h, of the prism. (L.A.=ph)

**Theorem 12.2**

The volume of a ~~right~~ prism equals the area of a base, B, times the height, h, of the prism. (V=Bh)

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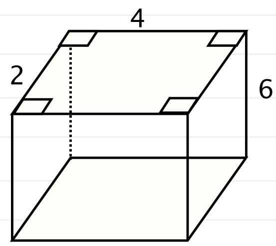


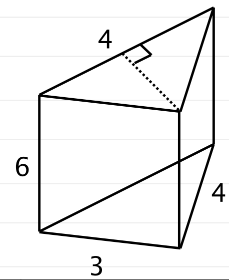


| | | Right Rectangular Prism | Right Triangular Prism |
|---|---|---|---|
| 1 | p | | |
| 2 | B | | |
| 3 | L.A. | | |
| 4 | T.A. | | |
| 5 | V | | |





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**Example 5**

Given that the volume of a cube is 8 $cm^3$, find

(a) the length of each edge.

(b) total surface area. Show in two different way.

**Example 6**

The length of a rectangular prism is four times the width and the height equal to the width. If the volume is $32m^3$, then find dimension.

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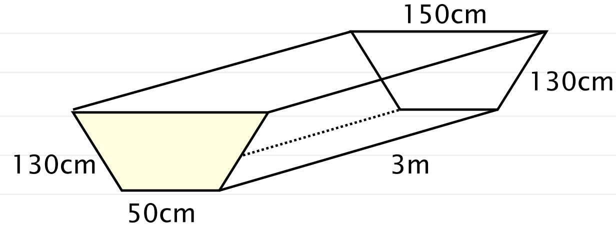
**Example 7**

A drinking trough for horses is a right trapezoidal prism with dimensions shown. If the water is filled 2/3 of the way up, about how will the water weight? (Note: 1 m$^3$ of water weight 1 metric ton).





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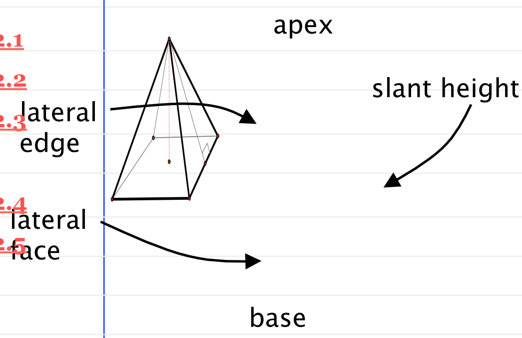
PART OF PYRAMID




We'll be studying mostly regular pyramid in this section.

**Regular pyramids have following properties:**

- the base is a regular polygon
- all lateral edges are congruent
- all lateral faces are isosceles triangle
- the altitude meets the base at its center

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# Chapter 12: Areas and Volumes of Solids
## Unit 1: Important Solids
### Section 2: Pyramids

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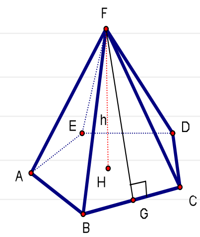
**Given regular pentagonal pyramid, name the following**

base:




lateral edges:

lateral faces:

altitude:

slant height:

apex:



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**Theorem 12.3**

The lateral area of a regular pyramid equals half the perimeter of the base times the slant height. (L.A.=pl/2)

Can you prove the formula of lateral area?

**Theorem 12.4**

The volume of a pyramid equals one third the area of the base times the height of the pyramid. (Volume=Bh/3)

on your desk

**Example 1**

A regular square pyramid has base edge 6m and lateral edge 5m.

12.1 (a) length of a slant height=___________

12.2 (b) lateral area =___________

12.3 (c) base area =___________

(d) total area =___________

12.4 (e) length of altitude =___________

12.5 (f) volume =___________

**Example 2**

A regular triangular pyramid has slant height 9cm and base perimeter 12cm.

(a) lateral area =___________

(b) base area=___________

(c) total area=___________





on your desk

**Example 3**

The height of a regular triangular pyramid is 6cm, and the radius of the base is 8cm. Find the base area and the volume of the pyramid.

12.1

12.2

12.3

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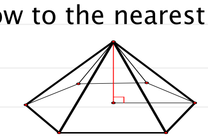
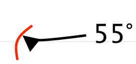
**Example 4**

Find the volume of the regular pyramid below to the nearest tenth. The measure of each side of the base is 6.





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## *Chapter 12: Areas and Volumes of Solids*
*Unit 1: Important Solids*
*Section 3: Cylinders and Cones*

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**Definition**

Cylinder is a prism with bases that are congruent circles on a parallel plane. Cones is a pyramid with a circular base. All formulae shown in previous two sections apply to both cylinder and cones.

COMPARE AND CONTRAST the new theorems from Thm12.1 & Thm12.3 !!!!

**Theorem 12.1**

The lateral area of a right prism equals the perimeter, p, of a base times the height, h, of the prism. (L.A.=ph)

**Theorem 12.5**

The lateral area of a cylinder equals the circumference of a base, 2πr, times the base times the height, h, of the cylinder. (L.A.=2πrh)

**Theorem 12.2**

The volume of a ~~right~~ prism equals the area of a base, B, times the height, h, of the prism. (V=Bh)

**Theorem 12.6**

The volume of a cylinder equals the area of a base, B, times the height, h, of the prism. (V=Bh=$\pi r^2 h$)



Notes

## *Chapter 12: Areas and Volumes of Solids*
*Unit 1: Important Solids*
*Section 3: Cylinders and Cones*

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**NOTE**

Cylinder = SPECIAL prism; Cone = SPECIAL pyramid

**Theorem 12.3**

The lateral area of a regular pyramid equals half the perimeter of the base times the slant height. (L.A.=pl/2)

**Theorem 12.7**

The lateral area of a cone equals half the circumference of the base times the slant height. (L.A.=pl/2 or 2πrl/2=πrl)

**Theorem 12.4**

The volume of a pyramid equals one third the area of the base times the height of the pyramid. (Volume=Bh/3)

**Theorem 12.8**

The volume of a cone equals one third the area of the base times the height of the pyramid. (Volume=Bh/3=$\pi r^2 h/3$)

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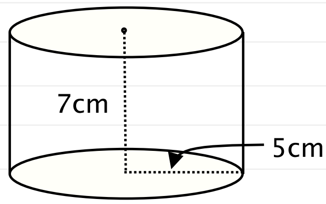


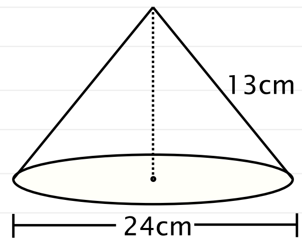


| | | Cylinder | Cone |
|---|---|---|---|
| 1 | B | | |
| 2 | L.A. | | |
| 3 | T.A. | | |
| 4 | V | | |





on your desk
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**Example 5**

A cone with radius 6cm and height 12cm is filled to capacity with liquid. Find the minimum height of a cylinder with radius 4cm that will hold the same amount of liquid.

**Example 6**

A right cone and a right cylinder have equal base areas. The height of the cylinder is four times the height of the cone. Compare the volumes.

**Example 7**

A pipe is 3m long and has inside radius 4cm and outside radius 5cm. Find the volume of metal. Round to the nearest tenth. Draw the diagram, first.

on your desk

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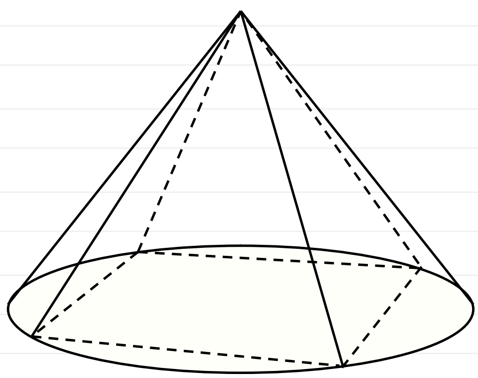
**Example 8**

A regular square pyramid is inscribed in a cone with radius 4cm and height 4cm.

(a) What is the volume of the pyramid?

(b) Find the slant height of the cone and the pyramid.







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**Theorem 12.9**

The surface area of a sphere is $4\pi r^2$

**Theorem 12.10**

The volume of a sphere is $\frac{4}{3}\pi r^3$

| | d | r | A | V |
|---|---|---|---|---|
| 1 | 12 | | | |
| 2 | | 7 | | |
| 3 | | | | $\frac{32000\pi}{3}$ |
| 4 | | | $12\pi$ | |
| 5 | | r | | |
| 6 | | 2r | | |

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**Example 7**

The volume of a sphere is $36\pi$. Find the surface area.

**Example 8**

a) Compare the areas of the spheres in 5 and 6.

b) Compare the volumes of the spheres in 5 and 6.

c) What can you generalize from this example?

**Example 10**

The number of square centimeters in the area of a sphere is twice the number of cubic centimeter in the volume of a sphere. Find the radius of the sphere.





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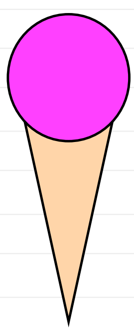
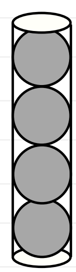
**Example 11**

A scoop of ice cream with diameter 8cm is placed on an ice-cream cone with diameter 7cm and height 10cm. If the ice creams melts, will the ice cream overflow? Show why or why not.



**Example 12**

Four metal ball with a diameter of 4cm fit snugly inside a cylinder. If you melt it and pour it back into the cylinder, how high will the molten metal be after it cools inside the cylinder?



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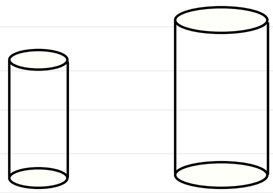
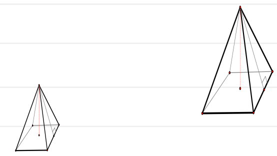
**Similar solids** are solids that have the same shape, but not necessarily the same size.  It's analogous to similar polygons.





| I | II | I | II |
|---|---|---|---|
| radius =2<br>height=6 | radius =4<br>height=12 | side of base=3<br>height=4 | side of base=9<br>height=12 |

Find the ratios of volumes for each set of solids.



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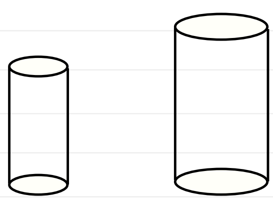

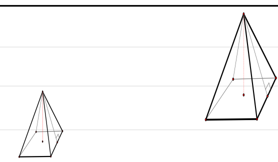

| I | II | I | II |
|---|---|---|---|
| radius =2<br>height=6 | radius =4<br>height=12 | side of base=3<br>height=4 | side of base=9<br>height=12 |

| | | Cylinder I and II | Pyramids I and II |
|---|---|---|---|
| 1 | scale factor | | |
| 2 | $\frac{\text{base perimeter I}}{\text{base perimeter II}}$ | | |
| 3 | $\frac{\text{L.A. I}}{\text{L.A. II}}$ | | |
| 4 | $\frac{\text{Volume I}}{\text{Volume II}}$ | | |

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**Theorem 12.11**

If the scale factor of two similar solids is a:b, then

(1) the ratio of corresponding perimeters is a:b.

(2) the ratio of the base areas, the lateral areas, and the total area is $a^2:b^2$.

(3) the ratio of the volume is $a^3:b^3$.

**Example 1**

(a) Are all spheres similar?

(b) Are all right cylinders similar?

**Example 2**

Two cones have base radii 8 and 12, and heights 16 and 24, respectively. Are the cones similar?

**Example 3**

Two similar square pyramids have base areas 4m2 and 36m2.

- Find the ratio of the height of the pyramids.
- If the height of the larger pyramid is 27m, what is the height of the smaller pyramid?



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**Problem 1**

Two regular pyramids have equilateral triangular bases with sides 4 and 6. Their heights are 6 and 9, respectively. Are the two pyramids similar?

**Problem 2**

Two similar cones have bases with area ratios of 4:9. Find the ratios of the following:

(a) radii (b) heights (d) total areas (d) volumes

**Problem 3**

The volumes of two spheres have a ratio of 24:64. Find the area of the larger sphere if the area of the smaller sphere is 18.

**Problem 4**

The radii of two similar cylinders are 2 and 5. Find the ratios of their volumes and of their lateral areas.

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**Problem 5**

The volumes of two similar rectangular solids are $125cm^3$ and $64cm^3$. Find the ratio of their base perimeters.

**Problem 6**

(a) A diagonal of one cube is 2cm. Find its volume.

(b) Using the ratios of similar solids, find the volume of a cube whose diagonal is 5cm.