Instruction Sheet	Learning Guide #12

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics –

- Appropriate performance of calculation to achieve the required result
- Material requirements calculation
- Selection of appropriate formula for calculating quantities work
- Quantity estimation from performed calculation
- Conformation and recording result data following enterprise format and standards

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to –

- Perform appropriate calculation method for achieving the require result.
- Perform calculation for determining material requirements.
- Select and calculate appropriate formulas for calculating quantities.
- Confirm and record following enterprise format and standards for result data.

Learning Instructions

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described in number 3 to 20.
3. Read the information written in the “Information Sheets 1”. Try to understand what are being discussed. Ask your teacher for assistance if you have hard time understanding them.
4. Accomplish the “Self-check 1” in page 27
5. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-check 1).

6. If you earned a satisfactory evaluation proceed to “Information Sheet 2”. However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Instruction #3.
7. Submit your accomplished Self-check. This will form part of your training portfolio.
8. Read the information written in the “Information Sheet 2”. Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
9. Accomplish the “Self-check 2” in page 31.
10. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-check 2).
11. Read the information written in the “Information Sheets 3 and 4”. Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
12. Accomplish the “Self-check 3” in page 35 & 39 .
13. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-check 3).
14. If you earned a satisfactory evaluation proceed to “Operation Sheet 1and 3” in page 41 & 56. However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Instruction #11.
15. Read the “Operation Sheet 1 & 3” and try to understand the procedures discussed.
16. Go to your teacher if you need clarification or you want answers to your questions or you need assistance in understanding a particular step or procedure.
17. Do the “LAP test” in page 60 (if you are ready). Request your teacher to evaluate your performance and outputs. Your teacher will give you feedback and the evaluation will be either satisfactory or unsatisfactory. If unsatisfactory, your

teacher shall advice you on additional work. But if satisfactory you can proceed to Learning Guide #8.

Information Sheet-1	**Appropriate performance of calculation**

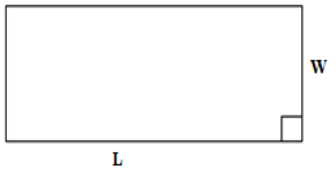
3.1.1 Calculation factors like length (width & depth), area, weight, height, volume, mass, scales, ratios, perimeters, quantities

Determining calculation factors

Once the measurements have been taken and recorded, it may be necessary to include these in formulas to carry out a further process. The methods and calculation factors involved often depend on the work procedures and processes used.

- ✓ *Length*

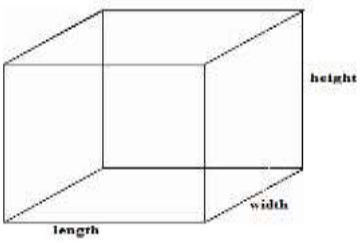
The longest sides of the rectangle



Where, L is length of rectangle.

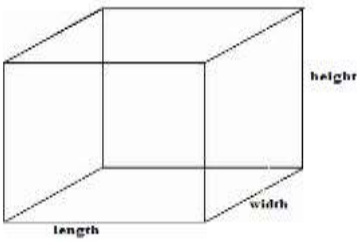
- ✓ *Height*

The vertical distance from top to bottom



- ✓ *Width*

Width is the distance from side to side.

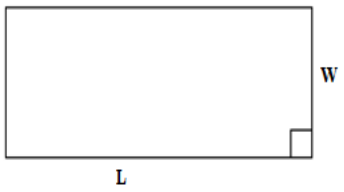


- ✓ *Depth*

Depth is a dimension taken through an object or body of material, usually downward from an upper surface, horizontally inward from an outer surface or from top to bottom of something regarded as one of several layers.

- ✓ Area

Area is length by width:

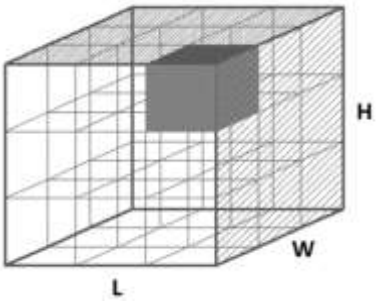


Area = Length × Width

- ✓ *Volume*

Volume is Height by Width by Length:

Volume = L * W * H



- ✓ *Mass*

Mass is the amount of matter containing in a substance.

Example

- The mass of leather jacket
- The mass of packing box
- The mass of accessories etc.

- ✓ *Weight*

Aren't "weight" and "mass" the same?

Answer - Not really.

An object has mass (say 100 kg). This makes it heavy enough to weigh 100 kg.

This makes it heavy enough to weigh 100 kg.

An objects weight is how hard gravity is pulling on it.

We think the weight is the same everywhere ... because we all live on the surface of the planet Earth!

But if the object were far out in space it would just float around, exerting no force on the scales.

The scales would show 0 kg ... but the mass is still 100 kg!

An object's mass doesn't change (unless you remove some!), but its weight can change.

- ✓ *Scale factor*

A scale factor is a number which scales, or multiplies, some quantity.

In the equation y= Cx,

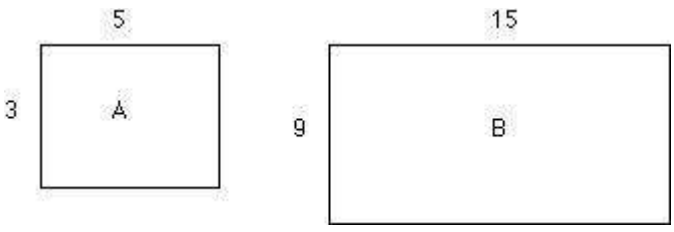
C is the scale factor for x.

C is also the coefficient of x, and may be called the constant of proportionality of y to x.

Scale Factor/Similarities:

Two figures are similar if:

- They have the same shape. What does this mean?
    - It means that the corresponding angles are equal.
- Corresponding sides change by the same scale factor. What does this mean?
    - It means that all the sides of the small figure are multiplied by the same number to obtain the lengths of the corresponding sides of the large figure.



- The scale factor of figure A to B is: 3 (3 * **3** = 9; 5 * **3** = 15)
- The scale factor of figure B to A is: 1/3 (9 * **1/3** = 3; 15 * **1/3** = 5)

- ✓ *Ratio*

A ratio is a comparison of two similar quantities obtained by dividing one quantity by the other. Ratios are written with the (**:**) symbol.

Example: The ratio of 6 to 3 is

$$6 \div 3 = 6/3 = 6 : 3 = 2$$

Example: The ratio of 3 to 6 is

$$3 \div 6 = 3/6 = 3 : 6 = 1/2$$

Notes about ratios:

- ✓ Since a ratio is only a comparison or relation between quantities, it is an abstract number. For instance, the ratio of 6 miles to 3 miles is only 2, not 2 miles.
- ✓ As you can see above, ratios can be written as fractions. They also have all the properties of fractions that you have learned in the previous part of this station.
- ✓ The ratio of 6 to 3 should be stated as 2 to 1, but common usage has shortened the expression of ratios to be called simply 2.
- ✓ If two quantities cannot be expressed in terms of the same unit, there cannot be a ratio between them.

Example

If two full time employees accomplish 20 tasks in a week, how many such tasks will 5 employees accomplish in a week?

$$2 : 5 = 20 : x$$

$$2 \times x = 5 \times 20$$

$$x = 50 \text{ tasks}$$

- ✓ *Perimeter*

A perimeter is a path that surrounds an area.

shape	**formula**	**variables**
circle	$2\pi r$	Where, r = the radius of the circle.
triangle	$a + b + c$	Where, a, b and c are the lengths of the sides of the
square	$4a$	Where, a is the side length
rectangle	$2 (L + W)$	Where, h is the height and w is the width

Example

The perimeter of rectangular leather piece, it has 20cm length and 32cm width.

Perimeter of rectangle = 2 (L + W)

= 2 (20cm + 32cm)

= 2 (52cm)

= 104cm

- ✓ *Quantities*

Quantity means an amount, measure or number. That is the exact amount of a particular thing.

Example: how many amounts of rivet in a pack?

- ✓ *Numbers*

a sign or word that represents an amount or quantity.

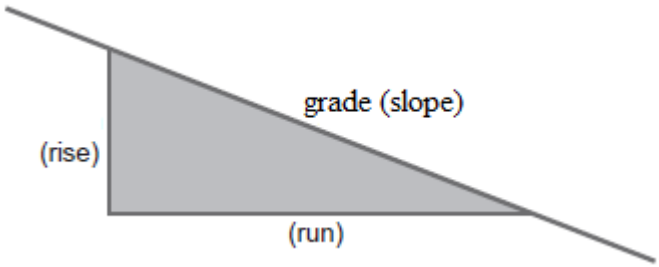
Number tells us how much of something there is. We never have a measurement without a number. I don't say that my height is inches or meters. There must be some amount of these units. That is the number portion of the measurement.

The result of a measurement is normally in two parts: a number and a unit of measurement, e.g. 'How long is it? ... 2 meters.'

- ✓ *Grade(slop)*

The grade (also called slope, incline, gradient, pitch or rise) of a physical feature, topographic landform or constructed element, refers to the amount of inclination of that surface to the horizontal.

It can be defined as Rise ÷ Run.



The slope of the line (Grade) = $\Delta y/\Delta x$ = (y1-y2)/(x1-x2) = rise/run

Suppose a line on the pattern runs through two points: P1 = (1, 2), and P2 = (13, 8). By dividing the difference in y-coordinates by the difference in x-coordinates, one can obtain the slope of the line:

The slope of the line = (8 - 2) / (13 – 1)

= 6/12

= 0.5

- ✓ *Percentages*

Percentage means out of one hundred.

Percentages can be worked out manually or with a calculator. Consider the following example.

1. Manually calculating a percentage:

   Find 10% intensive for technical support of 250birr

   First meaning of 10% = 0.1

   Percentage = 0.1 x 250

   = 25birr

   Therefore, there is 25birr for intensive.

2. Using a calculator

   You can simply use the percentage button on the calculator:

- ✓ *Addition*

Addition is finding the total, or sum, by combining two or more numbers.

Example: 5 + 11 = 16 is an addition

Where, 5 & 11 are addend and 26 is sum

- ✓ *Subtraction*

It is taking one number away from another.

Example: 5 - 2 = 3

Where, 5 is minuend, 2 is subtrahend & 3 is difference.

- ✓ *Multiplication*

The basic idea of multiplication is repeated addition.

For example: 5 × 3 = 5 + 5 + 5 = 15

Here 5 and 4 are the "factors" and 12 is the "product or result".

- ✓ *Division*

Division is splitting into equal parts or groups. It is the result of "fair sharing".

In the expression a ÷ b = c

Where, ‘a’ is called the dividend or numerator,

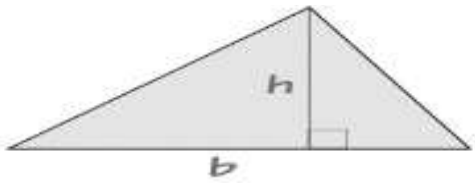
‘b’ the divisor or denominator and

‘c’ is called the quotient.

3.1.2 Areas and volumes triangles, trapeziums, rectangles, rhombus, squares, circles, triangles, cubes, cones and cylinders that represent calculations taken in a leather garments production environment

Area of Triangles

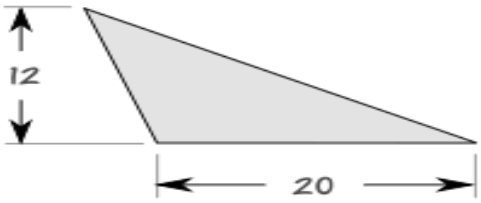
The area of triangle is half of the base & its height.



Area = ½ × b × h

Example 1

What is the area of this triangle?



(Note: 12 is the height, not the length of the left-hand side)

Area of triangle = ½ × b × h

= ½ × 20 × 12

= 120unit square

Example 2

The area of the right angle triangle is 42 m^2& its base is 12m. What is the height of the triangle?

Area of triangle = ½ bh

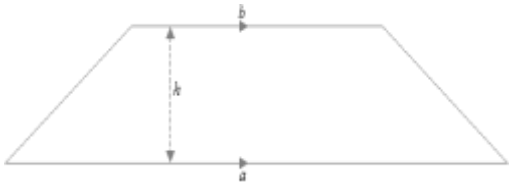
H = 2area of triangle/b

= 2 x 42m^2/12m

= 7m

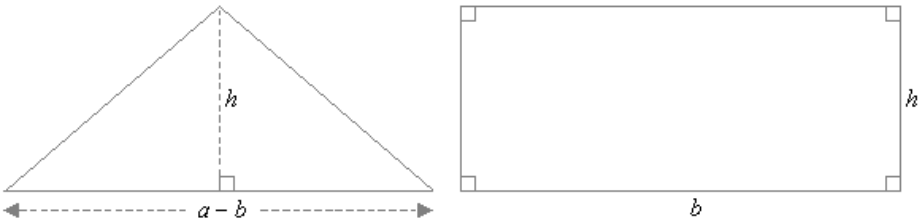
Area of trapezium

Consider the area of the following trapezium.



To calculate the area of a trapezium, divide it into a rectangle and two triangles as shown below.

Now, piece together the triangular ends so that the trapezium is divided into a triangle and rectangle. The base of the triangle is the difference between the lengths of two parallel sides. That is, a – b



∴ Area of the trapezium = Area of rectangle + Area of the triangle

= bh + ½bh , but here b=a-b

= bh + ½ (a-b) h

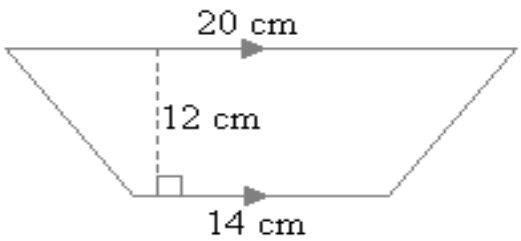
= h [b + ½ (a-b)]

= h [(2b+a-b)/2]

= h/2 (b + a)

Example 1

Find the area of the following trapezium.



Solution a = 20cm, b = 14cm, & h = 12cm

Area of the trapezium = h/2 (b + a)

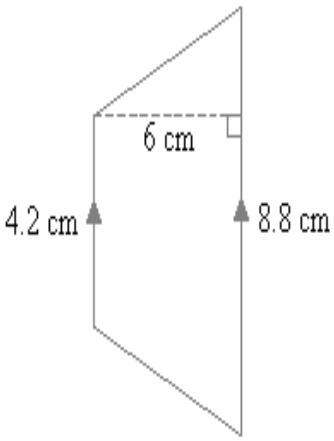
= 12cm/2 (14cm + 20cm)

= 6cm (34cm)

= $\underline{\underline{204cm^2}}$

Example 2

Find the area of the following trapezium.



Solution a = 8.8cm, b = 4.2cm, & h = 6cm

Area of the trapezium = h/2 (b + a)

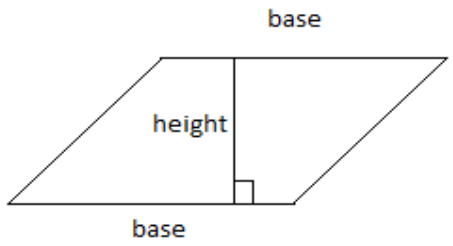
= 6cm/2 (4.2cm + 8.8cm)

= 3cm (13cm)

= $\underline{\underline{39cm^2}}$

Area of parallel gram

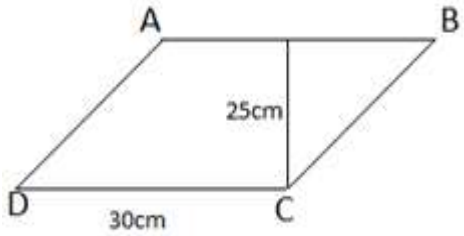
The area of a parallelogram is given by the product of the base and the height.



A = bh

Example 1

What is the area of a parallelogram with base 30cm and height 25 cm?



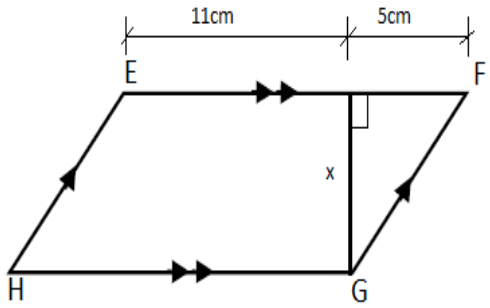
A = bh

= 30cm x 25cm

= $\underline{750cm^2}$

Example 2

If the area of parallelogram EFGH is 112 square centimeters, what must the value of x be?



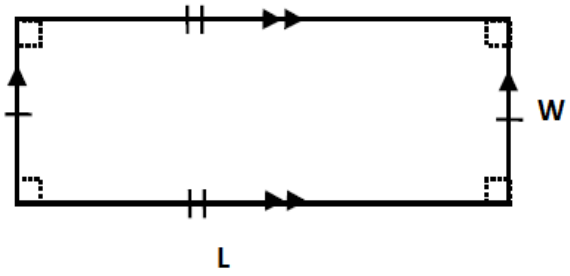
X or h = A/b , but b = 11cm + 5 cm = 16cm

= $112cm^2$ / 16cm

= $\underline{7cm}$

Area of rectangle

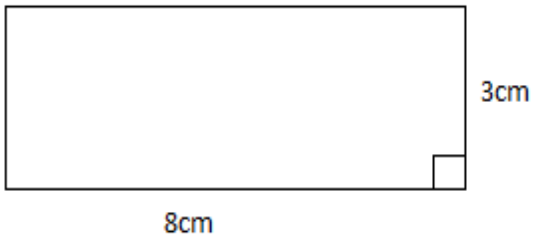
To find the area of a rectangle, multiply the length by the width.



A = L x W

Example 1

A rectangle has a length of 8 centimeters and a width of 3 centimeters. Find the area.

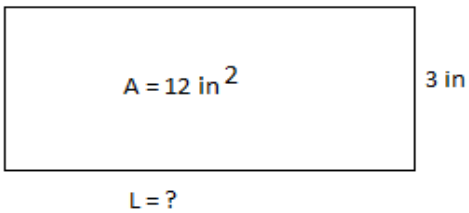


Solution:

$A = 8cm \times 3cm = 24\ cm^2$

Example 2

The area of a rectangle is 12 in^2 and the width is 3 inches. What is the length?



Solution:

$12\ in^2 = L \times 3\ in$

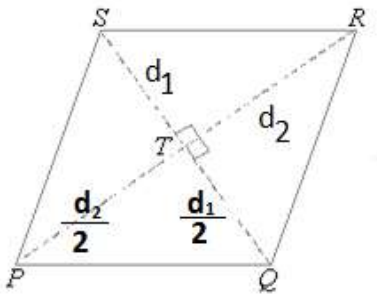
$L = 12in^2/3in$

$L = \underline{4\ in}$

Area of rhombus

A rhombus has four equal sides and its diagonals bisect each other at right angles.

Consider the area of the following rhombus.



The diagonals of a rhombus bisect each other at right angles.

∴ Area of the rhombus = Area of triangle PQR + Area of triangle PSR

$= [\frac{1}{2}d_2 \times d_1/2] + [\frac{1}{2}d_2 \times d_1/2]$

$= d_1d_2/4 + d_1d_2/4$

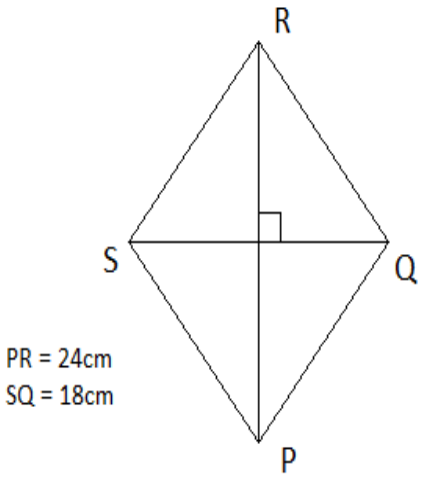
$= 2d_1d_2/4$

$= \frac{1}{2}\, d_1d_2$

= half of the product of the diagonals

Example 1

Find the area of the following rhombus.



Solution

Area of rhombus = $\frac{1}{2}\, d_1d_2$

$= \frac{1}{2}$ PR x SQ

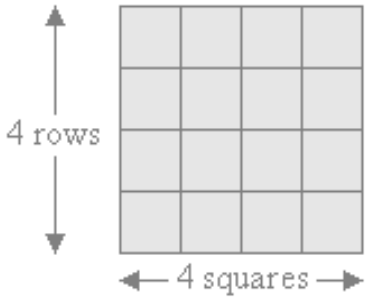
$= \frac{1}{2}$ (24cm x 18cm)

$= \frac{1}{2}$ ($432cm^2$)

= $\underline{216cm^2}$

Area of square

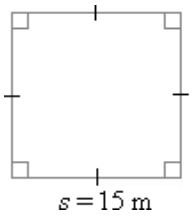
- The area of a square can be found by multiplying the base times itself.
- This is similar to the area of a rectangle but the base is the same length as the height.



Where L = W, it means Area of square = L^2

Example 1

Find the area of a square flower-bed of side 15 m.



∴ Area of the square = s^2

= 15cm x 15cm

= $225cm^2$

Example 2

The area of the square is $49cm^2$, find its length?

Area of the square = L^2

$49cm^2 = L^2$

$\sqrt{49cm2} = L^2$

L = 7cm

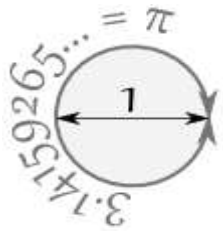
Area & circumference of circle

The formula to find a circle's area = π× (radius) 2

= Πr^2

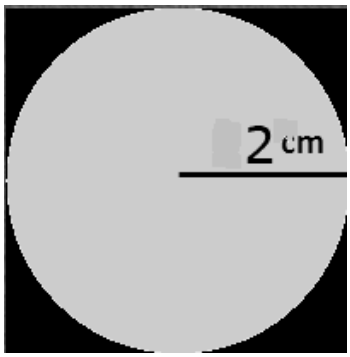
Where, Π is the division of the circumference (the distance around the edge of the circle) of the circle & its diameter. So when the diameter is 1, the circumference is Π (3.141592654...)

∴ Circumference of a circle = 2Πr or ΠD , here D = 2r



Example 1

What is the area of the circle?



Solution

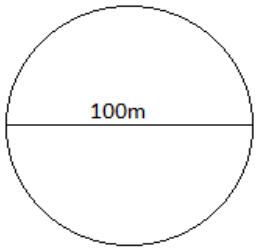
Area of circle = Πr^2

= 3.14 x (2cm) ^{2}

= $\underline{12.56cm^2}$

Example 2

You walk around a circle which has a diameter of 100m, how far have you walked?



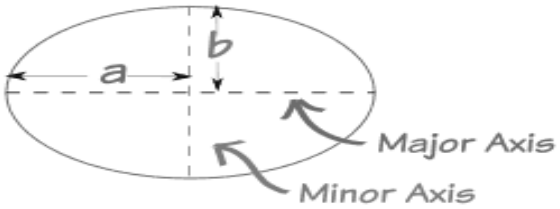
Circumference = π × 100m

= 3.14 x 100m

= 314m (to the nearest m)

Area of ellipse

The area of an ellipse is π × a × b

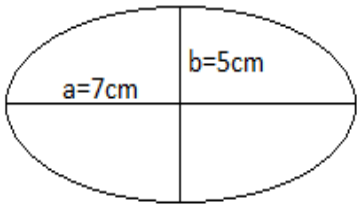


Where 'a' is the Semi-major Axis and 'b' is the Semi-minor Axis.

Note that for a circle, 'a' and 'b' are equal to the radius, and you get $\pi \times r \times r = \pi r2$, which is right!

Example 1

What is the area of ellipse of the picture?



∴ Area of ellipse = πab

= π x 7cm x 5cm

= 35 π cm^2

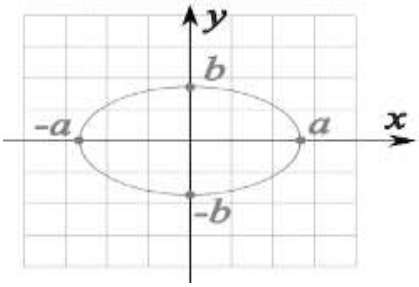
Example 2

What is the area of ellipse $x^2/16 + y^2/9 = 1$?

Solution

Note:

By placing an ellipse on an x-y graph (with its major axis on the x-axis and minor axis on the y-axis), the equation of the curve is:



$$X^2/a^2 + Y^2/b^2 = 1$$

∴ $X^2/16 + Y^2/9 = 1$ is the form $X^2/a^2 + Y^2/b^2 = 1$ then $a2 = 16$ ($a = 4$) & $b^2 = 9$ ($b = 3$)

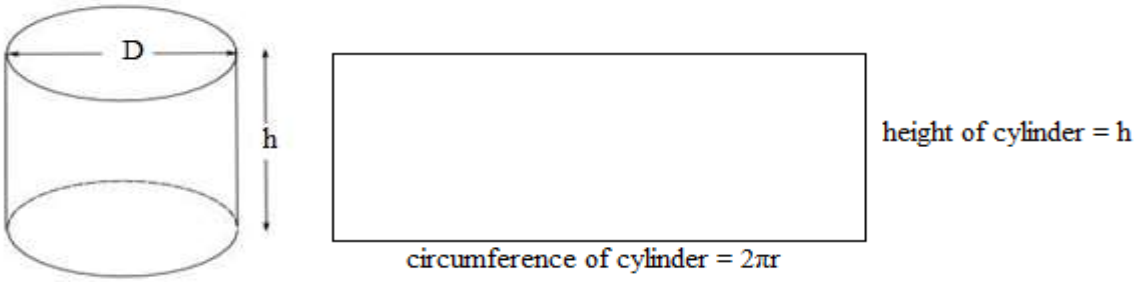
Area of ellipse = πab

= π x 4 x 3

= 12π unit square

Surface Area & volume of the cylinder

- ✓ Total surface area of cylinder



Total surface area of the circle = area of the top & bottom circle + area of rectangle shown at the right

= area of two end circles + area of the side curve

$= 2\pi r^2 + 2\pi r * h$

$= 2\pi r (r + h)$

- ✓ Volume of cylinder

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

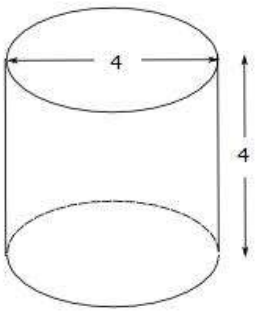
Volume of cylinder = area of the base cylinder * height of cylinder

$= \pi r^2 * h$

$= \pi r^2 h$

Example 1

What is surface area & volume of cylinder?



Surface area = 2 π r(r + h)

= 2 X 3.14 X 2(2 + 4)

= 75.36unit square

Volume = π × r2 × h

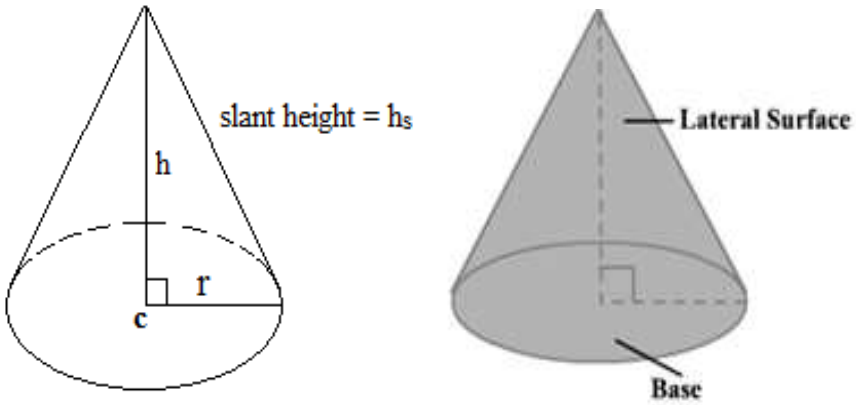
$=3.14 \text{ X } 2^2 \text{ X } 4$

$= 50.24 \text{ unit}^3$

Surface Area & volume of the cone

- ✓ Surface area of cone

The total surface area of a cone is the sum of the area of its base and the lateral (side) surface. The lateral surface area of a cone is the area of the lateral or side surface only.



Total surface area of cone = A_{base} (circumference of the circle) + A_{side} (lateral surface area of cone)

= $\pi r^2 + A_{side}$, here $A_{side} = \pi r h_s$

∴ Total Surface area of cone = $\pi r^2 + \pi r h_s$

= $\pi r (h_s + r)$

- ✓ Volume of cone

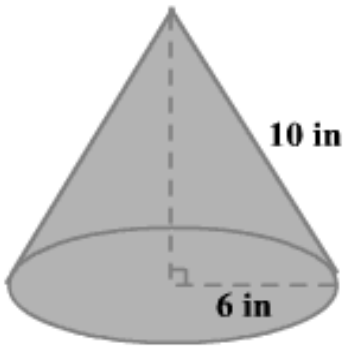
It is one third of the product of area of the base circle and the measure of the height.

Volume = 1/3 x area of circular base x height of cylinder

= $1/3 * \pi r^2 * h$

Example 1

Find the total surface area of a right cone if the radius is 6 inches and the slant height is 10 inches.



Total surface area of cone = $\pi r (h_s + r)$

= $\pi 6in (10in + 6in)$

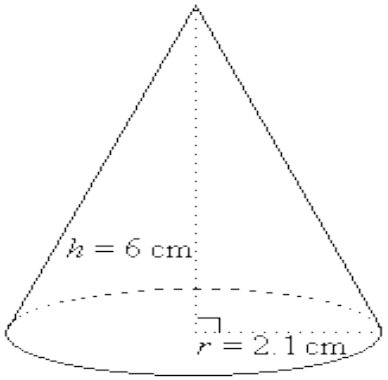
= $60\pi in^2 + 36\pi in^2$

$= 96in^2 \times 3.14$

$= 301.44\ in^2$

Example 2

Find the volume of a cone whose base radius is 2.1cm and height is 6cm using $\pi = 22/7$



Solution

Volume of cone = $1/3\pi r^2h$

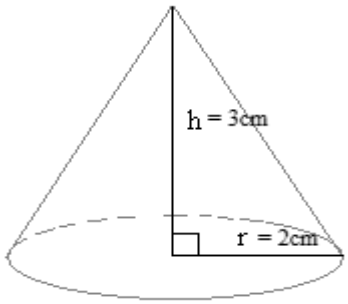
$= 1/3 \times 22/7 \times (2.1cm)^2 \times 6cm$

$= 22 \times 0.21cm^2 \times 6cm$

$= \underline{27.69cm^3}$

Example 3

Calculate the volume of the fig.



Solution

Volume of cone = $1/3\pi r2h$

$= 1/3 \times 3.14 \times (2cm)^2 \times 3cm$

$= 3.14 \times 4cm^2 \times 1cm$

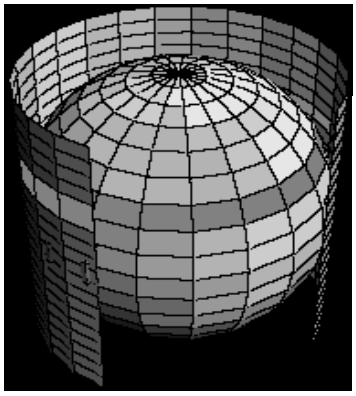
$= \underline{12.56cm3}$

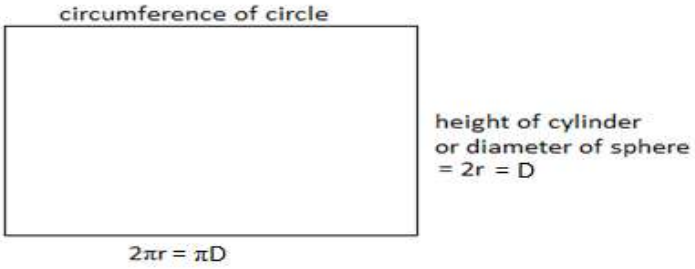
Surface Area & volume of the sphere

- ✓ Surface Area of sphere

It is the same as the area of the curved part of the cylinder.

What is the area of the curved part of the cylinder?





∴ Surface area of the sphere = area of rectangle (L x W)

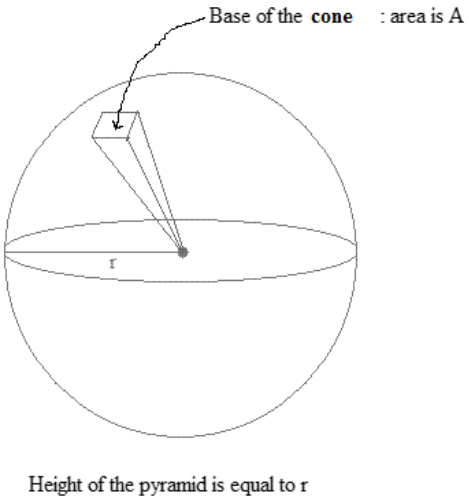
= circumference of circle x height of cylinder

= 2πr x 2r

= $4\pi r^2$

- ✓ Volume of sphere

Volume of sphere = volume of free formed based conical objects



Note:

Area of cone = 1/3πr2 * h, but in this case h is equal to radius of cone. Then, for many conical objects

= {1/3 * A_1 * r} + {1/3 * A_2 * r} + {1/3 * A_3 * r} + … + {1/3 * A_n * r}

= 1/3 {A_1} + {A_2} + {A_3} + … + {An} * r

= 1/3 {area of the sphere} * r

= 1/3 {4πr2} * r

$= 4/3\ \pi r3$

Example 1

If r = 5cm for a given sphere, and pi = 3.14, then the surface area of the sphere is:

∴ Surface area = $4\pi r2$

$= 4 \times 3.14 \times (5cm)^2$

$= 4 \times 3.14 \times 25cm^2$

$= \underline{314cm^2}$

Example 2

If the surface area of a sphere is 500, and pi = 3.14, find the radius of the sphere?

Solution

∴ Surface area = $4\pi r2$

$r = \sqrt{\text{surface area}/4\pi}$

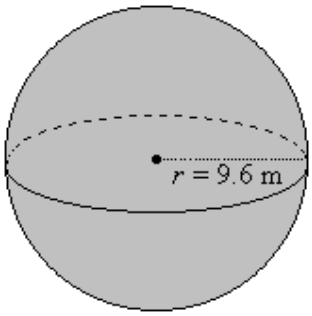
$= \sqrt{500/4x3.14}$

$= \sqrt{39.81}$

$= \underline{6.31unit}$

Example 3

Find the volume of a sphere of radius 9.6 m, rounding your answer to two decimal places.



Solution

∴ Area of the sphere = $4/3\ \pi r^3$

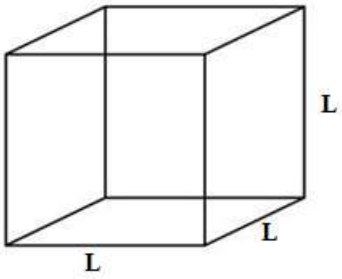
$= 4/3 \times \pi \times (9.6m)^3$

$= 4/3 \times \pi \times 884.736m^3$

$= \underline{3704.1m^3}$

Surface area & volume of cube

- ✓ Surface area of cube



Surface area cube = six times of edge length square

$= 6 \times (\text{Edge Length})^2$

$= 6L^2$

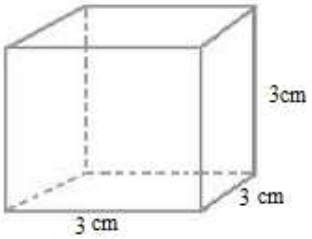
- ✓ Volume of cube

Volume of cube = cube of edge length

$= L^3$

Example 1

A cube has edge length 3 cm. What is its surface area?



Surface area of cube = $6L^2$

$= 6 \times (3cm)^2$

$= \underline{54cm^2}$

Example 2

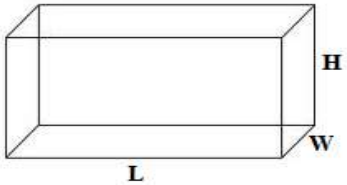
What is the volume of a cube of edge length 5 cm?

Volume of cube = L^3

$= \underline{5cm^3}$

Surface area & volume of cuboid

- ✓ Surface area of cuboid



Surface area of cuboid = the sum of the areas of its 6 faces,

$$= 2[(L \times W) + (L \times H) + (W \times H)]$$

- ✓ Volume of cuboid

Volume of cuboid = L x W x H

Example 1

Find the total surface area of a cuboid with dimensions 8 cm by 6 cm by 5 cm.

Total surface area = $2[(L \times W) + (L \times H) + (W \times H)]$

$= 2 (8*6 + 6*5 + 5*8)$

$= 2 (48 + 30 + 40)$

$= \underline{236cm^3}$

Example 2

Find the volume of a brick whose size is 30 cm by 25 cm by 10 cm.

Volume of cuboid = $L \times W \times H$

$= 30 \times 25 \times 10$

$= \underline{7500\ cm^3}$

3.1.3 Material quantities are to be calculated in either packed, piece or bundled state and might be converted to volumes as required

Calculating packaging material

Instructions to calculate packing materials:

1) Multiply the width, length and height of the box to Measure the width, length and height of the packing box.
2) Calculate its volume. For example the width, length & height of the box are 90cm, 60cm and 50cm respectively, then the volume of the box is about (90)(60)(50) = 270000cubic centimeters.
3) Measure the width, length and height of the object that you are packing. If the object is not a perfect rectangle, take the average width and length. For example, if the object is 10 centimeters at its widest point and 8 centimeter at its narrowest point, use 9 centimeter for the width.
4) Multiply the width, length and height to find the volume of the object you are packing. For example, if the object is about 9 centimeters wide, 15 centimeters long and 10 centimeters high, then the volume is about (9)(15)(10) = 1,350 cubic centimeters.

5) Divide the volume of the box by the volume of the object to find the amount of the object packaging in a box. That is the volume of the box is 270000cubic centimeters and the object is 1,350 centimeters, then the amount of the object in a packaging box is 270000 -- 1,350 = 200 cubic centimeters.

3.1.4 Calculations to be performed include manually and with the aid of a calculator

Calculation can made simply by manually or with the aid of calculator

Calculation made by manually

Example Add the following number 0.34 + 2.01 + 20.5

Solution , 0.34

2.01

+ 20.50

22.85

Calculation made by calculator

There are many different types of calculators.

Some are very simple and easy to use. Others such as scientific calculators have many more keys and functions available.

For example calculators are useful when making percentage calculations.

Calculators have a 

key.

Example 1 change 3/20 to a percentage

Press

With the simpler calculators once you have pressed the 

it is not necessary to press 

.

Example 2 change ½ to a percentage

Press

or

Answer 50%

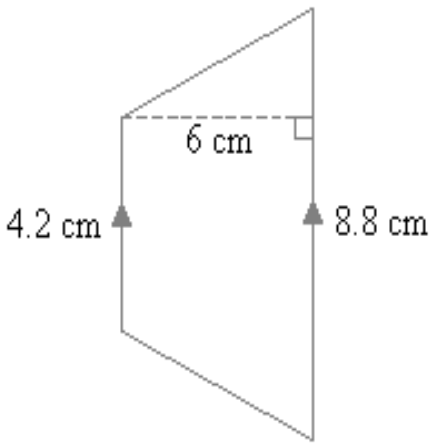
Self-Check 1	**Written Test**

Name: _____ Date: _____

Time started: _____ Time finished: _____

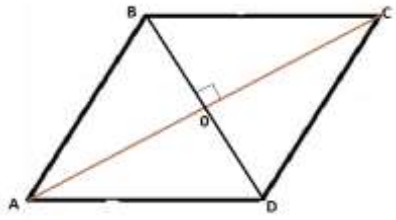
Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1) Explain the difference between mass and weight? (3 point)
2) What is ratio? Explain the answer by giving one example. (2 points)
3) Calculate the area of the trapezium. (5 points)



a.

4) The area of rhombus is 24cm2, find the diagonal BD? (5 points)

a. 

b. AO = 4cm

5) Change ½ to a percentage by the aid of calculator? (3 points)

6) The volume of a cube is $1cm^3$; find the length of each side? (4 points)

Note: **Satisfactory rating - 20 points** **Unsatisfactory - below 20 points**
You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

Short Answer Questions

1_____
_

_____

_____

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2_____
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3_____
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1. _____

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2. _____

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3. _____

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Information Sheet-2	Material requirements calculation

Material requirement calculation to make ladies leather jacket

In order to calculate the required amounts follow the standard costing system

The standard costs are developed based on direct and indirect costs budgeted. The standard cost is a measure of how much should cost to produce or deliver a product or service.

The standard cost of a product is made of the costs of the components required to produce that product.

Example, the standard cost of a leather jacket includes:

- Direct materials cost (leather, zipper, buttons, etc.)
- Direct labor cost (the time required to cut the design, sew it, etcetera, at the rate of production of employees who work in the process), and
- Indirect manufacturing costs related to the product (depreciation of the skin cutter machine, electricity, rent of the factory, etc.)

Direct material requirement

The direct material requirement is direct costs, such as direct materials and labor; they are the costs that can be specifically assigned to a unit of products. The standard cost for the direct costs of a product involves two components: the price component and quantity component. The standard cost for one unit of production is calculated by multiplying the standard quantity to be used by the price per standard unit.

Indirect (overhead) material requirement

Overhead cost includes a rent, machinery Depreciation, supervision salaries, indirect material, and electricity.

Self-Check 2	**Written Test**

Name: _____ Date: _____

Time started: _____ Time finished: _____

***Instructions**:* Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers. Write your answers in the sheet provided in the next page.

1 What is direct material requirement?

2 Explain about indirect material requirement?

3 Prepare a material requirement for male leather jacket?

Answer Sheet

Note: **Satisfactory rating - 25 points** **Unsatisfactory - below 25 points**

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

1_____

_____

2_____

_____

3_____

_____

Information Sheet-3	Selection of appropriate formula

Selection of appropriate formula for calculating material quantity

You don't always get asked to calculate the area of a regular shape like a square, rectangle or circle. Sometimes, you'll get very weird looking shapes, perhaps something like this one:

There are no formulas for finding the area of weird shapes like these. There are different methods of calculating the area of the shape such as measuring by net pattern area measuring techniques & measuring by instrument.

Net Pattern Area Measuring Techniques

a) Using square or graph paper placing the pattern on the graph paper and draw the perimeter of the pattern and calculating the net pattern area by net pattern area measuring techniques. Here to calculate the pattern area coverage on the graph, counting the area covered by the pattern. We have two types of counting system:

1. Counting the number of squares that are fully filled and more than half filled by the shape but not counting less than half of the filled and take as a result.

2. Count the number of fully filled squares in one group and not fully filled in another group and add up the fully filled square and half of not fully filled square.

b) Using Measuring (square) Grid – net pattern area can be measured using transparent plastic grid divided into 1/100 sq. ft. Place the plastic grid on top of the pattern and count the squares and add up the two to get the net pattern area.

c) Use of CAD (computer):- net pattern area can be calculated using CAD computer with digitizing. Insert the pattern in to CAD computer by digitizing and then calculating the net pattern area on the computer.

d) Using by instrument: - net pattern area also measured by instrument

Leather & plastic Area measuring instrument

Put the leather or synthetic on the mirror, turn on the instrument & adjust it, move the scanner from left to right & and get back right to left and the instrument read the measurement by scanning the area of the leather or synthetic

.

Self-Check 3	Written Test

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Perform the following tasks. Write your answers in the answer sheet provided:

1. Differentiate the point between measuring the pattern area using by graph paper & square grid. (5 points)

2. Calculate the net pattern area of one component of the leather jacket by selecting an appropriate formula. (5 points)

Note: **Satisfactory rating - 15 points points** **Unsatisfactory - below 15**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

1. _____

_____

2. _____

_____

_____

_____

3. _____

_____

Information Sheet 4	Estimating quantity from performed calculation

4.1. Quantity estimation

4.2. Direct material quantity estimation

4.3. Direct material cost estimation

Example: Assume that our leather jacket contains an average of 41.6square feet of skin including 30%wastage (it is calculated by net pattern area method) at a cost of 46.00birr per square feet, a zipper at a cost of 5.00birr per meter and two buttons at a cost of $0.50 each. Based on a time study recently made by the administration, a jacket requires an average of 8 hours of time spent by an employee to be produced. The production workers are paid on average 23birr per hour of work. The standard cost for the direct costs (the one for indirect costs will be seen later in this section) shall be as follows:

Note: wastage for skin = 30% and for lining = 15%

No	Material	Measuring unit	Required quantity	wastage	Total req. quantity	Unit cost(birr)	Total cost (in birr)
1	Sheep Napa (black)	Sq.ft.	32.00	9.6	41.6	46	1913.6
2	Lining	Mt.	1.25	0.19	1.44	35	50.40
3	Non-woven	Mt.	0.75	no	0.75	12	9.00
4	Shoulder pad	pcs	1pair	no	1pair	12	12.00
5	Zipper No 5	Mt.	0.40	no	0.40	15	6.00
Total							1990.60

Direct Labor cost estimation

Assume that 4056birr/month, 22 working days, 8working hours and 8hrs production time

= 8hrs * 23birr/hr

= 184birr

Therefore, direct cost = direct material cost + direct labor cost

= 1990.60 + 184birr

= 2174.60birr

Overhead or indirect material quantity estimation

Indirect material quantity (overhead cost) includes a rent, machinery Depreciation, supervision salaries, indirect material, and electricity.

Assume it is 20% of direct material quantity estimation

Therefore, overhead cost = 20% of direct cost

= 20% of 2174.6birr

= 0.2 x 1642.73

= 434.92birr

Therefore, material quantity estimation for

The standard cost of a product = Direct cost + overhead or indirect cost

= 2174.60birr + 434.92birr

= 2609.52birr

Self-Check 4	**Written Test**

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: read the following questions and write your answers in the answer sheet provided:

1. What is the difference b/n direct & indirect quantity estimation? Explain by giving one example (10 points)

Note: **Satisfactory rating - 7 points** **Unsatisfactory - below 7 points**
You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

Short Answer Questions

1 _____

_____

_____

_____

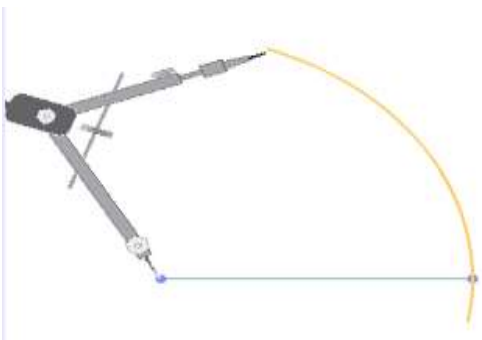
Operation Sheet 1	Procedures to Construct geometric shape

- Procedure to construct triangle (equilateral triangle)

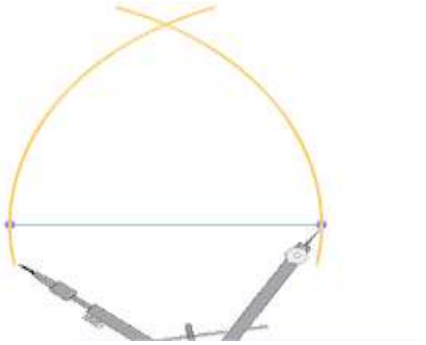
Steps:

- Make any straight line.

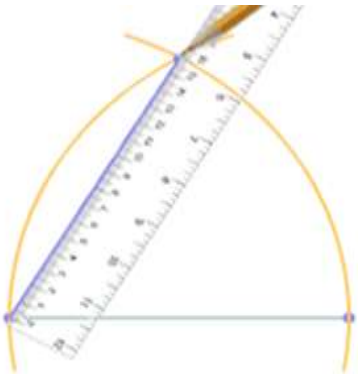
- Adjust compasses at the end point of the line with same width of the line, and draw arc



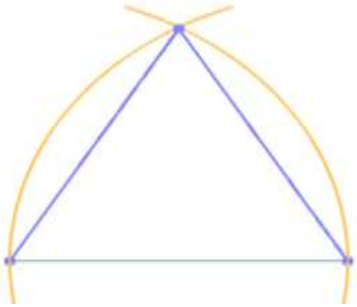
- Adjust compasses at the other end point of the line with same width of the line, and draw arc



- Place ruler where the arcs cross and the starting point of the line, and draw the line



- Again place ruler where the arcs cross and the other end point of the line, and draw the line



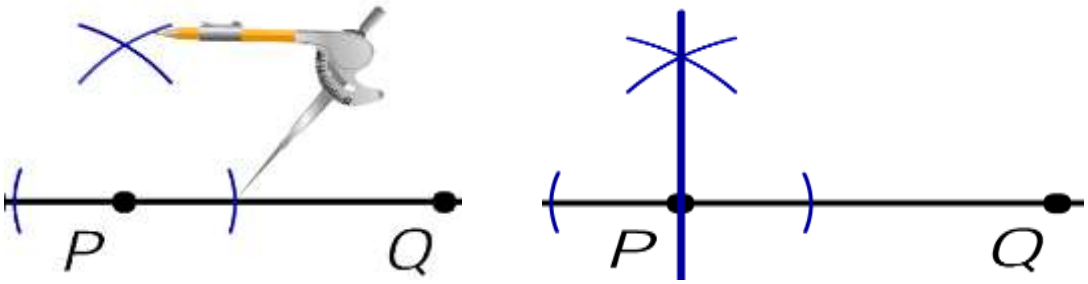
- Procedure to construct rectangle

Steps:

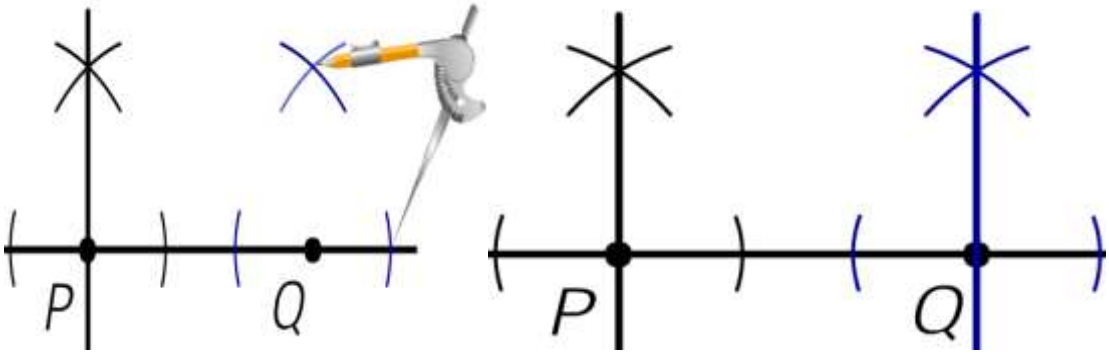
- Draw straight horizontal line by using ruler

- Label points P & Q on the line

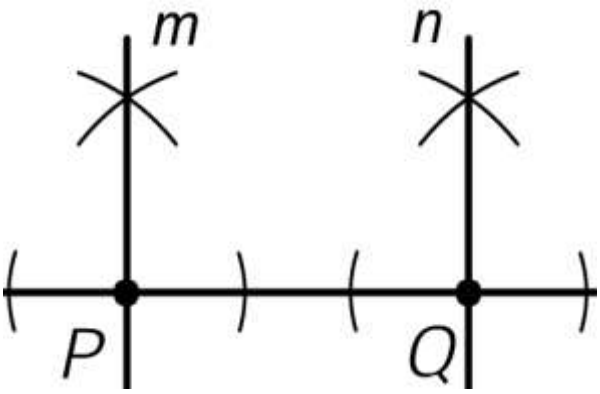
- Construct a perpendicular line through point P



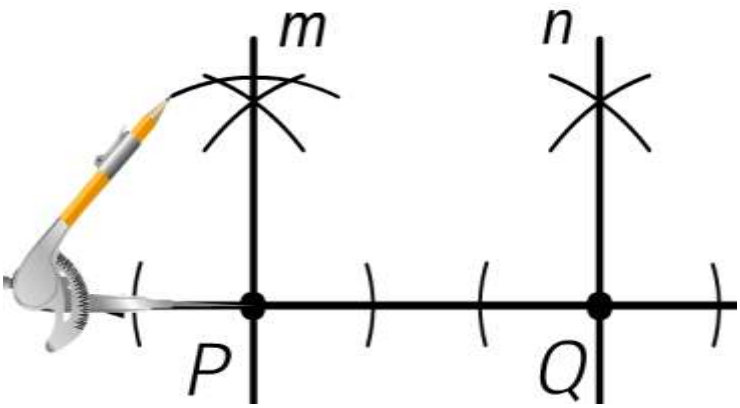
- Construct a perpendicular line through point Q



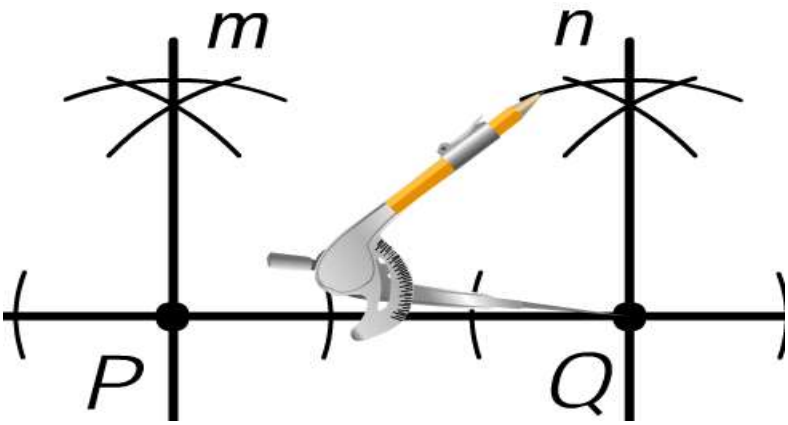
- Label the lines m & n



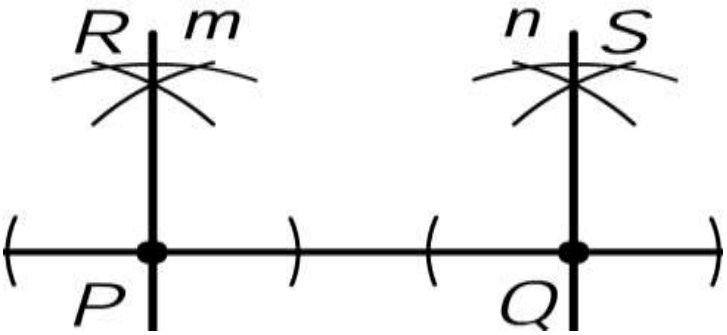
- Place the compass at point P and draw arc by adjusting the arc length



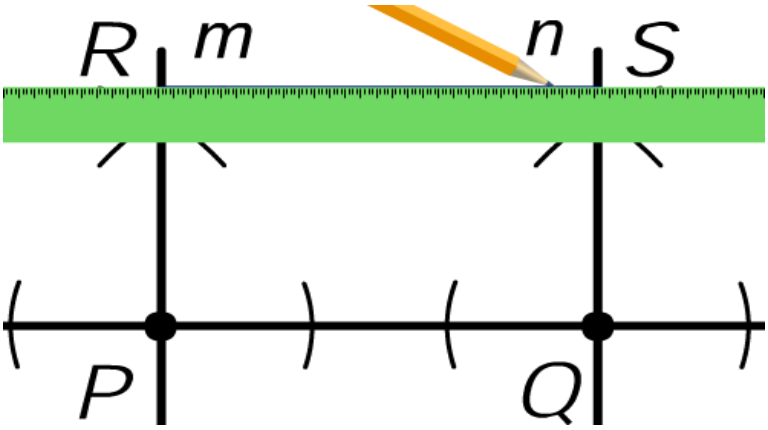
- Place the compass at point Q and draw arc with same arc length



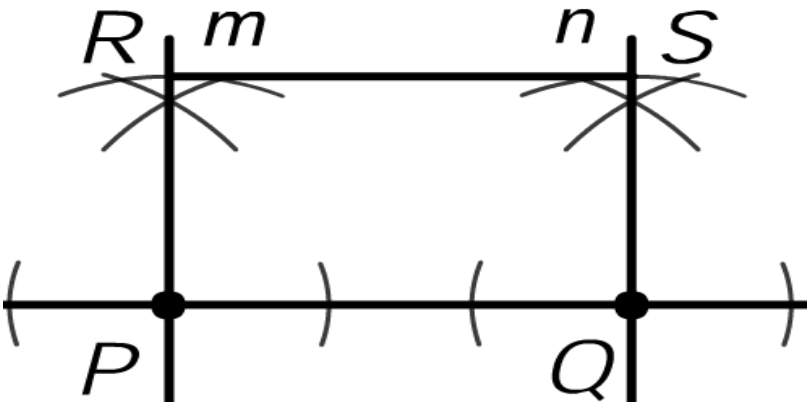
- Label these points R & S



- Draw line to connect R & S



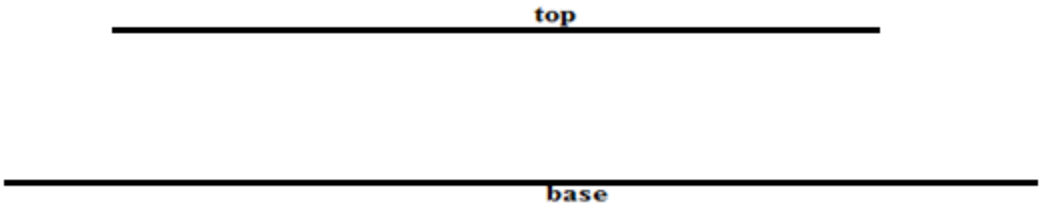
- PQRS rectangle



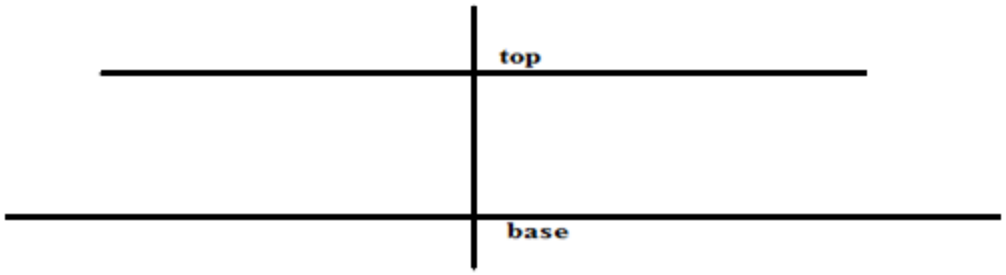
- Procedure to construct isosceles trapezoid

Steps:

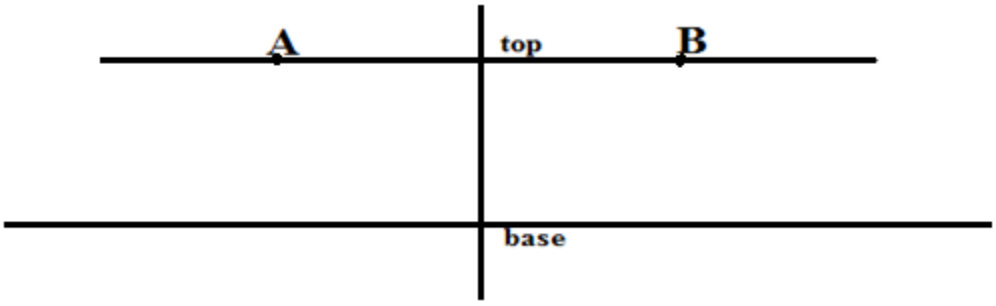
- Construct parallel lines by using constructing parallel line method



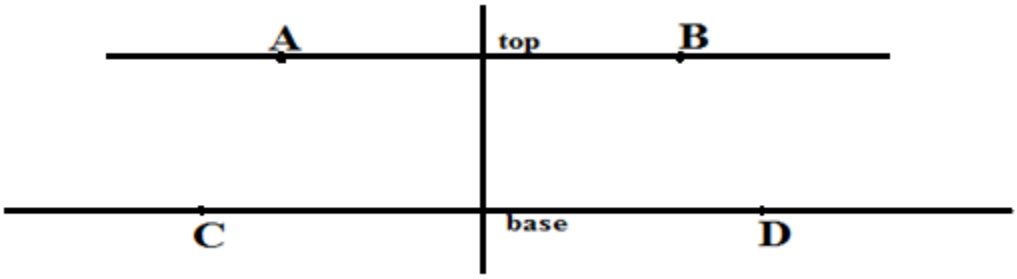
- Bisect the base and the line cross both the top & base



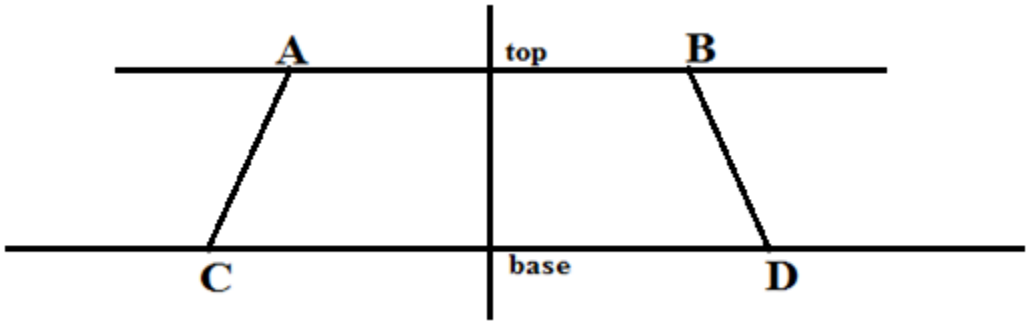
- Label the two end points of the top A & B with equal arc length from the center, and measured by your ruler with equal distance from the center line



- Label the two end points of the base C & D, and measured by your ruler with equal distance from the center line



- Connect point A & C and B & D at the left & right end points.



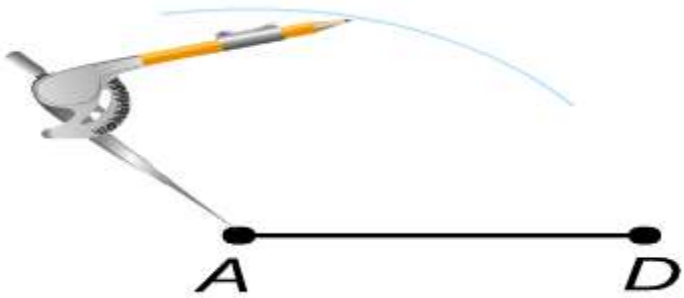
- ABCD is an isosceles trapezoid

- Procedure to construct isosceles triangle

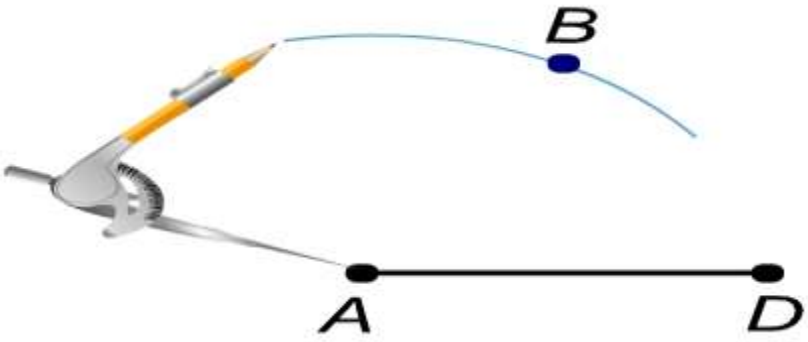
Steps:

- Draw any horizontal straight line AD

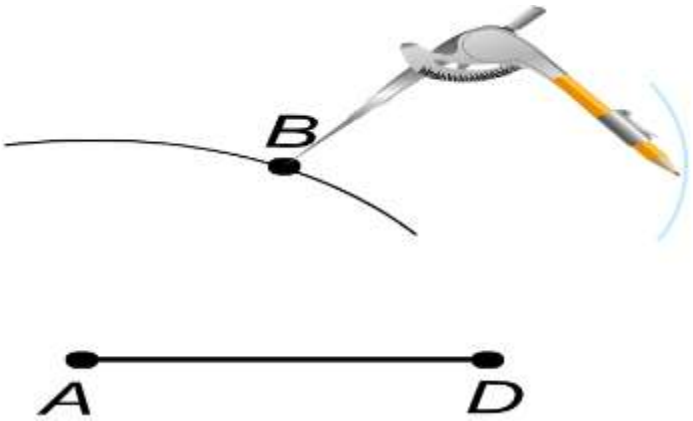
- Place the compass at A & adjust it at D and then draw arc above AD



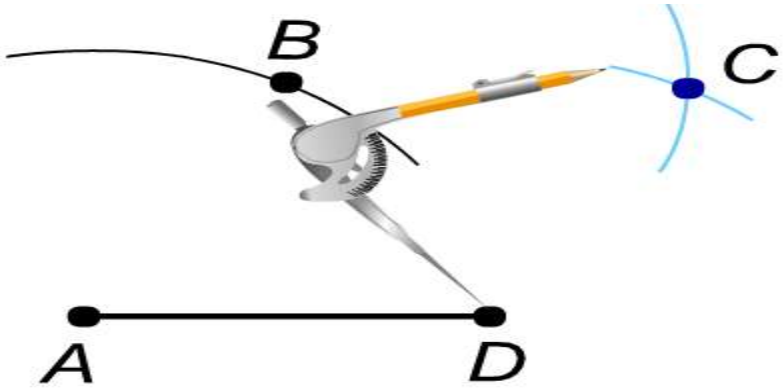
- Label any point on the arc as B



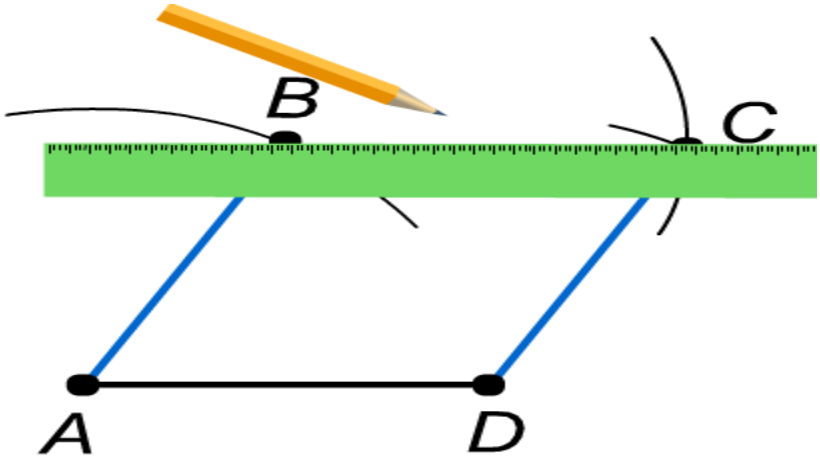
- Place the compass at B and draw arc to the right of B with the same arc length



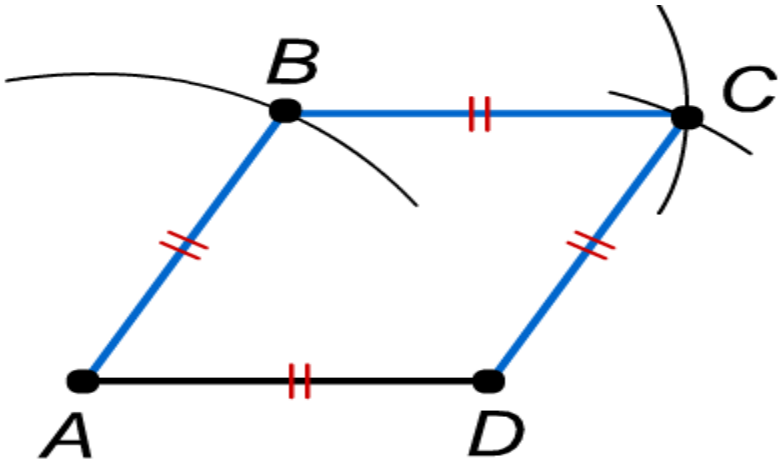
- Place compass on D and draw an arc to intersect the arc from B with same length and Label the point of intersection C



- Use a straight edge to draw AB, BC, and CD.



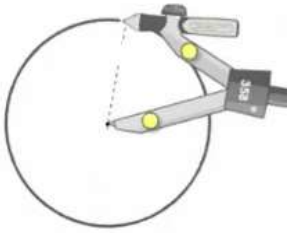
- Since all sides are congruent, quadrilateral ABCD is rhombus.



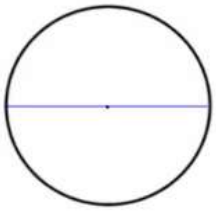
- Procedure to construct square

Step:

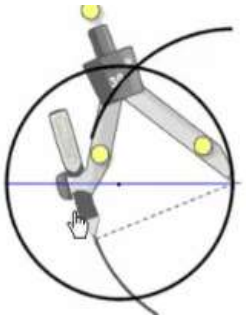
- Make any circle



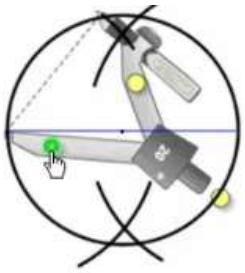
- Draw diameter of the circle.



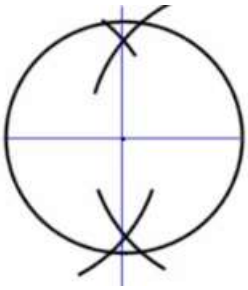
- Place compass at the end of diameter, and open it a little beat longer than the center of the circle, & draw arc below & above the diameter of the circle.



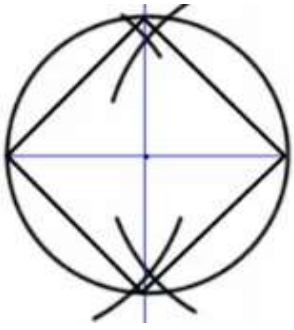
- Make another arc with same width from the other end point of diameter.



- Place ruler where the two arcs cross, and draw line.



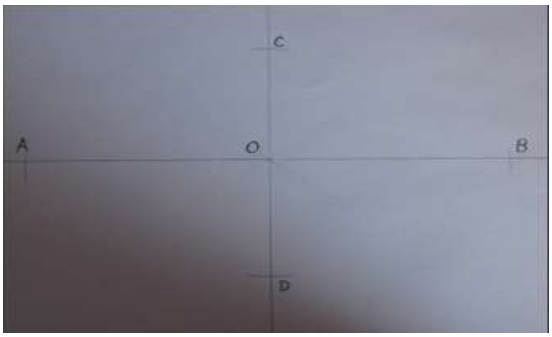
- Join the four end points of the diameter, and you get square.



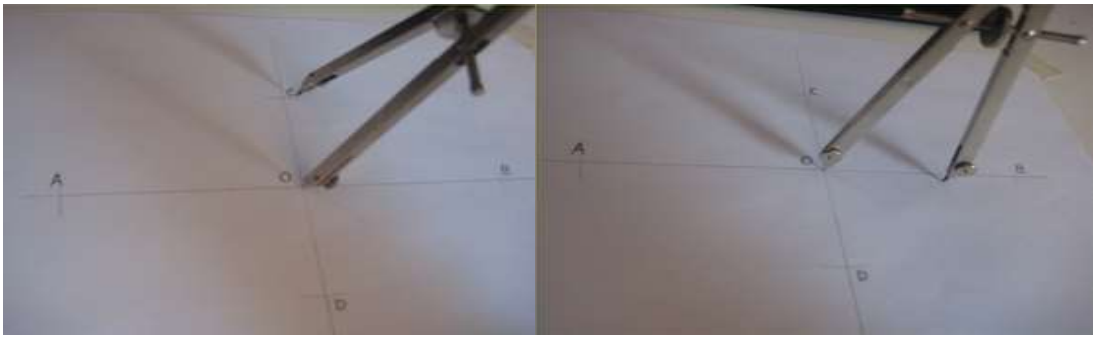
- Procedure to construct ellipse

Steps:

- Draw the major axis, AB, and the minor axis, CD, which are mutually perpendicular at the midpoint, O, as shown in the diagram.

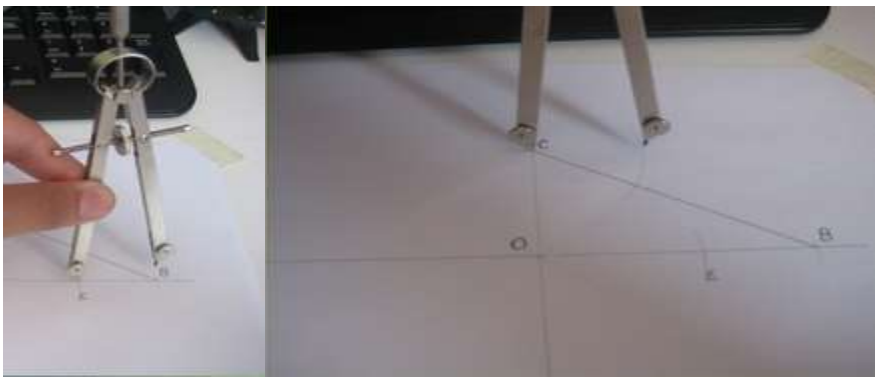


- Set compass from O to C; Make a mark on the right side of major axis and Label it E

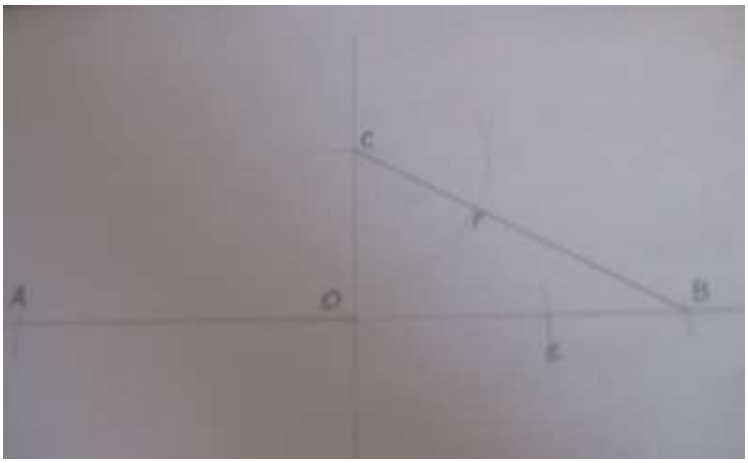


- Draw CB that connects the end points of the two axes.

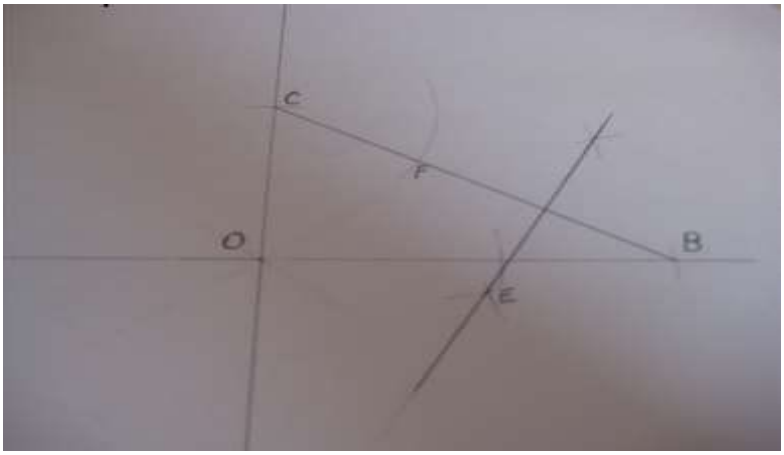
- Set compass to EB, Set compass on C and swing an arc intersecting line CB



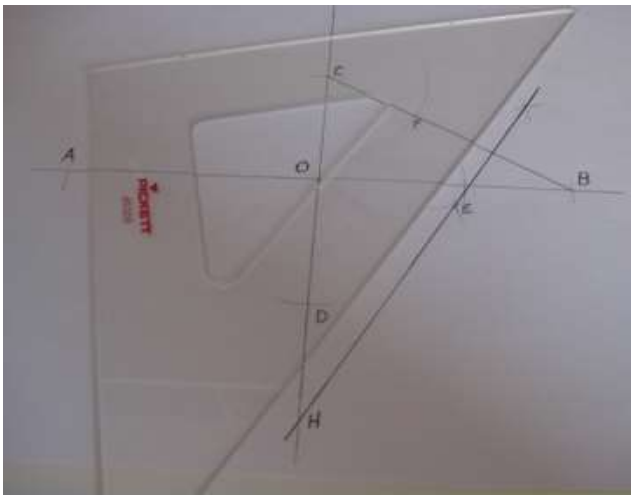
- Label intersection F



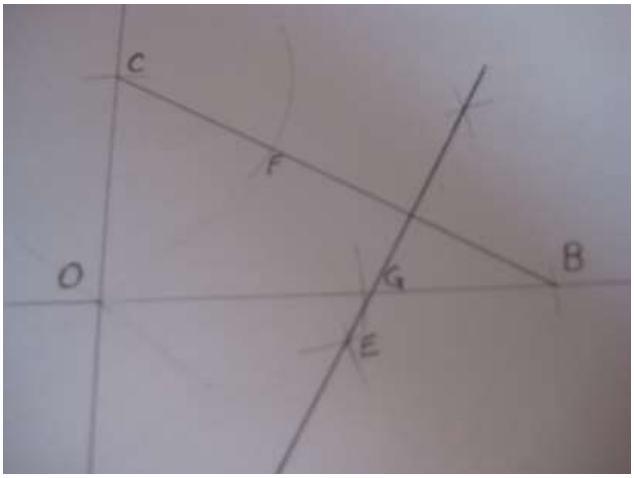
- Bisect line FB (see earlier lessons on bisecting a line)



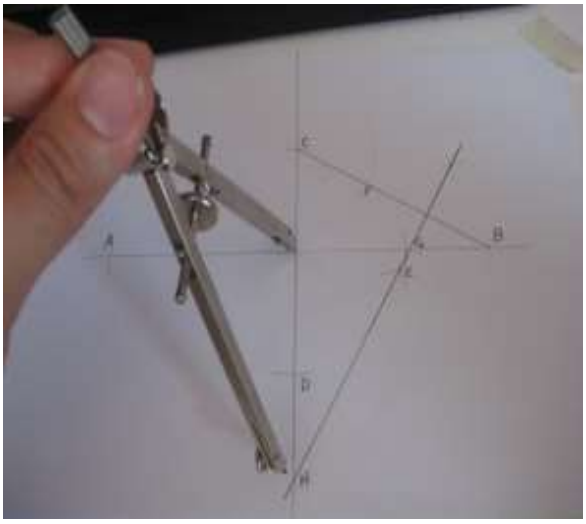
- Extend Bisector to make point H

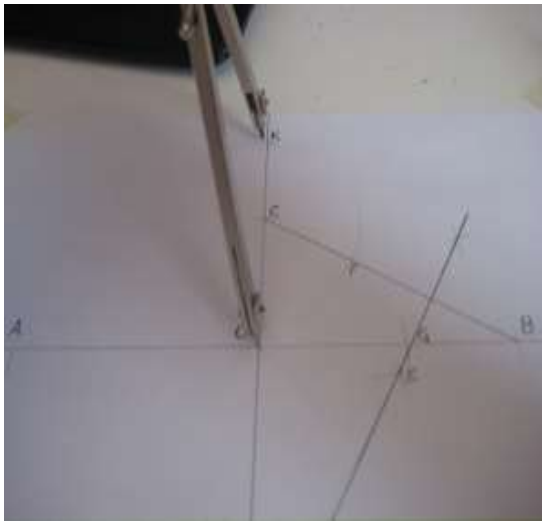


- Mark point G where bisect or intersected line AOB

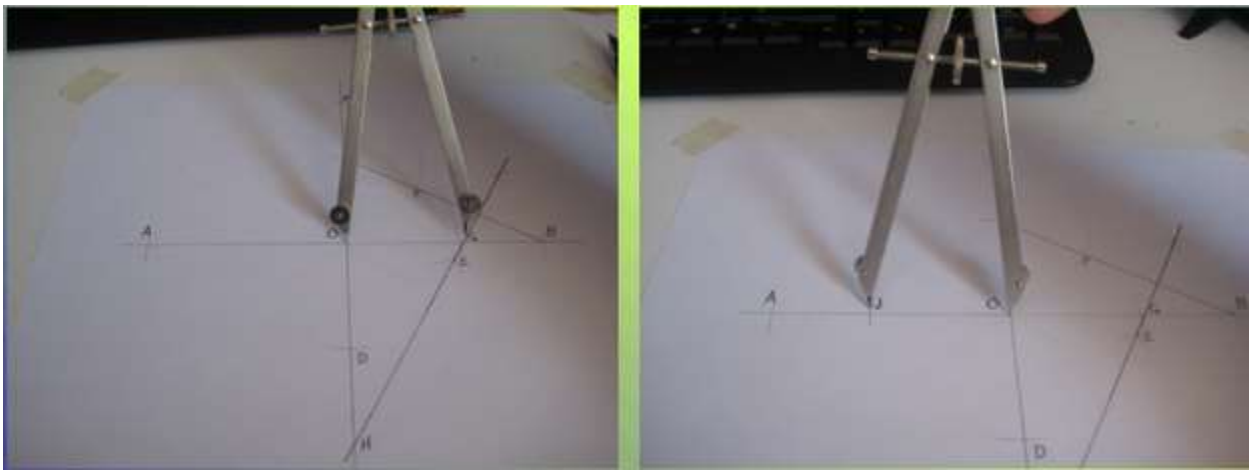


- Set compass O to H, From O make a mark above C and label it K

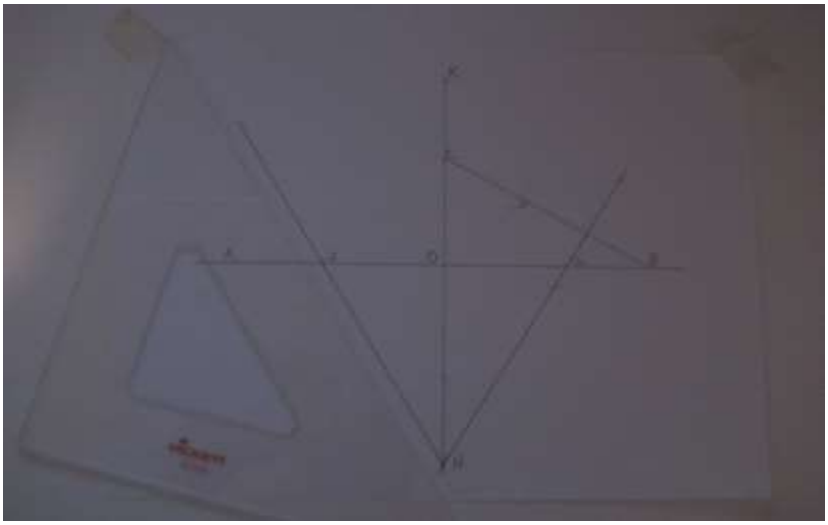




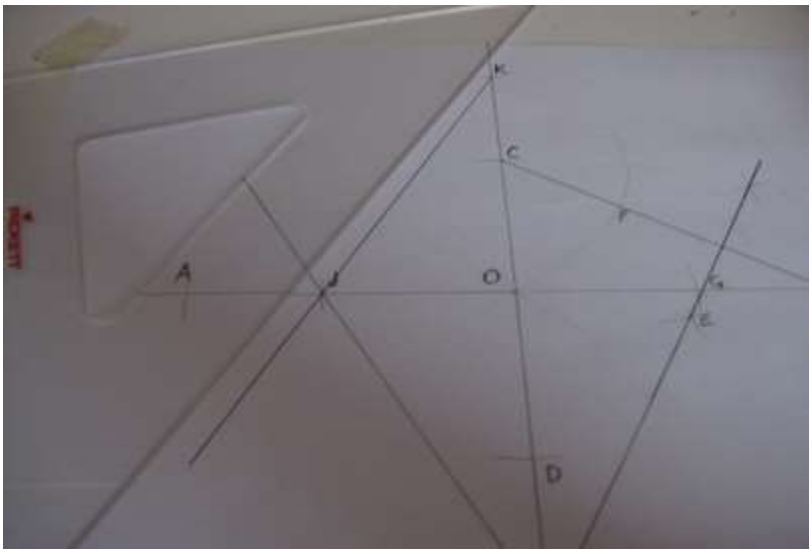
- Set compass O to G, From O make a mark to the right A and label it J



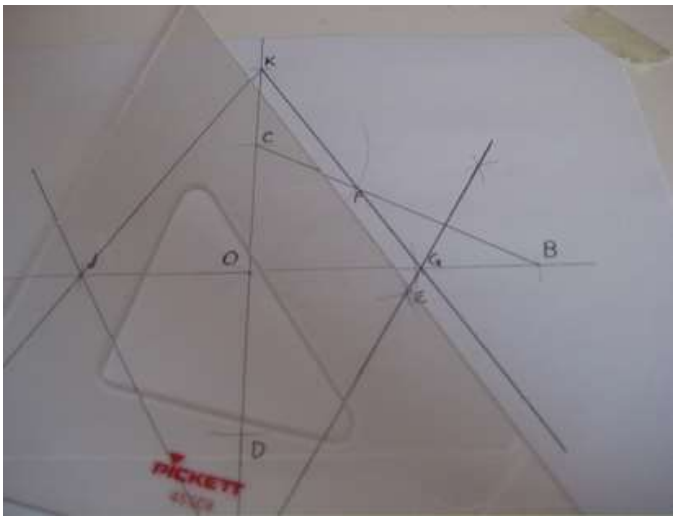
- Using your triangle draw a Line from H through J



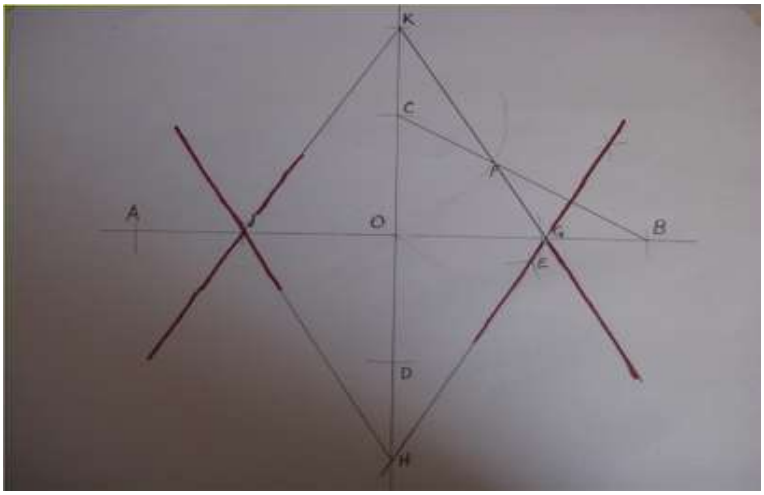
- Using your triangle draw a Line from K through J



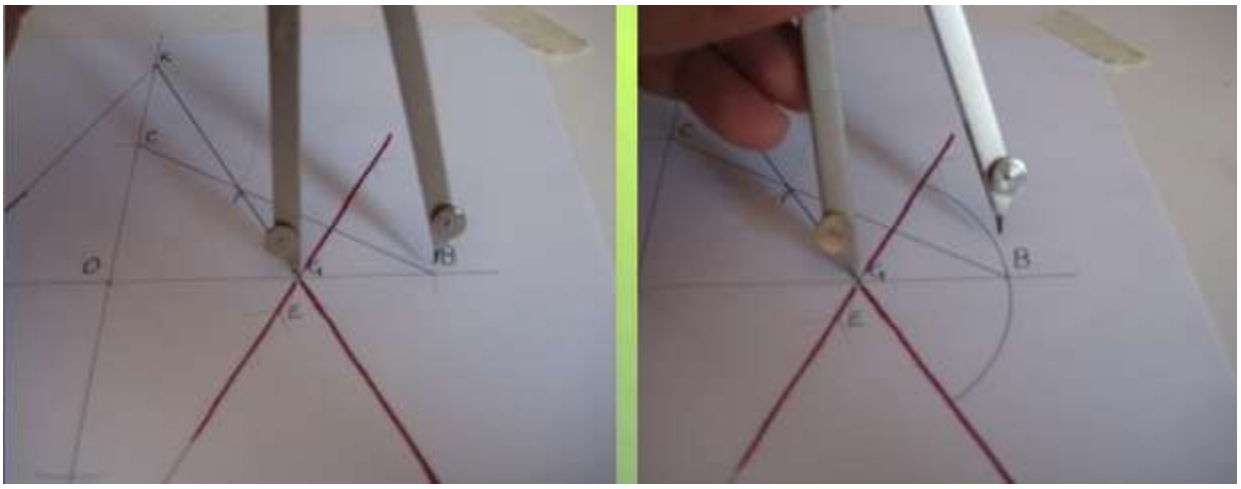
- Using your triangle draw a Line from K through G



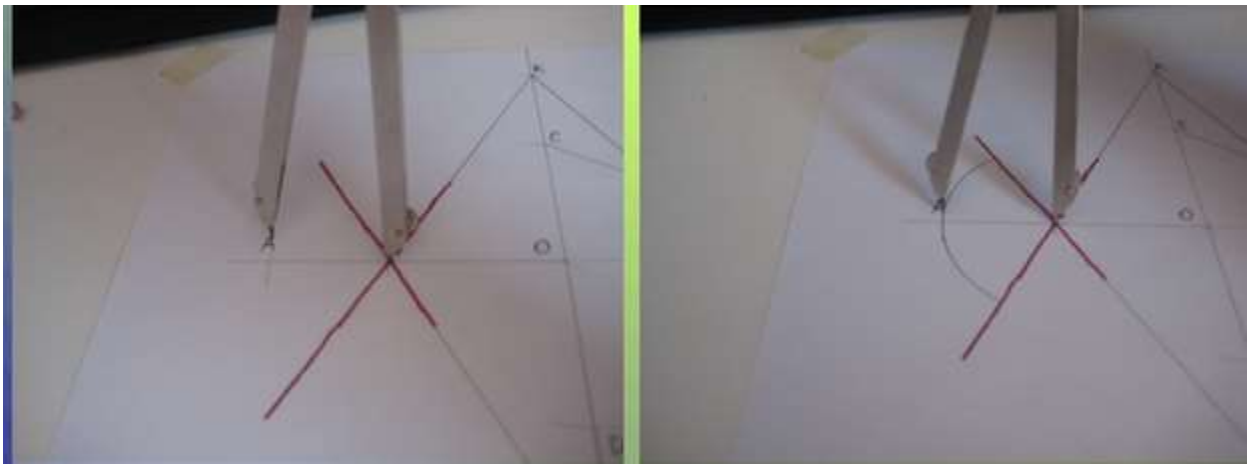
- Tangency Line KJ, Line HJ, Line KG & Line HG



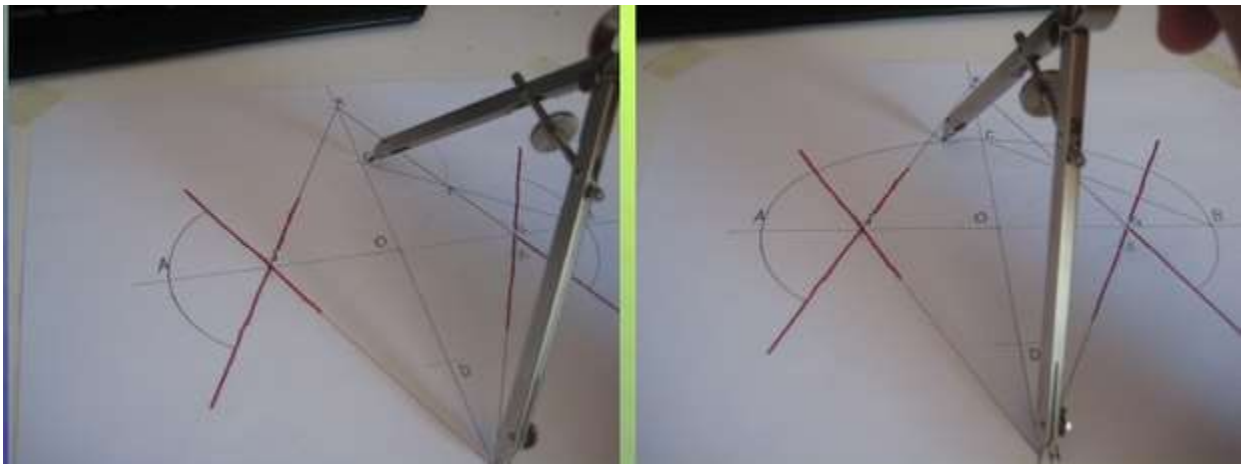
- Set compass to GB, Having the center on G draw an arc to both Tangency lines



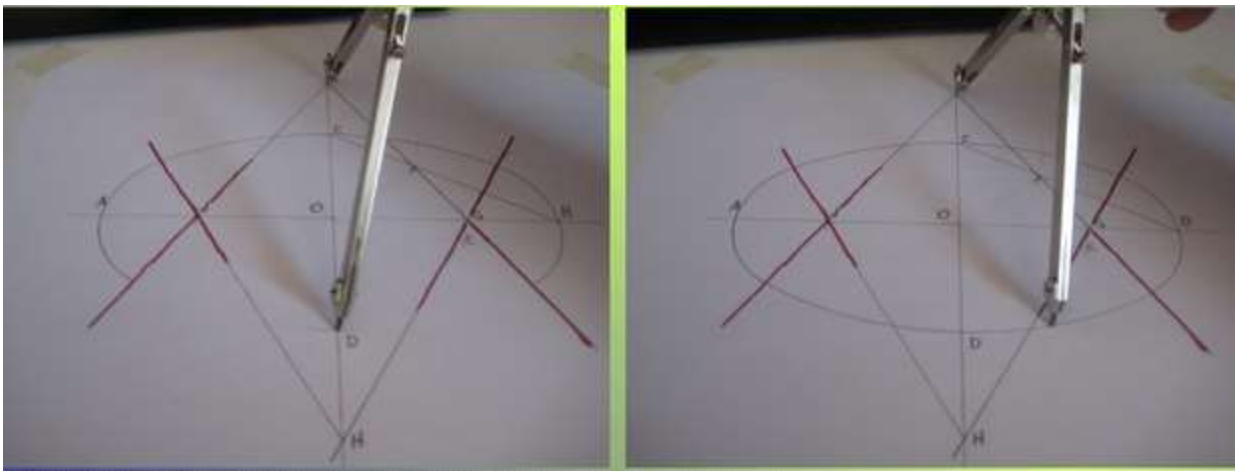
- Set compass to JA, Having the center on J draw an arc to both Tangency lines



- Set compass to HC, Having the center on H draw an arc to both Tangency lines



- Set compass to KD, Having the center on K draw an arc to both Tangency lines

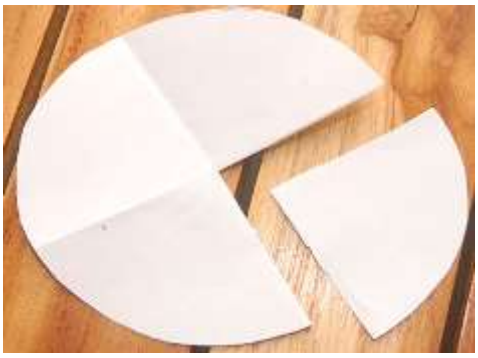


- Procedures to construct cone by paper

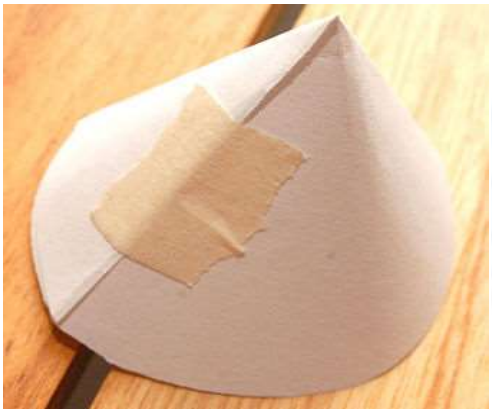
Steps:

- Make a paper disk; Cut a circle out of a piece of any kind of paper. The height of your cone will be determined by the radius of your circle. The larger the radius, the taller the cone

- Cut out a section; Cut a triangle by making two cuts to the center of the circle as shown. Small wedges removed from the disk will result in a cone with a broad bottom. To make a cone with a small bottom



- Make the cone; Fold the circle, overlapping the edges a little, and tape together. You now have your cone. Have fun with it!



Operation Sheet 3	Steps to finding net pattern area of the leather by using square/graph paper method & instrument

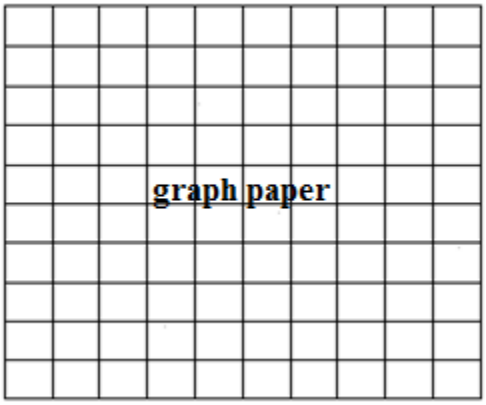
Steps to finding net pattern square of the leather by using area/graph paper method

We have two methods

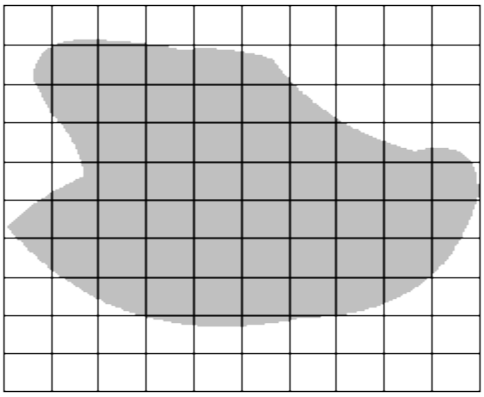
Method 1

Counting the number of squares that are fully filled and more than half filled by the shape but not counting less than half of the filled and take as a result

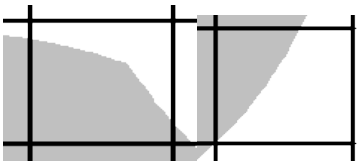
Steps 1 prepare a 1cm by 1cm graph paper



Steps 2place the pattern on the paper and draw perimeter

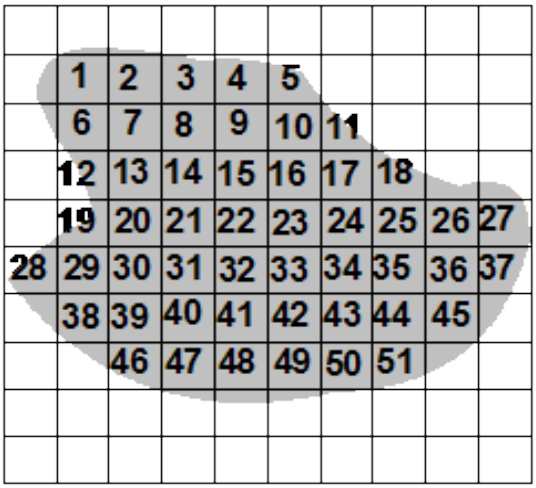


Steps 2 count the number of squares that are *more than half filled* by the shape. That is if a square is more than half filled by the shape, then it counts as '1'. If the square is *less than* half filled by the shape, then it *doesn't count*.



Doesn't count as a filled square does count as a filled square

Steps 3 write down the number under fully filled & more than half filled square



Steps 4 calculate the area

So the area of this shape is *about* 51 squares. Assuming the graph paper/square paper is partitioned with 1cm by 1cm. Then net pattern area will be:

∴ Net pattern area = the representing area of square x no of fully filled square

$= 1cm^2 \times 51$

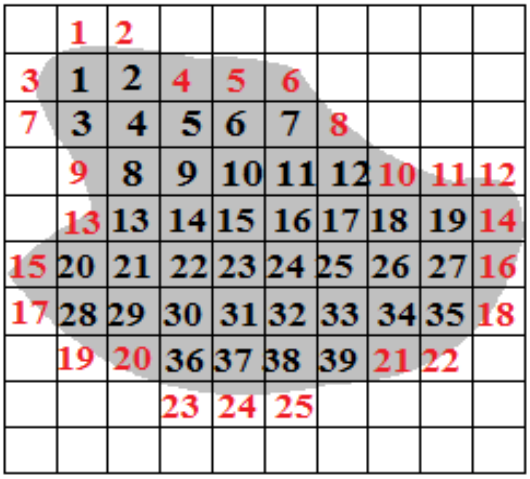
$= \underline{51cm^2}$

Method 2

Count the number of fully filled squares in one group and not fully filled in another group and add up the fully filled square and half of not fully filled square

Steps 1 place the pattern on the paper and draw perimeter (see method 1 of step 1& 2 picture)

Steps 2 count the number of fully filled squares in one group and not fully filled in another group.



Steps 3 calculate the area of the pattern by the formula

No of fully filled squares + half of No of squares not filled fully = average no. of squares covered and /or touched by the pattern's perimeter

The area of the square paper/graph paper is $1cm^2$ and no of fully filled squares = 39 and half of the no of squares not filled fully is (25/2) = 12.5

∴Net pattern area = area of graph paper (39+ 12.5)

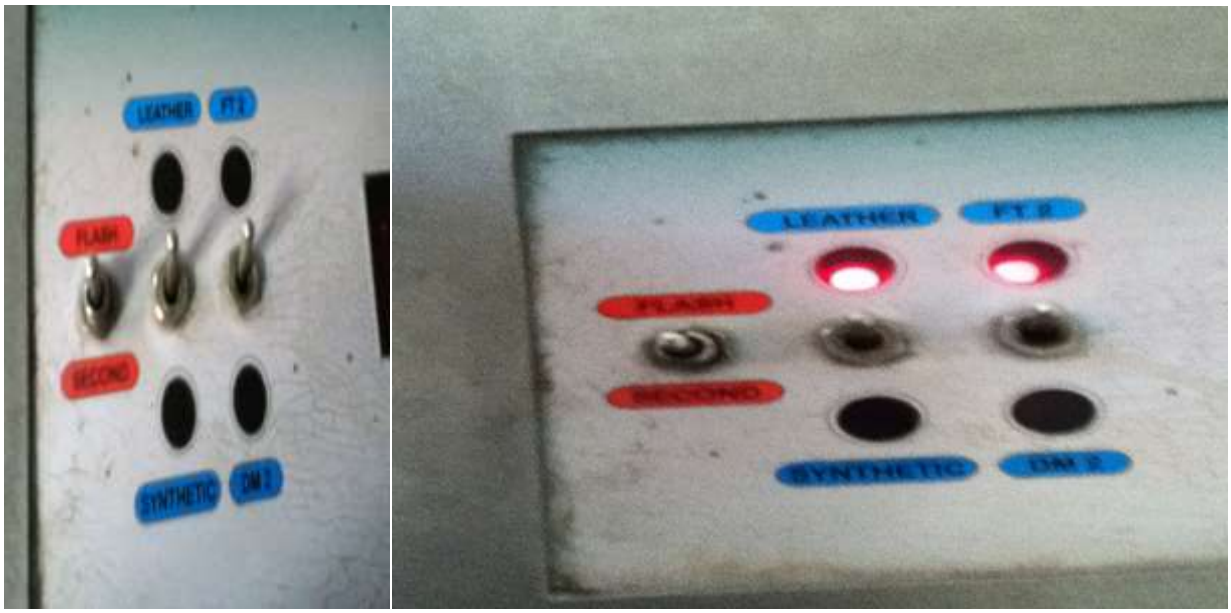
$= 1cm^2(39+ 12.5)$

$= \underline{51.5cm^2}$

Steps to finding net pattern square of the leather by using instrument

Steps 1 turn on the instrument

Steps 2 place the switch on the leather &feet square (sq.ft).



Steps 3 put the leather on the mirror of an instrument

Steps 4 move the scanner from left end to right end

Steps 5 read the result from the scanner

The measurement read 2.66ft^2

LAP Test	**Practical Demonstration**

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given answer sheet, workshop, square/graph paper & instrument and leather you are required to perform the following tasks within 3 hours.

Task 1: Clean the given tools and materials.

Task 2: Using the given paper, write the necessary steps to find the net area pattern

Task 3: perform each activity carefully and then put the result for each tools on the paper.

Task 4: compare the result getting by the two different measuring tools

References

Pedhazur, Elazar J.; Schmelkin, Liora Pedhazur (1991). Measurement, Design, and Analysis: An Integrated Approach (1st ed.). Hillsdale, NJ: Lawrence Erlbaum

Associates. pp. 15–29. ISBN 978-0-8058-1063-9. (PDF) (3rd ed.). International Bureau of Weights and Measures. 2008. p. 16.

C.S. Peirce (July 1879) "Note on the Progress of Experiments for Comparing a Wave-length with a Metre" American Journal of Science, as referenced by Crease 2011, p. 203