Solid Geometry

Solid Geometry is the geometry of three-dimensional space, the kind of space we live in ...

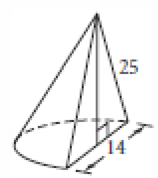
For more geometry fun, go to http://www.mathsisfun.com/geometry/index.html

Solid Geometry

Solid Geometry is the geometry of three-dimensional space, the kind of space we live in ...

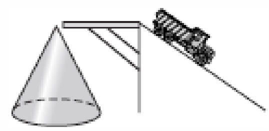
Example 1:
Find the volume:

. Half of a right cone



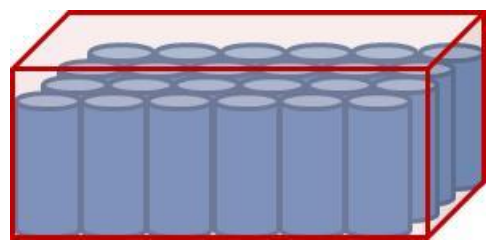
Example 2:

The North County Sand and Gravel Company stockpiles sand to use on the icy roads in the northern rural counties of the state. Sand is brought in by tandem trailers that carry 12 m^3 each. The engineers know that when the pile of sand, which is in the shape of a cone, is 17 m across and 9 m high they will have enough for a normal winter. How many truckloads are needed to build the pile?



Example 3:

Jerry is packing cylindrical cans with diameter 6 in. and height 10 in. tightly into a box that measures 3 ft by 2 ft by 1 ft. All rows must contain the same number of cans. The cans can touch each other. He then fills all the empty space in the box with packing foam. How many cans can Jerry pack in one box? Find the volume of packing foam he uses. What percentage of the box's volume is filled by the foam?



p.438

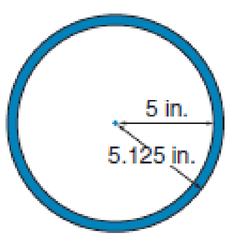


Figure 9.44

EXAMPLE 6

A child's hollow plastic ball has an inside diameter of 10 in. and is approximately $\frac{1}{8}$ in. thick (see the cross-section of the ball in Figure 9.44). Approximately how many cubic inches of plastic were needed to construct the ball?

Solution The volume of plastic used is the difference between the outside volume and the inside volume. Where R denotes the length of the outside radius and r denotes the length of the inside radius, $R \approx 5.125$ and $r = 5$.

$$V = \frac{4}{3}\pi R^3 - \frac{4}{3}\pi r^3, \qquad \text{so} \qquad V = \frac{4}{3}\pi(5.125)^3 - \frac{4}{3}\pi \cdot 5^3$$

Then $$V \approx 563.86 - 523.60 \approx 40.26$$

The volume of plastic used was approximately 40.26 in^3.

For more geometry fun, go to http://www.mathsisfun.com/geometry/index.html

Solid Geometry

Solid Geometry is the geometry of three-dimensional space, the kind of space we live in ...

Cylinder

Cylinder Facts

Notice these interesting things:

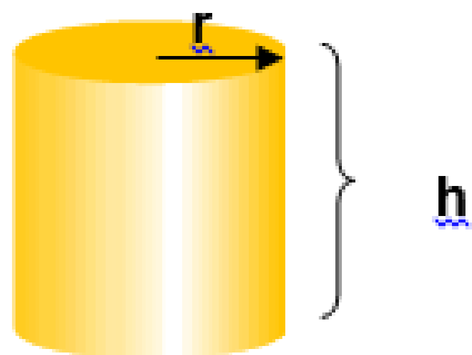
It has a flat base and a flat top

The base is the same as the top, and also in-between

It has one curved side

Because it has a curved surface it is not a polyhedron.

An object shaped like a cylinder is said to be **cylindrical**



And for reference:

Surface Area = $2 \times \pi \times r \times (r+h)$

- *Surface Area of One End* = $\pi \times r^2$
- *Surface Area of Side* =
- $2 \times \pi \times r \times h$

Volume - Just multiply the area of the circle by the height of the cylinder:

- Area of the circle: $\pi \times r^2$
- Height: **h**
- Volume = Area × Height
- $= \pi \times r^2 \times h$

Cone

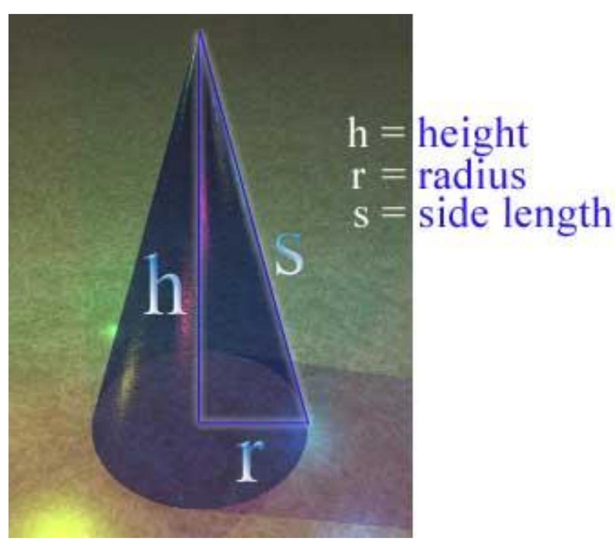
Cone Facts

Notice these interesting things:

It has a flat base

It has one curved side

Because it has a curved surface it is not a polyhedron.



And for reference:

Surface Area of Base = $\pi \times r^2$

Surface Area of Side = $\pi \times r \times s$

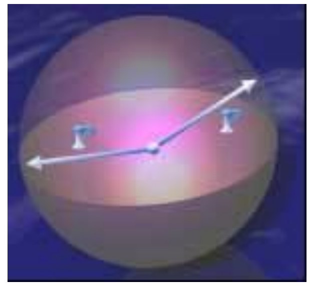
or Surface Area of Side = $\pi \cdot r \cdot \sqrt{r^2 + h^2}$

For more geometry fun, go to http://www.mathsisfun.com/geometry/index.html

Solid Geometry

Solid Geometry is the geometry of three-dimensional space, the kind of space we live in ...

Spheres



Notice these interesting things:

It is perfectly symmetrical

It has no edges or vertices

It is **not** a polyhedron

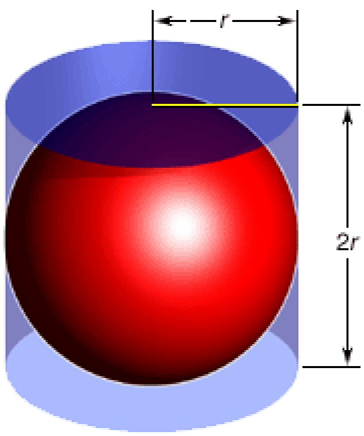
All points on the surface are the same distance from the center

And for reference:

Surface Area = S =4 × π × r^2

Volume = (4/3) × π × r^3 = (1/3) × 4× π × r^2 × r = (1/3) × S× r

Archimedes' Sphere



Volume of a Sphere = (2/3) X Volume of a Cylinder with height equaling the diameter of the sphere.

Proof:

Volume of Cylinder with Height, 2r = Base X Height = $\pi \times r^2 \times 2r$

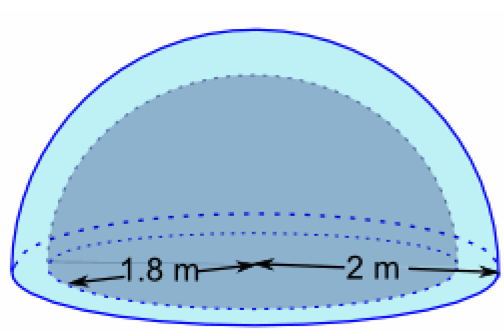
$= 2\pi r^3$

(2/3)xVolume of Cylinder = $(2/3) \times 2\pi r^3$

$=(4/3)\pi r^3$

=Volume of Sphere

Example:



The diagram shows an igloo which consists of a hemispherical shell of outside radius 2 m and inside radius 1.8 m. What is the volume of the walls of the igloo?

(Ignore any openings)

For more geometry fun, go to http://www.mathsisfun.com/geometry/index.html

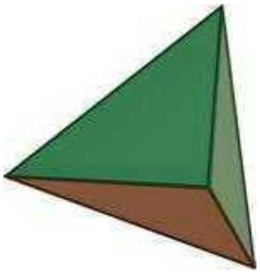
Solid Geometry

Solid Geometry is the geometry of three-dimensional space, the kind of space we live in ...

A **polyhedron** is a solid with flat faces (from Greek poly- meaning "many" and -edron meaning "face"). Each face is a polygon (a flat shape with straight sides). There are hundreds of polyhedrons made up of different kinds of polygons for its faces.

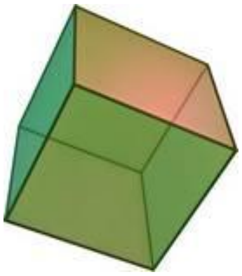
Platonic Solids

Below are the five platonic solids (or *regular polyhedra*). For each solid there is a printable net. These nets can be printed onto a piece of card. You can then make your own platonic solids. Cut them out and tape the edges together.



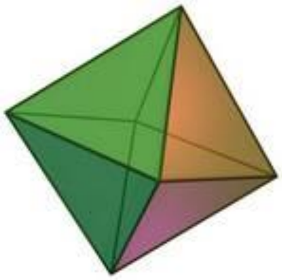
Tetrahedron

- 4 Faces
- 4 Vertices
- 6 Edges



Cube

- 6 Faces
- 8 Vertices
- 12 Edges



Octahedron

- 8 Faces
- 6 Vertices
- 12 Edges

Dodecahedron

- 12 Faces
- 20 Vertices
- 30 Edges

Icosahedron

- 20 Faces
- 12 Vertices
- 30 Edges

For more geometry fun, go to http://www.mathsisfun.com/geometry/index.html

Solid Geometry

Solid Geometry is the geometry of three-dimensional space, the kind of space we live in ...

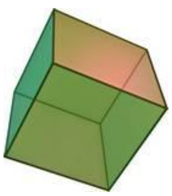
Euler's Formula

For any polyhedron *that doesn't intersect itself,* the

- **Number of Faces**
- plus the **Number of Vertices** (corner points)
- minus the **Number of Edges**

always equals 2

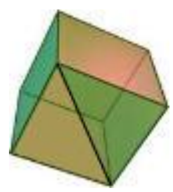
This can be written: **F + V - E = 2**



Try it on the cube:
A cube has 6 Faces, 8 Vertices, and 12 Edges,
so: 6 + 8 - 12 = **2**

To see why this works, imagine taking the cube and adding an edge (say from corner to corner of one face). You will have an extra edge, plus an extra face:

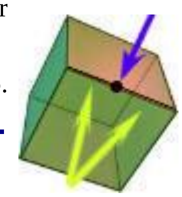
7 + 8 - **13** = 2



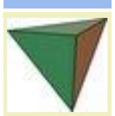
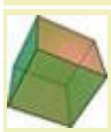
Likewise if you included another vertex (say halfway along a line) you would get an extra edge, too.

6 + **9** - **13** = 2.

"No matter what you do, you always end up with 2"
(But only for this type of Polyhedron ... read on!)



Example With Platonic Solids

Name		Faces	Vertices	Edges	F+V-E
Tetrahedron		4	4	6	**2**
Cube		6	8	12	**2**
Octahedron		8	6	12	**2**
Dodecahedron		12	20	30	**2**
Icosahedron		20	12	30	**2**

For more geometry fun, go to http://www.mathsisfun.com/geometry/index.html