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Abstract: The article presents information related to solid geometry which deals with objects that take up space, and contain volume. As reported, surface area and volume are the main calculations performed on solid figures. Also, several terms and formula related to solid geometry including volume of a pyramid and spheres are discussed. (Copyright applies to all Abstracts)

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Solid Geometry

Solid Geometry deals with objects that take up space, and contain volume, The main calculations performed on solid figures are surface area and volume
A prism is a solid figure with a uniform cross section. The main types of prisms are rectangular prisms, circular prisms (cylinders), and triangular prisms.

Surface area of Prisms

The surface area of a prism equals the sum of the areas of its faces. The surface area of a prism = (2 × area of base) + (perimeter of base × Height).

The area of the base depends on the type of prism.

- For a rectangular prism, it is length times width.
- For a circular prism, it is πr^2.
- For a triangular prism, it is (½ × base × height) of the triangular base.
- For a circular prism, the perimeter of the base is the circle's circumference.

Example 1:

Find the surface area of a rectangular prism with a base of 2 inches × 4 inches and height of 10 inches.

SA (Surface Area) = (2 × area of base) + (perimeter of base × Height)

The base is a rectangle, so its area is 1 × w = 2 × 4 = 8 in^2

The perimeter of the base is 2+4+2+4 = 12 inches, so the surface area (SA) is:

$(2 \times 8) + (12 \times 10) = 16 + 120 = 136\ in^2$

SA (Surface Area) = (2 × area of base) + (perimeter of base × Height)

The base is a rectangle, so its area is l × w = 2 × 4 = 8 in^2

The perimeter of the base is 2+4+2+4 = 12 inches, so the surface area (SA) is: (2 × 8) + (12 × 10) = 16 + 120 = 136 in^2

Example 2:

Find the surface area of a circular prism (cylinder) with a circular base of radius 2 cm and a height of 5 cm.

[Insert Figure 2]

SA (Surface Area) = (2 × area of base) + (perimeter of base × Height)

The base is a circle, so its area is πr^2 = 3.14 × 2 × 2 = 12.56 cm^2

The perimeter of the base is πD = 3.14 × 4 = 12.56 cm, so the surface area (SA) is:

(2 × 12.56) + (12.56 × 5) = 25.12 + 62.8 = 87.92 cm^2

Volume of Prisms

The volume of a prism equals the product of the area of its base and its height. The volume of a prism = (area of base) × (Height). The area of the base depends on the type of prism. For a rectangular prism, it is length × width. For a circular prism, it is πr^2. For a triangular prism, it is (½ × base × height) of the triangular base.

Example 3:

Find the volume of a rectangular prism with a base of 2 inches × 4 inches and height of 10 inches.

V (Volume) = (area of base) × (height)

The base is a rectangle, so its area is l times; w = 2 × 4 = 8 in^2

The volume is 8 × 10 = 80 in^3

Example 4:

Find the volume of a circular prism (cylinder) with a circular base of radius 2 cm and a height of 5 cm.

V (Volume) = (area of base) × (height)

The base is a circle, so its area is πr^2 = 3.14 × 2^2 = 3.14 × 4 = 12.56 cm^2

The volume is 12.56 × 5 = 62.8cm^3

Cones

Cones are objects shaped like ice cream cones. They have a circular base and have decreasing circular cross sections that decrease to a point at the top of the cone.

Surface Area of a Cone

The surface area of a cone is:

$\pi rs + \pi r^2$ where r=radius of the base and s is the length from the top of the cone to a point on the base.

Example 5:

Find the surface area of a cone with a base of radius 5 cm and an edge of length 10 cm.

$SA = \pi rs + \pi r^2 = (3.14)(5)(10) + (3.14)(5)(5) = 157 + 78.5 = 235.5\ cm^2$

Volume of a Cone

Consider a circular prism that has the same base and height as a cone. If you filled the cone with water, you would be able to fill the circular prism exactly three times with water from the cone. This means that the volume of the cone is one-third the volume of its respective circular prism. The volume of a cone is: $\frac{1}{3} \pi r^2 h$, where r is the radius of the base, and h is the height.

Example 6:

Find the volume of the cone in the previous example.

$V = \frac{1}{3} \pi r^2 h = (\frac{1}{3})(3.14)(5)(5)(10) = 261.7$ cm[sup
3]

Pyramids

Pyramids are objects shaped like the great pyramids of Egypt. They have a rectangular base and have decreasing rectangular cross sections that decrease to a point at the top of the pyramid.

The Great Pyramids of Egypt are actually square pyramids because they have a square base.

Surface Area of a Pyramid
The surface area of a pyramid is:

SA = lw + l/2ps, where l=length of the base, w=width of the base, p=perimeter of the base, and s=length of the line drawn from the top of the pyramid to the midpoint of a side of the base.

However, this only works with square pyramids, and another term would have to be added for rectangular pyramids.

Example 7:

Find the surface area of a square pyramid with a base of length 5 cm and a height of 15 cm.

$SA = lw + \frac{1}{2} ps$

This example is a little more difficult. The problem is in findings. But we notices is the hypotenuse of a right triangle with legs h and ½ of one of the sides of the base! So using the Pythagorean Theorem:

$15^2 + 2.5^2 = s^2$
225 + 6.25 = s2
231.25 = s2
s=15.2

Now we can proceed with the rest of the formula:

SA = lw + ½ ps = (5)(5) + (½)(20)(15.2) = 25 + 152 = 177 cm^2

Volume of a Pyramid

Consider a rectangular prism that has the same base and height as a pyramid.

If you filled the pyramid with water, you would be able to fill the rectangular prism exactly three times with water from the pyramid.

This means that the volume of the pyramid is one-third the volume of its respective rectangular prism.

The volume of a cone is:

⅓ lwh, where l is the length of the base, w is the width of the base, and h is the height of the pyramid.

Example 8:

Find the volume of the pyramid in Example 7.

V = ⅓ lwh = (⅓)(5)(5)(15) = 125 cm^3

Spheres

A sphere is an object which is the set of all points equidistant from a center point C in three-dimensional space.

The simplest example of a sphere would be a basketball or a globe.

Surface Area of a Sphere

The surface area of a sphere is $4\pi r^2$, where r is the radius of the sphere (distance from a point on the sphere to its center C).

Example 9:

Find the surface area of a sphere with radius 10 m.

$SA = 4\pi r^2 = (4)(3.14)(10)(10) = (12.56)(100) = 1{,}256\ m^2$

Volume of a Sphere

The volume of a sphere is $4/3\pi r^3$, where r is the radius of the sphere (distance from a point on the sphere to its center C).

Example 10:

Find the volume of a sphere with radius 10 m.

$V = 4/3\pi r^3 = (4/3)(3.14)(10)(10)(10) = (4.2)(1,000)$
$= 4,200\ m^3$

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