1º ESO

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Objectives

1. To know what a physical magnitude is.
2. To know in which it consists to measure and to understand the necessity of an unit of measurement
3. To know the units of the international system of length, surface, volume, mass and temperature.
4. To know how to measure with simple instruments like rulers, scales, thermometers, graduated cylinders.
5. To know how to pass between the multiples or submultiples of the units of measurement of the magnitudes: length, surface, volume, mass and temperature.
6. To know that the mass of a system does not change if matter does not enter or leave.
7. To know that the gases weigh and measure volumes.
8. To know that the volume of a system does not depend on the state of division nor of its form.
9. To know that the volume of an object can change without material entering or leaving.
10. To differentiate between mass and volume.
11. To know how to calculate the density of an object knowing its mass and volume.
12. To know how to apply the values of density to decide what bodies float in others.
13. To know the density is a characteristic property because it allows for identifying substances. It depends on the nature of each substance and not on the amount nor on the form.
14. To know how to design and to carry out experiments to measure the density of an object.
15. To know that the temperature informs about the thermal state of objects.
16. To know that the temperature does not depend on the amount of substance nor on the type of substance.

What is matter?

It is any material in the Universe

It has mass and takes up a place in space

It occurs in different physical states, such as solid, liquid or gas

The weight of the drawing has a mass of 100 g

This space is already occupied by air

Properties of matter

Matter has qualities, such as colour, brightness, flavour, smell, hardness, touch, mass, volume….We use them to describe it. All these qualities and other many, are properties of matter

PROPERTIES OF MATTER

EXTENSIVE PROPERTIES: those properties that depend on the amount of substance.
Mass and volume are extensive properties.

INTENSIVE PROPERTIES: those properties that do not depend on the amount of substance.
Colour, brightness, flavour, smell, hardness are intensive properties.

What is measuring?

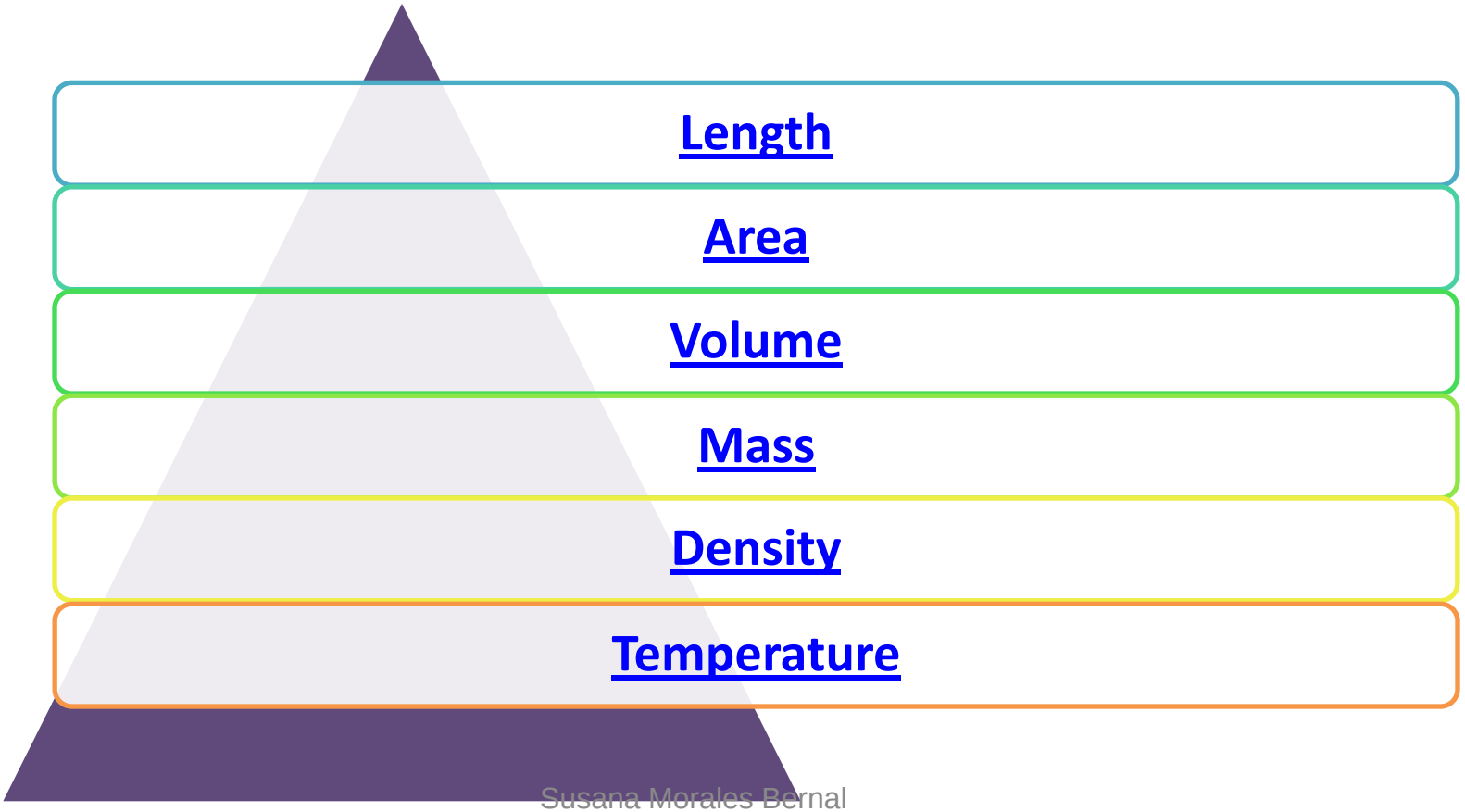
It is to compare what we want to measure with an amount of that magnitude that we use as a pattern

We need to measure:

1. A measurement instrument
2. A comparative pattern

We can measure some properties of matter but not others. Those that we can measure, are **quantitative properties**. Those that we cannot measure, are **qualitative properties**.

We call the quantitative properties, physical magnitudes. A physical magnitude is a property that we can measure. Some of these properties are:



Units of the international system

A system of units is the set of magnitudes and chosen units to measure them.

The system of units more extended all over the world is the international system of units, adopted in the General Conference of Weights and Measures, celebrated in Paris in 1960. Some magnitudes and its units are:

MAGNITUDE	UNIT	SYMBOL
Length	Metre	m
Area	Square metre	m^2
Volume	Cubic metre	m^3
Mass	Kilogram	kg
Temperature	Kelvin	K
Time	Second	s
Force	Newton	N
Energy	Joule	J
Density	Kilogram/Cubic metre	kg/m^3

LENGTH

Length is the distance between two points

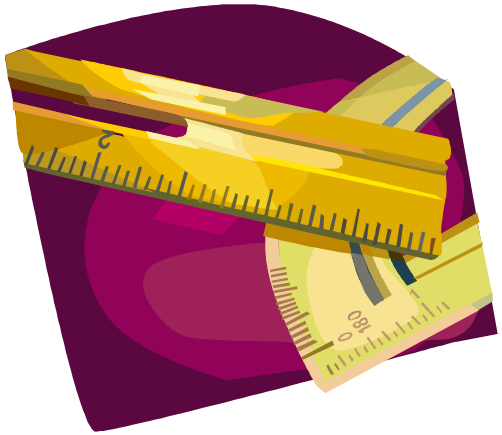
The unit of length in the international system of units is the metre (m)

The figure at the right is an equilateral triangle of side 8 cm

The perimeter of this triangle is:

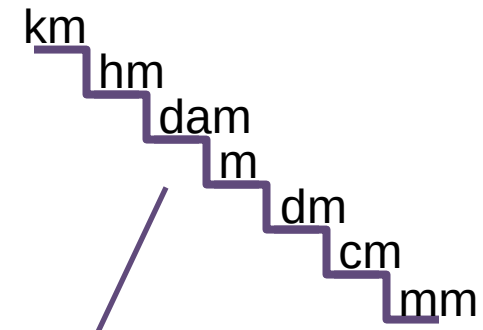
Perimeter = 8 cm + 8cm + 8 cm
Perimeter = 24 cm

The perimeter of a polygon is the sum of its sides, it is a length



Multiples and submultiples of metre

UNIT	SYMBOL	EQUIVALENT
Kilometre	km	1 km = 1 000 m
Hectometre	hm	1 hm = 100 m
Decametre	dam	1 dam = 10 m
Metre	m	1 m
Decimetre	dm	1 dm = 0,1 m
Centimetre	cm	1 cm = 0, 01 m
Millimetre	mm	1 mm = 0,001 m

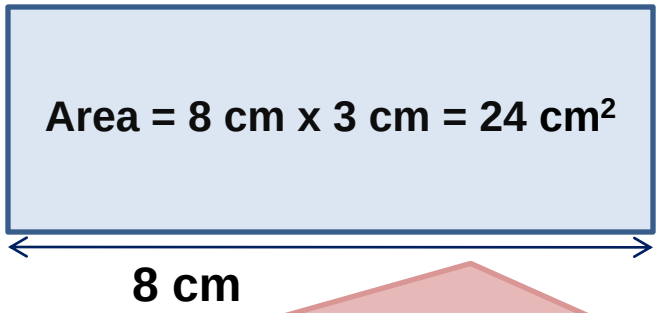


In the stairs of the length, each step is 10 times greater than the inferior immediate step.

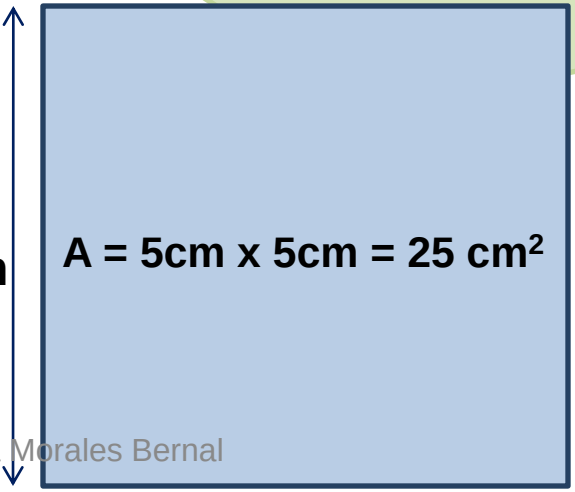
AREA

Area is the part of an object that is in contact with the outside

The unit of area in the international system of units is the square metre (m^2)

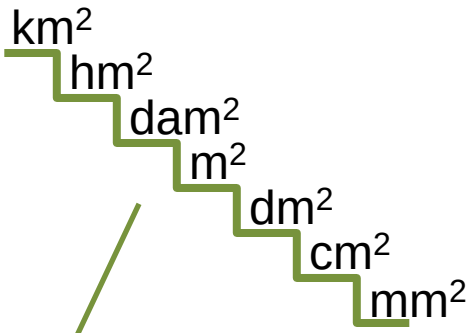


We calculate the area of a figure multiplying the width by the length



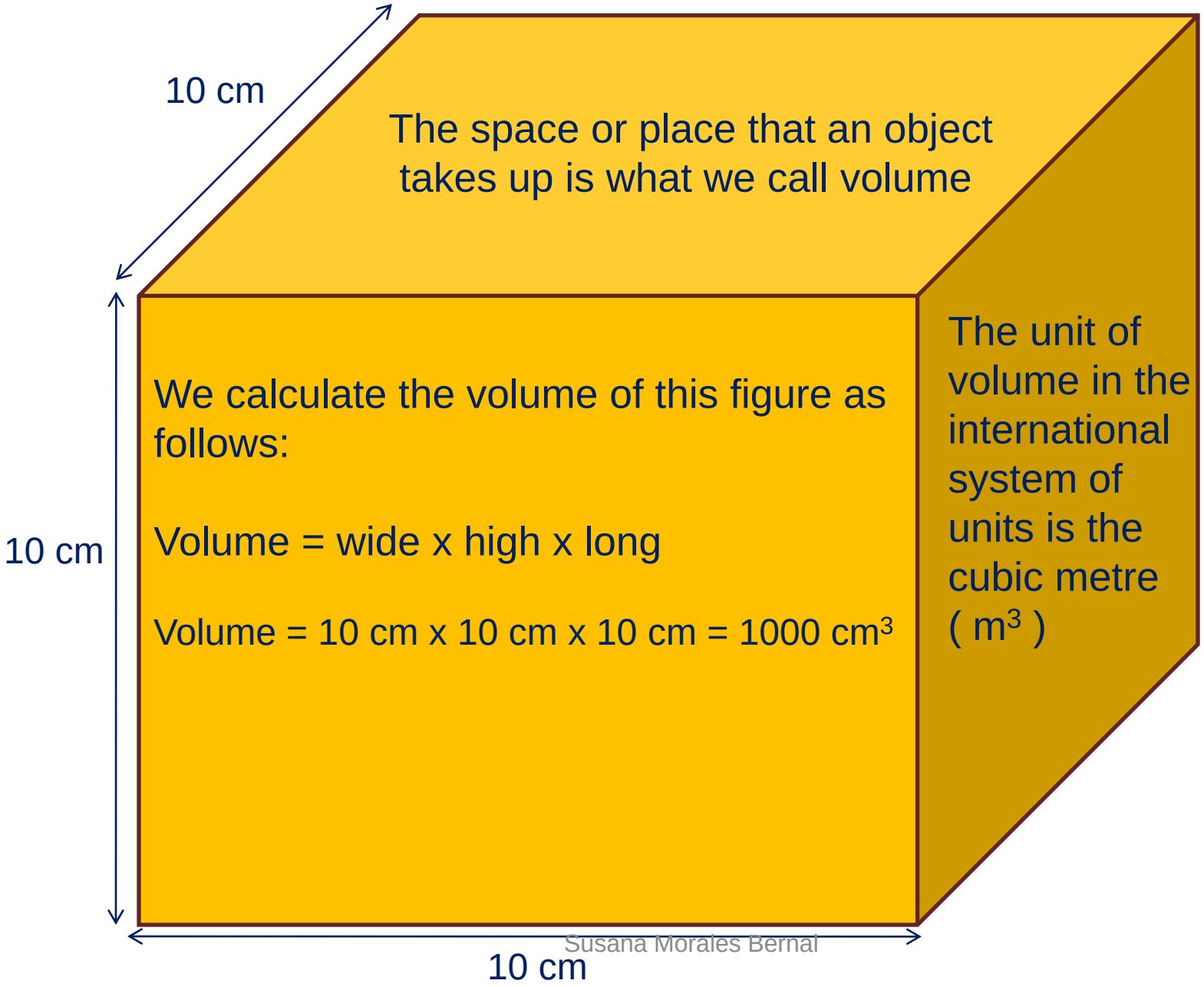
Multiples and submultiples of square metre

UNIT	SYMBOL	EQUIVALENT
Square kilometre	km^2	$1\ km^2 = 1\ 000\ 000\ m^2$
Square hectometre	hm^2	$1\ hm^2 = 10\ 000\ m^2$
Square decametre	dam^2	$1\ dam^2 = 100\ m^2$
Square metre	m^2	$1\ m^2$
Square decimetre	dm^2	$1\ dm^2 = 0,01\ m^2$
Square centimetre	cm^2	$1\ cm^2 = 0,\ 000\ 1\ m^2$
Square millimetre	mm^2	$1\ mm^2 = 0,000\ 001\ m^2$



In the stairs of the surface, each step is 100 times greater than the inferior immediate step.

VOLUME



The space or place that an object takes up is what we call volume

We calculate the volume of this figure as follows:

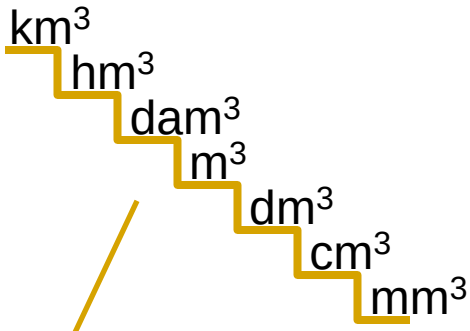
Volume = wide x high x long

Volume = 10 cm x 10 cm x 10 cm = 1000 cm^3

The unit of volume in the international system of units is the cubic metre (m^3)

Multiples and submultiples of cubic metre

UNIT	SYMBOL	EQUIVALENT
Cubic kilometre	km^3	1 km^3 = 1 000 000 000 m^3
Cubic hectometre	hm^3	1 hm^3 = 1 000 000 m^3
Cubic decametre	dam^3	1 dam^3 = 1 000 m^3
Cubic metre	m^3	1 m^3
Cubic decimetre	dm^3	1 dm^3 = 0, 001 m^3
Cubic centimetre	cm^3	1 cm^3 = 0, 000 001 m^3
Cubic millimetre	mm^3	1 mm^3 = 0,000 000 001 m^3

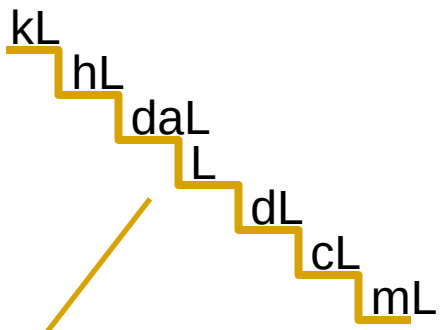


In the stairs of the volume, each step is 1000 times greater than the inferior immediate step.

Other units of volume

In addition to the unit of the international system, the cubic meter, and the multiples and submultiples that you already know, it is very frequent to use other units, like the litre (L), the decilitre (dL), the centilitre (cL) and the milllilitre (mL)

UNIT	SYMBOL	EQUIVALENT
Kilolitre	kL	1 kL = 1 000 L
Hectolitre	hL	1 hL = 100 L
Decalitre	daL	1 daL = 10 L
Litre	L	1 L = 1 dm^3
Decilitre	dL	1 dL = 0,1 L
Centilitre	cL	1 cL = 0,01 L
Millilitre	mL	1 mL = 0,001 L



In these stairs, each step is 10 times greater than the inferior immediate step.

We use different containers to measure the volume of liquids, in a laboratory. Some of them are the following ones

Erlenmeyer flask

Graduated cylinder

Beaker

Pipette

Volumetric flask

MASS

Mass is the amount of matter that an object has

The air and the other gases have mass and take up a place in space, just as solids and liquids

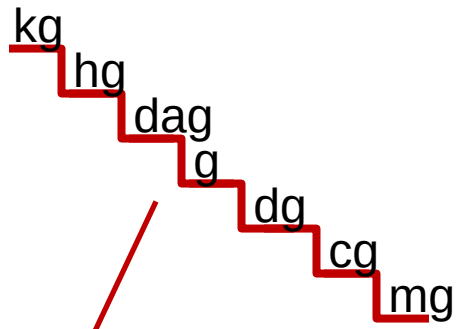
An object has the same mass in any place

The unit of mass in the international system of units is the kilogram (kg)

We can measure the mass with balances

Submultiples of kilogram

UNIT	SYMBOL	EQUIVALENT
Kilogram	kg	1 kg
Hectogram	hg	1 hg = 0,1 kg
Decagram	dag	1 dag = 0,01 kg
Gram	g	1 g = 0,001 kg
Decigram	dg	1 dg = 0,000 1 kg
Centigram	cg	1 cg = 0, 000 01 kg
Milligram	mg	1 mg = 0,000 001 kg



In the stairs of the mass, each step is 10 times greater than the inferior immediate step.

DENSITY

Density is the relationship between the mass of an object and its volume, we represent it by the symbol (ρ)

The density is a characteristic property because it allows us to identify substances

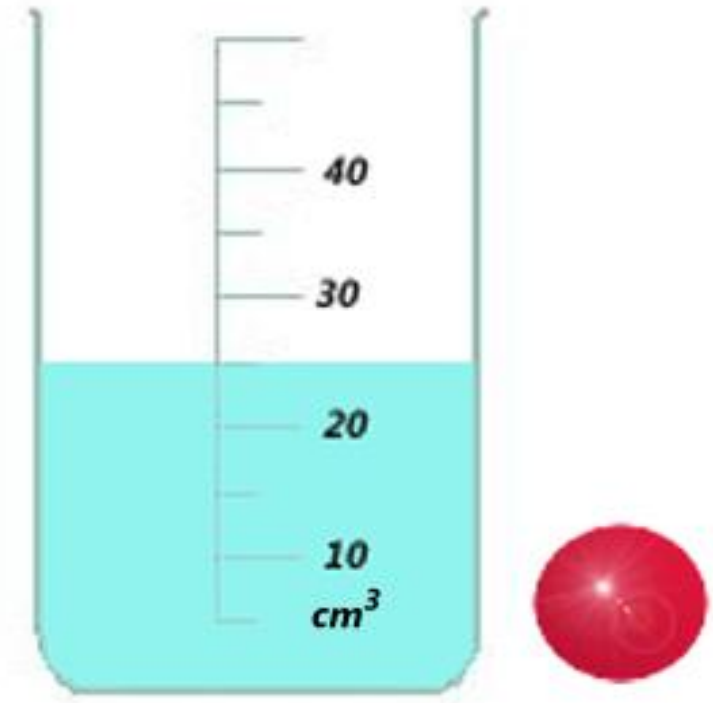
If we want to calculate the density of an object, we must calculate its mass and its volume

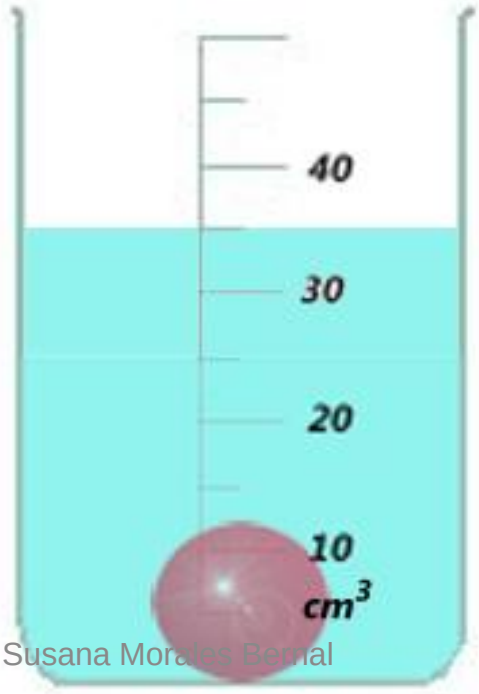
The mathematical expression of the density is:

$$\rho = \frac{m}{V}$$

The density of the ball of the figure is:

$$\rho = \frac{30\ g}{10\ cm^3} = 3\ g/cm^3$$





TEMPERATURE

Temperature informs us about the thermal state of objects

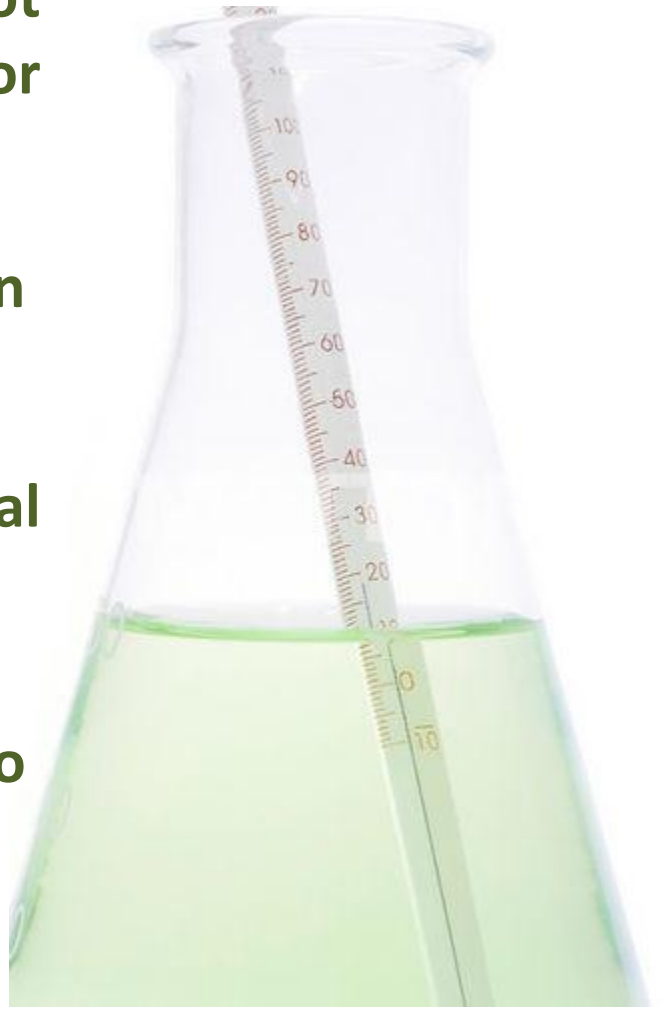
The temperature of the objects does not depend on either the type of substance nor the amount of substance

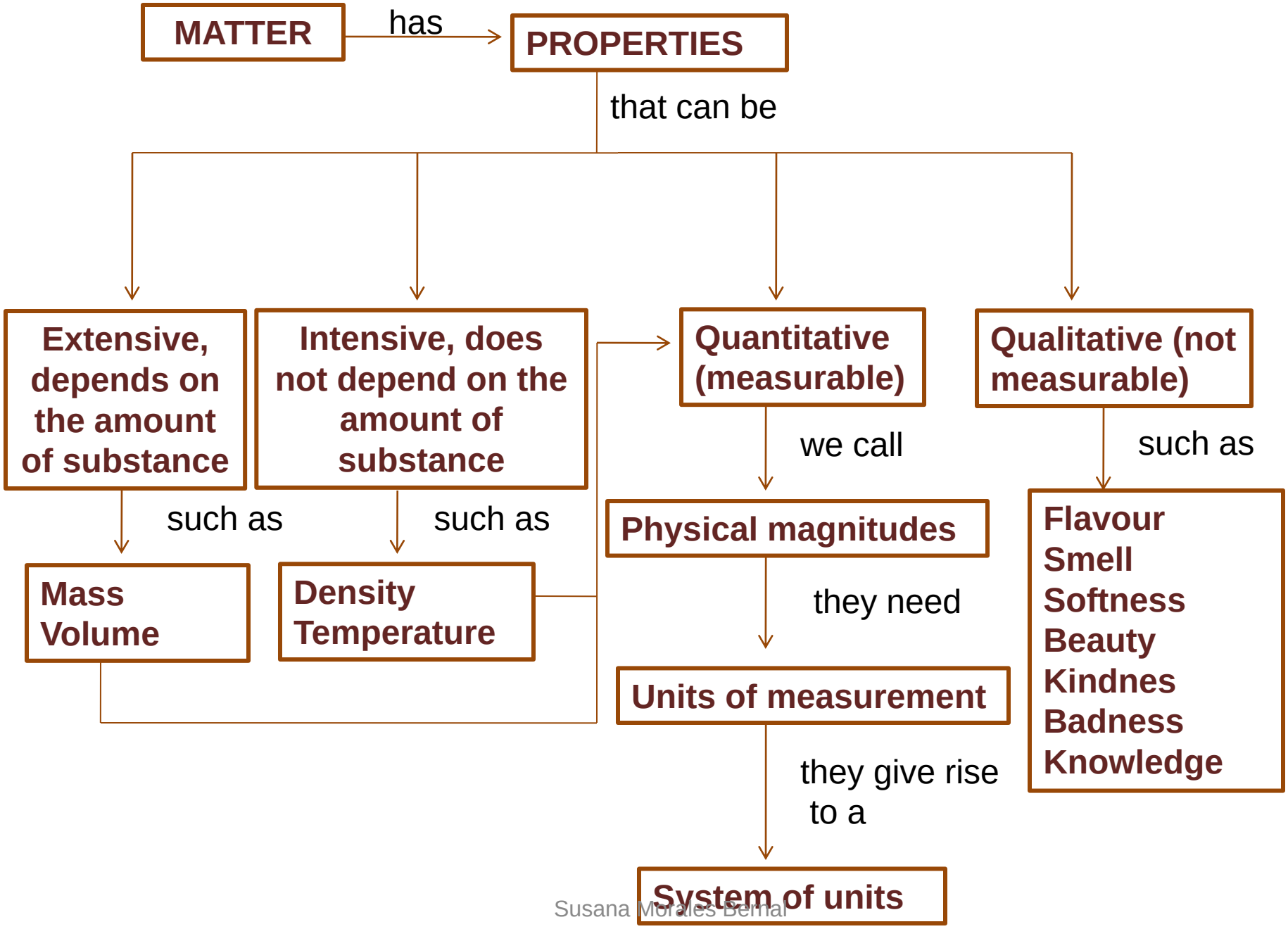
We can measure the temperature of an object with thermometers

The unit of temperature in the international system of units is the Kelvin

In order to transform the degrees Celsius into Kelvin we must add 273

$$T^a\ (K) = T^a\ (^oC) + 273$$





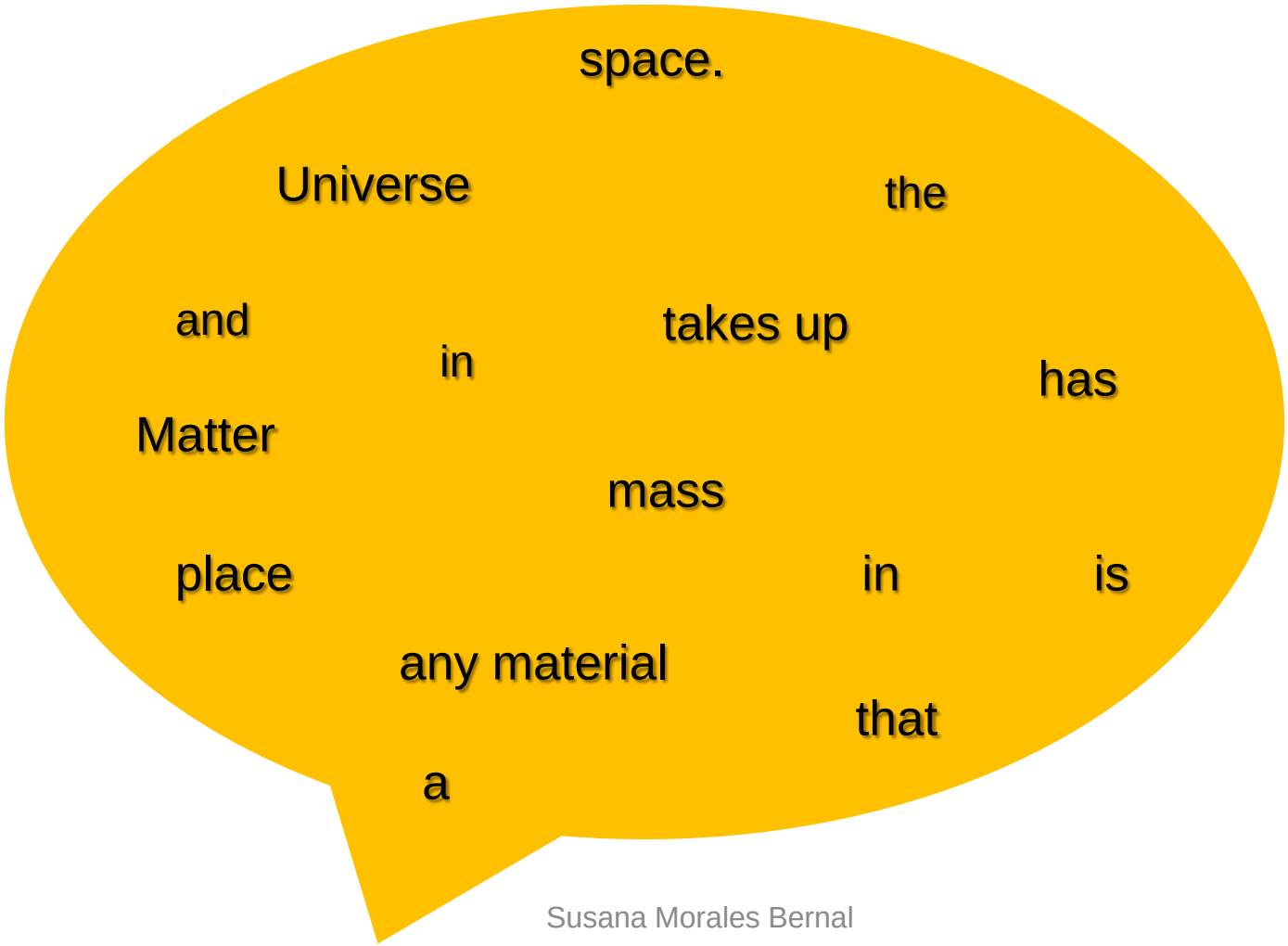
EXERCISE 1

Is the air matter?

A. No, because it does not weigh anything
B. Yes, although its weight is zero
C. No, because we do not see it
D. Yes, although we cannot see it

EXERCISE 2

Put the following words in order to form a text with sense



EXERCISE 3

Classify the following terms as material or not:

TERMS	YES OR NOT
A roll of film	
The temperature of soup	
Alcohol	
Kindness	
Butane gas	
Gold	
The volume of a table	
Smoke	
Clouds	

EXERCISE 4

Indicate in each case the magnitude (property that we measure), the unit and the amount of the following measures:

MEASUREMENT	MAGNITUDE	UNIT	AMOUNT
15 g			
10 m^3			
14 cm^2			
1000 L			
50 s			
100 cm			
1,2 g/cm^3			

EXERCISE 5

What are the decametre, the hectometre and the kilometre?

A. Multiples of metre
B. Submultiples of metre
C. Submultiples of hectare
D. Submultiples of length

Kilometre	**km**
Hectometre	**hm**
Decametre	**dam**
Metre	**m**
Decimetre	**dm**
Centimetre	**cm**
Millimetre	**mm**

EXERCISE 6

Complete the chart with the corresponding unit

km	hm	dam	m	dm	cm	mm
0,003						
	0,2					
		5				
			3000			
				56,8		
					1224,6	

EXERCISE 7

Complete the chart with the corresponding unit

km^2	hm^2	dam^2	m^2	dm^2	cm^2	mm^2
0,002						
	0,01					
		3				
			4000, 20			
				200,45		
					6000	

EXERCISE 8

Complete the chart with the corresponding unit

km^3	hm^3	dam^3	m^3	dm^3	cm^3	mm^3
0,003						
	0,03					
		0,3				
			3			
				30		
					300	

EXERCISE 9

Complete the chart with the corresponding unit

cm^3	dm^3	L	mL
50			
		4,5	
	3		

EXERCISE 10

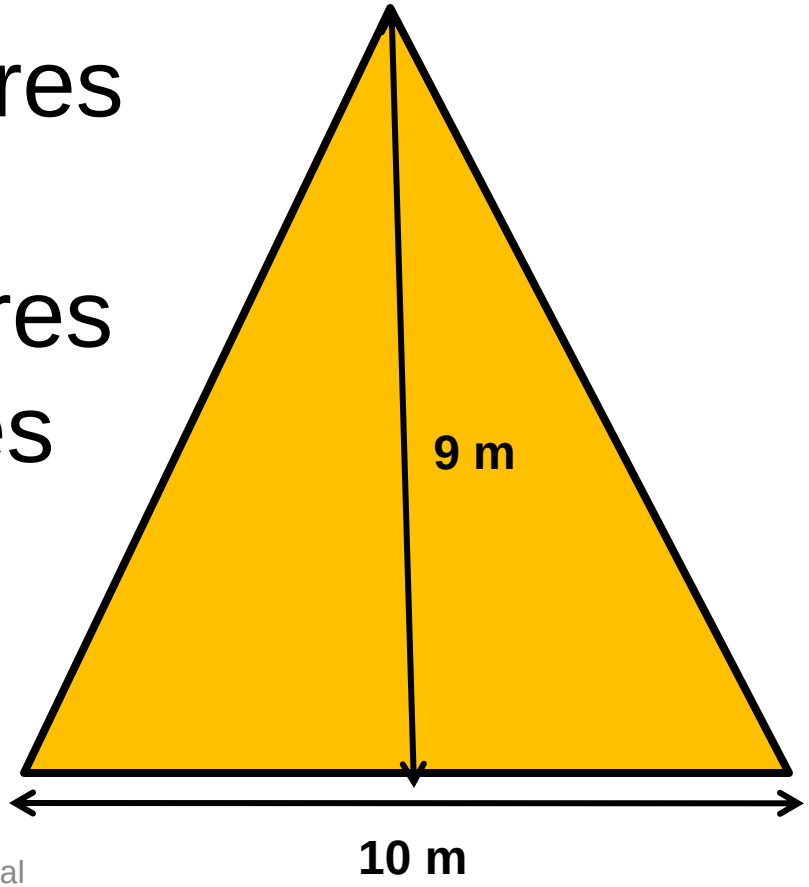
The mass of an object is 320 g, its area is 80 cm^2, its volume is 250 cm^3, its height is 70 mm and its temperature is 15 ^oC. Express the previous measures in the units of the international system.

Measurement	Unit of International System
320 g	
80 cm^2	
250 cm^3	
70 mm	
15 ^oC	

EXERCISE 11

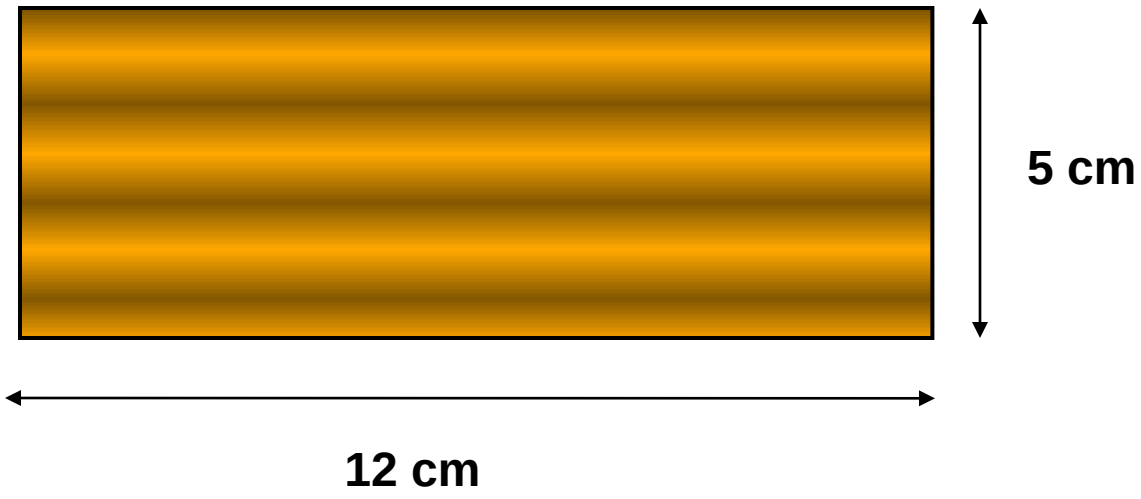
What is the area of the figure?

A. Forty five square metres
B. Ninety square metres
C. Nineteen square metres
D. Forty five cubic metres



EXERCISE 12

Calculate the area of the following figure

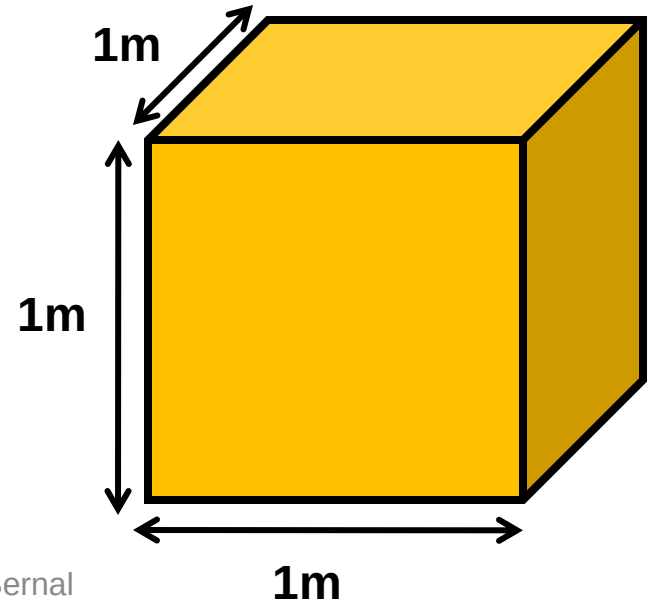


Express the result in m^2 and in mm^2

EXERCISE 13

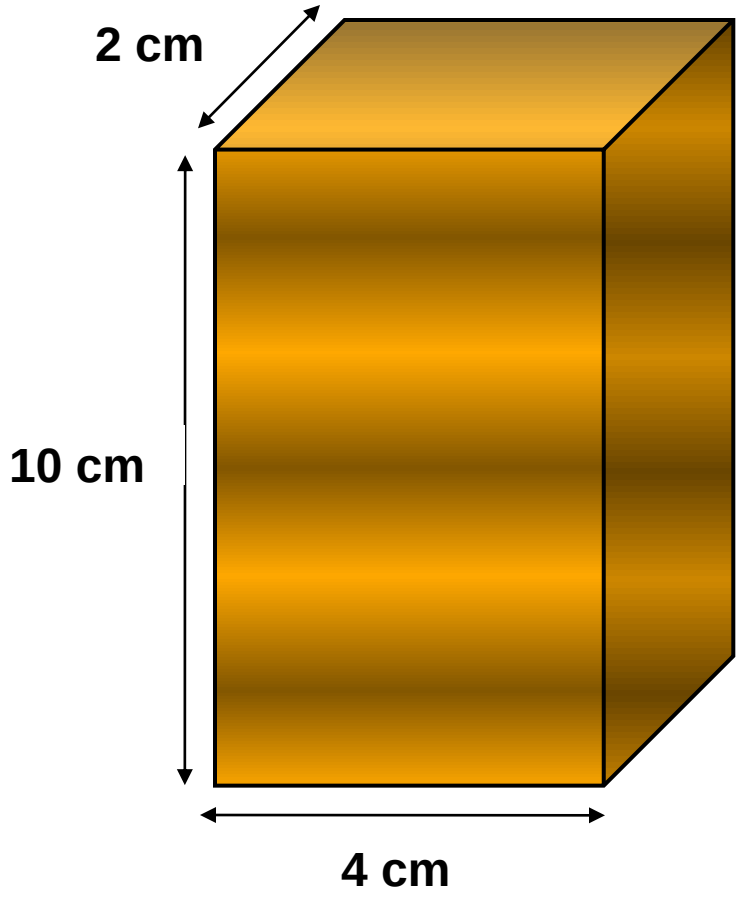
What is the volume of the cube?

A. A cubic metre
B. Three cubic metres
C. A square metre
D. A litre



EXERCISE 14

Calculate the volume of the figure below



Express the result in:

- m^3
- mm^3
- L

EXERCISE 15

You divide a chalk in pieces of different sizes. Tell if the following affirmations are true or false

A. The sum of the masses of the different chalk pieces is greater than the mass of the complete chalk

B. The volume of the complete chalk is equal to the sum of the volumes of the chalk pieces

C. The area of the complete chalk is equal to the sum of the areas of the chalk pieces

D. The temperature of a chalk piece is less than the complete chalk

EXERCISE 16

Complete :

In order to find the ..... of a substance, you have to divide its ..... between its.....

Complete the following chart

MASS	VOLUME	DENSITY
35 g	7 cm^3	
3000 kg	0,8 m^3	
300 g		600 g / L
	5 L	0,9 kg / L

EXERCISE 17

The wood piece and the metal piece are the same size. Why does the piece of metal weigh more?

A. Because the density of the wood is greater than the density of the metal
B. Because the metal is less dense than the wood
C. Because the metal is heavier than the wood
D. Because the density of the metal is greater than the density of the wood

EXERCISE 18

We have two exactly equal dice, one of silver and another one of gold. We submerge them in two containers that have the same amount of water.
Will the level that the water reaches be the same in both containers? Explain if each of the following expressions are true or false.

A. No, because both dice have the same volume

B. Yes, because although they are different substances, they have the same volume

C. It depends on what the containers are like

D. Yes, because the gold die weighs more than the silver one

EXERCISE 19

What is denser, one gram of mercury or one ton of mercury?

A. One gram of mercury
B. One ton of mercury
C. They are the same

What has more mass, one litre of water or one litre of mercury?

A. One litre of water
B. One litre of mercury
C. They are the same

What takes more volume, one litre of water or one litre of mercury?

A. One litre of water
B. One litre of mercury
C. They are the same

What is denser, water or mercury?

A. Water
B. Mercury

EXERCISE 20

Revise your vocabulary

Choose a word and fill the blanks below

distance, has, submultiple, magnitude, does, amount , square, depend, space, Kelvin, mass, takes up, volume, area, two, cubic, temperature, kilogram, mass, volume

A. Matter is all that has ..... and ..... a place in space.
B. Mass is the ..... of matter that an object ..... .
C. Length is the ..... between ..... points.
D. The ..... that an object takes up is the ..... .
E. The unit of volume in the international system of units is the ..... metre.
F. Density is the relationship between the ..... of an object and the ..... it takes up.
G. The unit of ..... in the international system of units is the ..... metre (m^2).
H. Beauty is not a physical ..... .
I. Temperature of the objects …….. not …….. on the amount of substance.
J. The unit of ..... in the international system of units is the ..... .
K. The milligram is a …… of the …….. .

GLOSSARY

- Amount
- Area
- Balance
- Beaker
- Characteristic
- Container
- Cubic meter
- Degree
- Density
- Distance
- Energy
- Erlenmeyer flask
- Force
- Gas
- Graduated cylinder
- International System
- Length
- Liquid
- Litre
- Mass
- Matter
- Metre
- Physical magnitude
- Pattern
- Pipette
- Point
- Property
- Qualitative
- Quantitative
- Relationship
- Set
- Solid
- Space
- Square metre
- Submultiples
- Substance
- Temperature
- Thermometer
- Time
- To allow
- To calculate
- To classify
- To compare
- To complete
- To describe
- To express
- To indicate
- To measure
- To order
- To take up
- To weigh
- Unit
- Volume
- Volumetric flask

Susana Morales Bernal

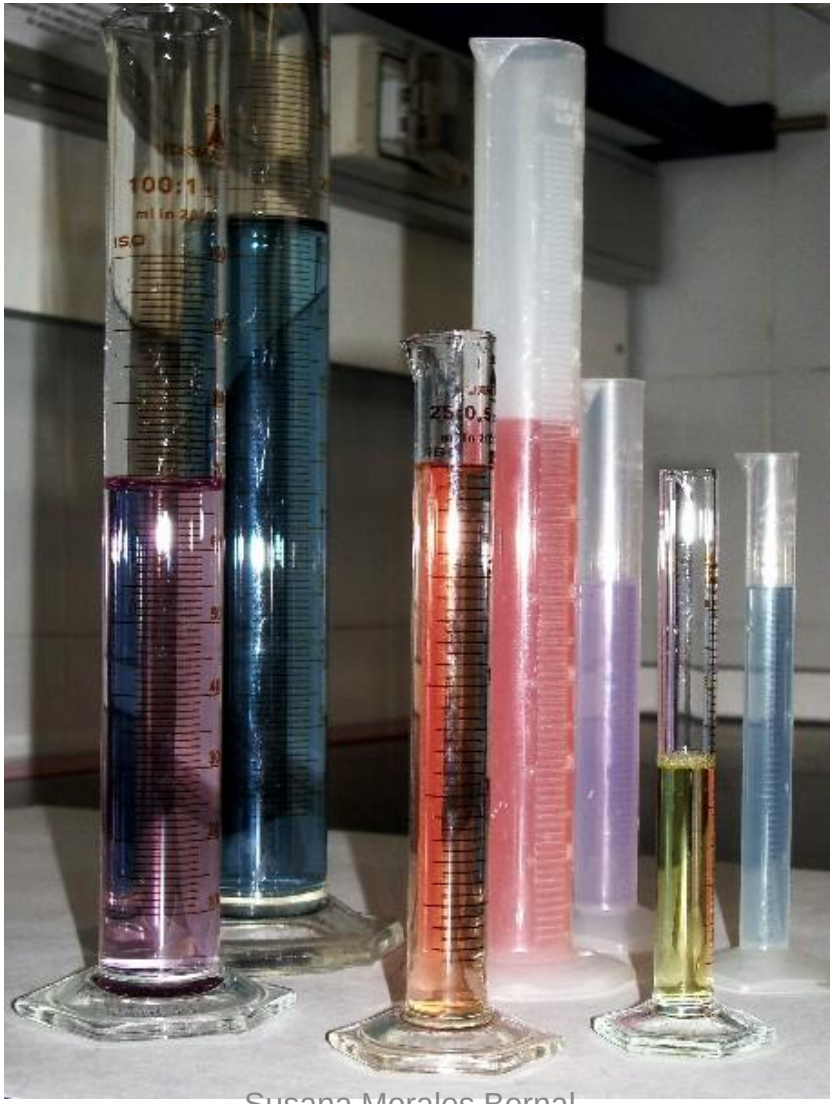
Erlenmeyer flask

Beaker

Susana Morales Bernal

Volumetric flask

Graduated cylinder



Pipette