

Logical Thinking Measurement Comparison Conversion 2

School Grade: K7/K9

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**Volume**

Volume is the measure of the capacity that an object holds. For example, if a cup can hold 100 ml of water up to the brim, its volume is said to be 100 ml. Volume can also be defined as the amount of space occupied by a 3-dimensional object. The volume of a solid like a cube or a cuboid is measured by counting the number of unit cubes it contains. The best way to visualize volume is to think of it in terms of the space enclosed/occupied by any 3-dimensional object or solid shape. This can be seen through a simple exercise at home:

Take a rectangular sheet of paper of length 'l' cm and width 'h' cm.

Join the opposite sides of the sheet of paper without folding the sheet.

You have made a 3-D object that encloses space inside it, from a 2-D sheet.

Area of a two-dimensional shape is the space occupied by it. In the given square, the space shaded in blue is the area of the square.

**Volume Definition**

Volume is defined as a capacity occupied by a three-dimensional solid shape. In any shape, it is hard to visualize but can be compared between shapes. For example, the volume of a compass box is greater than the volume of an eraser placed inside it. For calculating the area of any two-dimensional shape, we divide the portion into equal square units. Similarly, while calculating the volume of solid shapes we will divide it into equal cubical units. Let us learn how to calculate the volume of different solid shapes in our next section.

Obrázok, na ktorom je šodži, budova

Automaticky generovaný popis

**Volume of a Cuboid**

Suppose we have some rectangular sheets with length 'l' and width 'b'. If we stack them one on top of the other up to height 'h', we get a cuboid of dimensions l, b, h. This can be seen in the following figure which shows the length, width (breadth), and height of the cuboid thus formed.

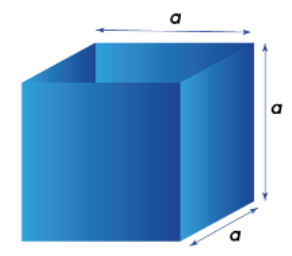
Obrázok, na ktorom je text, stôl, nábytok, pingpongový stôl

Automaticky generovaný popis

To calculate the amount of space enclosed by this cuboid, we use the formula: Volume of a Cuboid = l × b × h

**Volume of a Cube**

A cube is a special case of a cuboid where all three sides are equal in measure. If we represent this equal value as ‘a’, then the volume of this cube can then be calculated with the formula: Volume of a Cube = a × a × a = a³. Observe the following figure to see the equal sides of a cube and the space it occupies.



**Volume of a Cylinder**

Just as we built up a cuboid using rectangles, we can build a cylinder using circles of the same size.

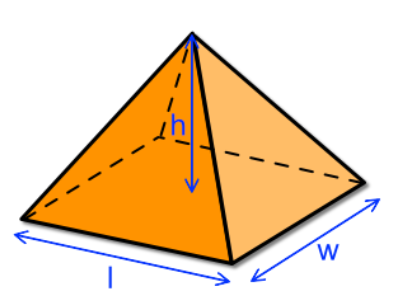
Obrázok, na ktorom je hudba, bubon

Automaticky generovaný popis

A cylinder is a tube-like structure with two parallel circular bases which are joined by a curved surface at a fixed distance from the center. The distance between these two bases is the height of the cylinder. If we consider 'r' as the radius of the circular base (and top) and 'h' as the height of the cylinder, then the volume of the cylinder can be expressed as Volume of a Cylinder = π r² h

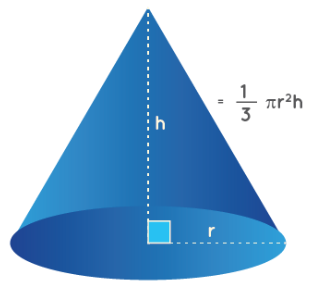
**Volume of a Pyramid**

Pyramids have a polygon as their base and triangular faces that meet at the apex. The volume of a pyramid is calculated with the help of the formula: Volume of a Pyramid = 1/3 × Base length × Base width × height of the pyramid. This formula can also be written as 1/3 × Base area of the polygon × height of the pyramid.

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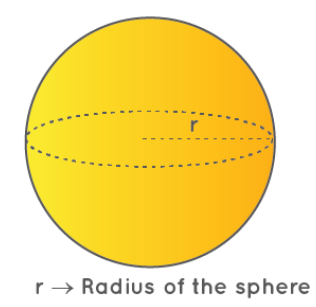
**Volume of a Cone**

The difference between a cone and a pyramid is that the base of a cone is circular whereas the base of a pyramid is a polygon. The volume of a cone is calculated with the formula: 1/3 ×πr2h.



**Volume of Sphere**

The volume of a sphere is the space occupied by it.



The volume of a sphere whose radius r is 4/3 πr³.

Now that we are familiar with the formulas of various geometric shapes, let’s take a look at the different units of volume.

**Formulas**

Obrázok, na ktorom je stôl

Automaticky generovaný popis

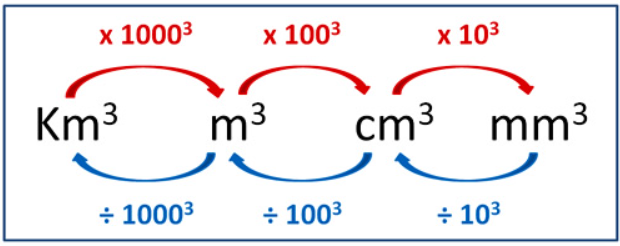
**Units of volume**

The S.I. unit of volume is cubic meter (m3) since volume is a quantity of the three-dimensional space occupied by a shape or surface. However, the most commonly used unit for volume is liter. Apart from this, large and small volumes are measured in other units like milliliter (ml), deciliter(dl), and others.

Obrázok, na ktorom je stôl

Automaticky generovaný popis

**Units of volume conversion**



Obrázok, na ktorom je stôl

Automaticky generovaný popis

For a length - you use the conversion once

For an area - you use the conversion twice

For a volume - you use the conversion 3 times

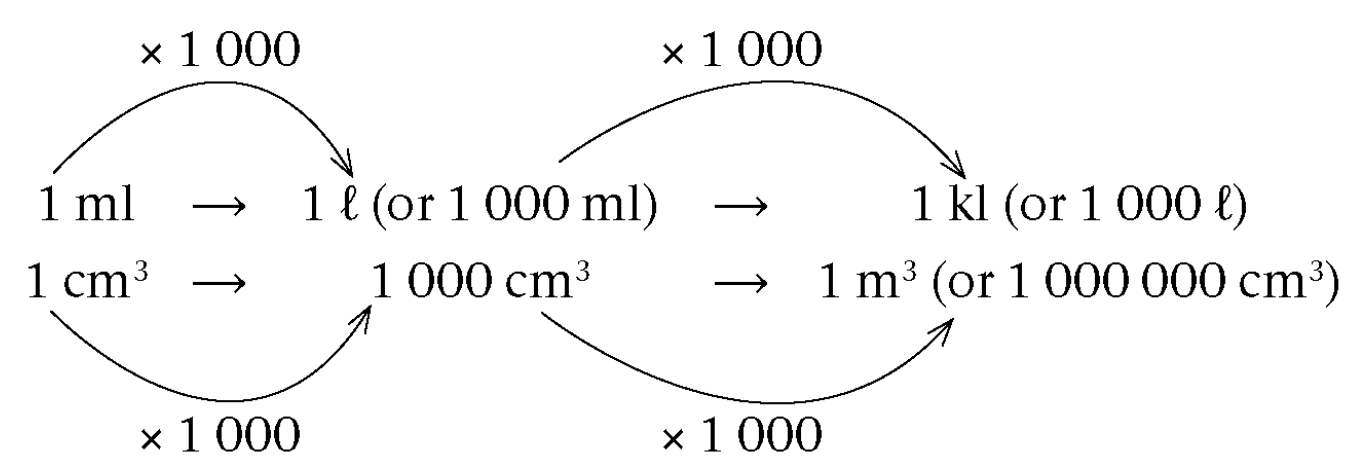
**Converting Cubic Meters to Liters**

Cubic meters and liters are two common metric units of volume.

1 cubic meter is 1000 liters.

The simplest way to convert cubic meters to liters is to move the decimal point three places to the right. In other words, multiply a value in cubic meters by 1000 to get the answer in liters.

To convert liters to cubic meters, you simply need to move the decimal point three places to the left. In other words, divide a value in liters by 1000 to get an answer in cubic meters.



How many liters are equal to 0.25 cubic meters?

Conversion factors needed

1 cm³ = 1 mL

100 cm = 1 m

1000 mL = 1 L

1 m³ = 1000 L

Method 1:

First, convert cubic meters to cubic centimeters.

100 cm = 1 m

(100 cm) ³ = (1 m) ³

1,000,000 cm³ = 1 m³

since 1 cm³ = 1 mL

1 m³ = 1,000,000 mL or 1000 L

0.25 m³ = 1000/4 L = 250L.

Method 2:

1 cubic meter = 1000 liters

so for 0.25 cubic meters:

Answer in Liters = 0.25 m³ \* (1000 L/m³)

Answer in Liters = 250 L

**Examples**

1) Joe loves playing with building blocks. He built a structure with 15 cubes. If the length (edge) of each cube is 3 cm, what would be the volume of his structure?

2) Calculate the volume of a cylinder with a length of 20cm, and whose circular end has a radius of 2.5cm.

3) Which is bigger by volume, a sphere with radius 2cm or a pyramid with base 2.5cm square and height of 10cm?

4) calculate the volume of a cone with a radius of 5cm and a height of 10cm

5) A right rectangular pyramid is based on a square, and the vertical height is the same value as the sides of the square.

If the volume of the pyramid is 72 cm3, what is the area of the base of the pyramid?

6) Convert:

500mm3= cm3

3m3 = cm3

25dm3 = mm3

3.8L = cm3

12.4dm3 = dL

290cm3 = L

**Answer Key**

1) Let's calculate the volume of one cube. Volume of Cube = Edge × Edge × Edge = 3 × 3 × 3 = 27 cm³

There are 15 cubes in his structure. So, the volume of the whole structure is:

Volume of structure =15 × volume of one cube = 15 × 27 = 405 cm³

Volume of the structure is 405 cm³.

2) First, work out the area of one of the circular ends of the cylinder.

The area of a circle is πr2 (π × radius × radius). π (pi) is approximately 3.14.

The area of an end is therefore:

3.14 x 2.5 x 2.5 = 19.63cm2

The volume is the area of an end multiplied by the length, and is therefore:

19.63cm2 x 20cm = 392.70cm³

3) First, work out the volume of the sphere.

The volume of a sphere is 4/3 × π × radius³.

The volume of the sphere is therefore:

4 ÷ 3 x 3.14 × 2 × 2 × 2 = 33.51cm³

Then work out the volume of the pyramid.

The volume of a pyramid is 1/3 × area of base × height.

Area of base = length × breadth = 2.5cm × 2.5cm = 6.25cm2

Volume is therefore 1/3 x 6.25 × 10 = 20.83cm³

The sphere is therefore larger by volume than the pyramid.

4) The area within a circle = πr2 (where π (pi) is approximately 3.14 and r is the radius of the circle).

In this example, area of base (circle) = πr2 = 3.14 × 5 × 5 = 78.5cm2.

78.5 × 10 = 785

785 × 1/3 = 261.6667cm³

5) Let h,l,w=x as they are all the same value

Pyramid: V=1/3 hlw

Substituting 72=1/3 x³

216=x3

x=6

Area of base A=x2

A=36

6) 0.5cm³ , 3 000 000cm³ , 25 000 000mm³ , 3800cm³ , 124dL , 0.29L

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