

MATHEMATICS NOTES

FORM 2 SIMPLIFIED TUTORIAL

QUICK REVISION NOTES

*An Updated Well-Organized Detailed Revision Notes for the
Current Form 2 Syllabus.*

SERIES 1

THIS IS A FREE SAMPLE OF THE
ORIGINAL NOTES

CONTACT US FOR FULL VERSION OF THE NOTES

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CUBES AND CUBE ROOTS

Specific Objectives

By the end of the topic the learner should be able to:

- a) Find the cube of a number by multiplication
- b) Find the cube root of a number by factor method
- c) Find cubes of numbers from mathematical tables
- d) Evaluate expressions involving cubes and cube roots
- e) Apply the knowledge of cubes and cube roots to real life situations

Content

- a.) Cubes of numbers by multiplication.
- b.) Cube roots of numbers by factor method.
- c.) Cubes from mathematical tables.
- d.) Expressions involving cubes and cube roots
- e.) Application of cubes and cube roots

Introduction

Cubes

The cube of a number is simply a number multiplied by itself three times e.g.

$$a \times a \times a = a^3$$

$$1 \times 1 \times 1 = 1^3;$$

$$8 = 2 \times 2 \times 2 = 2^3;$$

$$27 = 3 \times 3 \times 3 = 3^3;$$

Example 1

What is the value of 6^3 ?

$$\begin{aligned} 6^3 &= 6 \times 6 \times 6 \\ &= 36 \times 6 \\ &= 216 \end{aligned}$$

Example 2

Find the cube of 1.4

$$\begin{aligned} &= 1.4 \times 1.4 \times 1.4 \\ &= 1.96 \times 1.4 \\ &= 2.744 \end{aligned}$$

Use of tables to find roots

The cubes can be read directly from the tables just like squares and square root.

Cube Roots using factor methods

Cubes and cubes roots are opposite. The cube root of a number is the number that is multiplied by itself three times to get the given number

Example

The cube root of 64 is written as;

$$\sqrt[3]{64} = 4 \quad \text{Because } 4 \times 4 \times 4 = 64$$

$$\sqrt[3]{27} = 3 \quad \text{Because } 3 \times 3 \times 3 = 27$$

Example

Evaluate: $\sqrt[3]{216}$

$$= \sqrt[3]{(2 \times 2 \times 2 \times 3 \times 3 \times 3)}$$

$$= 2 \times 3$$

$$= 6$$

Note;

After grouping them into pairs of three you chose one number from the pair and multiply

Example

Find:

The volume of a cube is 1000 cm^3 . What is the length of the cube

Volume of the cube, $v = l^3$

$$L^3 = 1000$$

$$L = \sqrt[3]{1000}$$

$$= 10$$

The length of the cube is therefore 10 cm

CHAPTER TWENTY FIVE

RECIPROCAL

Specific Objectives

By the end of the topic the learner should be able to:

- a.) Find reciprocals of numbers by division
- b.) Find reciprocals of numbers from tables
- c.) Use reciprocals of numbers in computation.

Content

- a.) Reciprocals of numbers by division
- b.) Reciprocals of numbers from tables
- c.) Computation using reciprocals

Introduction

The reciprocal of a number is simply the number put in fraction form and turned upside down e.g., the reciprocal of 2.

Solution:

Change 2 into fraction form which is $\frac{2}{1}$,

Then turn it upside down and get $\frac{1}{2}$

Note:

When you multiply a number by its reciprocal you get 1,

$$\frac{2}{1} \times \frac{1}{2} = 1$$

Finding the reciprocal of decimals

Finding the reciprocal of a decimal can be done in a number of ways.

Change the decimal to a fraction first.

Example.

0.25 is 25/100 and is equivalent to the fraction 1/4. Therefore its reciprocal would be 4/1 or 4.

Keep the decimal and form the fraction 1/?? Which can then be or converted to a decimal.

Example

0.75 The reciprocal is 1/0.75. Using a calculator, the decimal form can be found by performing the operation: 1 divided by 0.75. The decimal reciprocal in this case is a repeating decimal, 1.3333.... After finding a reciprocal of a number, perform a quick check by multiplying your original number and the reciprocal to determine that the product.

Reciprocal of Numbers from Tables.

Reciprocal of numbers can be found using tables.

Example

Find the reciprocal of 2.456 using the reciprocal tables.

Solution.

Using reciprocal tables, the reciprocal of 2.456 is 0.4082 - 0.0010 = 0.4072

Example

Find the reciprocal of 45.8.

Solution

You first write 45.8 in standard form which is 4.58×10^1 .

$$\begin{aligned}\text{Then } \frac{1}{45.8} &= \frac{1}{4.58 \times 10^1} \\ &= \frac{1}{10} \times \frac{1}{4.58} \\ &= \frac{1}{10} \times 0.2183 \\ &= 0.02183\end{aligned}$$

Example

Find the reciprocal of 0.0236

Solution

Change 0.0236 in standard form which is 2.36×10^{-2}

$$\begin{aligned}\frac{1}{0.0236} &= \frac{1}{2.36 \times 10^{-2}} \\ &= \frac{1}{10^{-2}} \times \frac{1}{2.36} \\ &= 10^2 \times 0.4237 \\ &= 42.37\end{aligned}$$

Example

Use reciprocal tables to solve the following:

$$\frac{1}{0.0125} + \frac{1}{12.5}$$

Solution

Multiply the numerators by the reciprocal of denominators, then add them

$$1(\text{reciprocal } 0.0125) + 1(\text{reciprocal } 12.5)$$

Using tables find the reciprocals,

$$\begin{aligned}&= 1(80) + 1(0.08) \\ &= 80.08\end{aligned}$$

Example

$$\frac{4}{0.375} - \frac{3}{37.5}$$

Solution

$$\begin{aligned}&= 4(\text{rec } 0.375) - 3(37.5) \\ &= (4 \times 2.667) - (3 \times 0.026667) \\ &= 10.59\end{aligned}$$

CHAPTER TWENTY SIX

INDICES AND LOGARITHMS

Specific Objectives

By the end of the topic the learner should be able to:

- a.) Define indices (powers)
- b.) State the laws of indices
- c.) Apply the laws of indices in calculations
- d.) Relate the powers of 10 to common logarithms
- e.) Use the tables of common logarithms and anti-logarithms in computation.

Content

- a.) Indices (powers) and base
- b.) Laws of indices (including positive integers, negative integers and fractional indices)
- c.) Powers of 10 and common logarithms
- d.) Common logarithms:
 - ✓ characteristics
 - ✓ mantissa
- e.) Logarithm tables
- f.) Application of common logarithms in multiplication, division, powers and roots.

Introduction

Index and base form

The power to which a number is raised is called index or indices in plural.

$$2^5 = 2 \times 2 \times 2 \times 2 \times 2$$

5 is called the power or index while 2 two is the base.

$$100 = 10^2$$

2 is called the index and 10 is the base.

Laws of indices

For the laws to hold the base must be the same.

Rule 1

Any number, except zero whose index is 0 is always equal to 1

Example

$$5^0 = 1$$

$$10000000000000000^0 = 1$$

Rule 2

To multiply an expression with the same base, copy the base and add the indices.

$$a^m + a^n = a^{m+n}$$

Example

$$5^2 + 5^3 = 5^5$$

$$= 3125$$

Rule 3

To divide an expression with the same base, copy the base and subtract the powers.

$$a^m \div a^n = a^{m-n}$$

Example

$$9^5 \div 9^2 = 9^3$$

Rule 4

To raise an expression to the nth index, copy the base and multiply the indices

$$a^{mxn} = a^{mn}$$

Example

$$(5^3)^2 =$$

$$5^{3 \times 2} = 5^6$$

Rule 5

When dealing with a negative power, you simply change the power to positive by changing it into a fraction with 1 as the numerator.

$$a^{-m} = \frac{1}{a^m}$$

Example

$$2^{-2} = \frac{1}{2^2}$$

$$= \frac{1}{4}$$

Example

Evaluate:

a.) $2^3 \times 2^{-3} = 2^{(3+(-3))}$

$$= 2^0$$

$$= 1$$

b.) $\left(\frac{2}{3}\right)^{-2} = \left(\frac{1}{\frac{2}{3}}\right)^2$

$$= \left(\frac{3}{2}\right)^2$$

$$= 1 \div \frac{4}{9}$$

$$= 1 \times \frac{9}{4} = 2\frac{1}{4}$$

$$\text{or } \left(\frac{2}{3}\right)^{-2} = \left(\frac{3}{2}\right)^2 \text{ squared} = \frac{9}{4}$$

Fractional indices

Fractional indices are written in fraction form. In summary if $a^n = b$, a is called the n^{th} root of b written as $\sqrt[n]{b}$.

Example

$$27^{\frac{1}{3}} = \sqrt[3]{27} \quad 16^{\frac{3}{4}} = (\sqrt[4]{16})^3 = 2^3 = 8$$

$$= 3$$

$$4^{-\frac{1}{2}} = \frac{1}{4^{\frac{1}{2}}} = \frac{1}{\sqrt{4}}$$

LOGARITHM

Logarithm is the power to which a fixed number (the base) must be raised to produce a given number. In summary the expression $a^m = n$ is written as $\log_a n = m$.

$a^m = n$ is the index notation while $\log_a n = m$ is the logarithm notation.

Examples

Index notation	Logarithm form
$2^2 = 4$	$\log_2 4 = 2$
$9^{\frac{1}{2}} = 3$	$\log_9 3 = \frac{1}{2}$
$b^n = m$	$\log_b m = n$

Reading logarithms from the tables is the same as reading squares square roots and reciprocals. We can read logarithms of numbers between 1 and 10 directly from the table. For numbers greater than 10 we proceed as follows:

Express the number in standard form, $A \times 10^n$. Then n will be the whole number part of the logarithms. Read the logarithm of A from the tables, which gives the decimal part of the logarithm. Then add it to n which is the power of 10 to form the positive part of the logarithm.

Example

Find the logarithm of:

379

Solution

379

$$= 3.79 \times 10^2$$

$$\log 3.79 = 0.5786$$

Therefore the logarithm of 379 is $2 + 0.5786 = 2.5786$

The

whole number part of the logarithm is called the characteristic and the decimal part is the mantissa.

Logarithms of Positive Numbers less than 1

Example

Log to base 10 of 0.034

We proceed as follows:

Express 0.034 in standard form, i.e., $A \times 10^n$.

Read the logarithm of A and add to n

Thus $0.034 = 3.4 \times 10^{-2}$

Log 3.4 from the tables is 0.5315

Hence $3.4 \times 10^{-2} = 10^{0.5315} \times 10^{-2}$

Using laws of indices add $0.5315 + -2$ which is written as $\bar{2}.5315$.

It reads bar two point five three one five. The negative sign is written directly above two to show that it's only the characteristic is negative.

Example

Find the logarithm of:

0.00063

Solution

$$\begin{aligned}
 &= 6.3 \times 10^{-3} \text{ (Find the logarithm of } 6.3) \\
 &= 10^{0.7993} \times 10^{-3} \\
 &= 10^{-3} + 0.7993 \\
 &= \bar{3}.7993
 \end{aligned}$$

ANTILOGARITHMS

Finding antilogarithm is the reverse of finding the logarithms of a number. For example the logarithm of 1000 to base 10 is 3. So the antilogarithm of 3 is 1000. In algebraic notation, if

$\log x = y$ then $\text{antilog of } y = x$.

Example

Find the antilogarithm of $\bar{2}.3031$

Solution

Let the number be x

$$\begin{aligned}
 X &= 10^{\bar{2}.3031} \\
 &= 10^{-2+0.3031} \\
 &= 10^{-2} \times 10^{0.3031} \text{ (Find the antilog, press shift and log then key in the number)} \\
 &= 10^{-2} \times 2.01 \\
 &= \frac{1}{100} \times 2.01
 \end{aligned}$$

$$\begin{aligned} &= \frac{2.01}{100} \\ &= 0.0201 \end{aligned}$$

Example

Use logarithm tables to evaluate:

Number	Standard form	logarithm
456	4.56×10^2	2.6590
398	3.98×10^2	2.5999
5.2589 + 		
271	2.71×10^2	2.4330
6.697 $\times 10^2$ ← 2.8259 = 669.7		

To find the exact number find the antilog of 2.8259 by letting the characteristic part to be the power of ten then finding the antilog of 0.8259

Example

Operations involving bar

Evaluate $\frac{415.2 \times 0.0761}{135}$

Solution

Number	logarithm
415.2	2.6182
0.0761	<u>$\bar{2}.8814$</u> +
	1.4996
135	2.1303 –
2.341×10^{-1}	$\bar{1}.3693$
0.2341	

Example

$$\begin{aligned} \sqrt{0.945} &= (9.45 \times 10^{-1})^{\frac{1}{2}} \\ &= (10^{\bar{1}.9754 \times \frac{1}{2}}) \end{aligned}$$

Note;

In order to divide $\bar{1}.9754$ by 2, we write the logarithm in search away that the characteristic is exactly divisible by 2. If we are looking for the n^{th} root, we arrange the characteristic to be exactly divisible by n)

$$\begin{aligned}\bar{1}.9754 &= -1 + 0.9754 \\ &= -2 + 1.9754\end{aligned}$$

$$\begin{aligned}\text{Therefore, } \frac{1}{2}(\bar{1}.9754) &= \frac{1}{2}(-2 + 1.9754) \\ &= -1 + 0.9877 \\ &= \bar{1}.9877\end{aligned}$$

Find the antilog of $\bar{1}.9877$ by writing the mantissa as power of 10 and then find the antilog of characteristic.

$$\begin{aligned}&= 9.720 \times 10^{-1} \\ &= 0.9720\end{aligned}$$

Example

$$\begin{aligned}&\sqrt[3]{0.0618} \\ \hline \text{Number} & \qquad \qquad \text{logarithm} \\ & \sqrt[3]{0.0618} \bar{2}.7910 \times \frac{1}{3} \\ &= (\bar{3} + 1.7910) \times \frac{1}{3} \\ & \qquad \qquad \qquad 3.954 \times 10^{-1} = \bar{1}.5970 \text{ (find the antilog)} \\ & \qquad \qquad \qquad 0.3954\end{aligned}$$

Past KCSE Questions on the cubes, cubes roots, Reciprocals indices and logarithms.

1. Use logarithms to evaluate

$$\begin{array}{r} 3 \overline{) 36.15 \times 0.02573} \\ \underline{1,938} \end{array}$$

2. Find the value of x which satisfies the equation.

$$16^{x^2} = 8^{4x-3}$$

3. Use logarithms to evaluate $\frac{(1934)^2 \times \sqrt{0.00324}}{436}$

4. Use logarithms to evaluate

$$55.9 \div (0.2621 \times 0.01177)^{1/5}$$

5. Simplify $2^x \times 5^{2x} \div 2^{-x}$

6. Use logarithms to evaluate

$$(3.256 \times 0.0536)^{1/3}$$

7. Solve for x in the equation

$$32^{(x-3)} \div 8^{(x-4)} = 64 \div 2^x$$

8. Solve for x in the equations $81^{2x} \times 27^x = 729$

$$9^x$$

9. Use reciprocal and square tables to evaluate to 4 significant figures, the expression:

$$\frac{1}{\left(\frac{4.346^2}{24.56} \right)}$$

10. Use logarithm tables, to evaluate

$$\frac{0.032 \times 14.26^{2/3}}{0.006}$$

11. Find the value of x in the following equation

$$49^{(x+1)} + 7^{(2x)} = 350$$

12. Use logarithms to evaluate

$$(0.07284)^2$$

$$3\sqrt{0.06195}$$

13. Find the value of m in the following equation

$$(1/27^m \times (81)^{-1}) = 243$$

14. Given that $P = 3^y$ express the equation $3^{(2y-1)} + 2 \times 3^{(y-1)} = 1$ in terms of P hence or otherwise find the value of y in the equation $3^{(2y-1)} + 2 \times 3^{(y-1)} = 1$

15. Use logarithms to evaluate $55.9 \div (0.2621 \times 0.01177)^{1/5}$

16. Use logarithms to evaluate

$$\left(\frac{6.79 \times 0.3911^{3/4}}{\text{Log } 5} \right)$$

17. Use logarithms to evaluate

$$\frac{3}{79.54} \sqrt{1.23 \times 0.0089}$$

18. Solve for x in the equation

$$X = \frac{0.0056^{1/2}}{1.38 \times 27.42}$$

CHAPTER TWENTY SEVEN

GRADIENT AND EQUATIONS OF STRAIGHT LINES

Specific Objectives

By the end of the topic the learner should be able to:

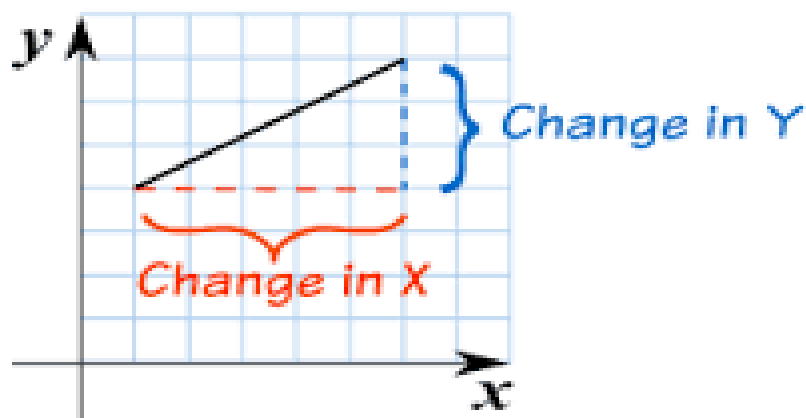
- a.) Define gradient of a straight line
- b.) Determine the gradient of a straight line through known points
- c.) Determine the equation of a straight line using gradient and one known point
- d.) Express a straight line equation in the form $y = mx + c$
- e.) Interpret the equation $y = mx + c$
- f.) Find the x- and y- intercepts from an equation of a line
- g.) Draw the graph of a straight line using gradient and x- and y- intercepts
- h.) State the relationship of gradients of perpendicular lines
- i.) State the relationship of gradients of parallel lines
- j.) Apply the relationship of gradients of perpendicular and parallel lines to get equations of straight lines.

Content

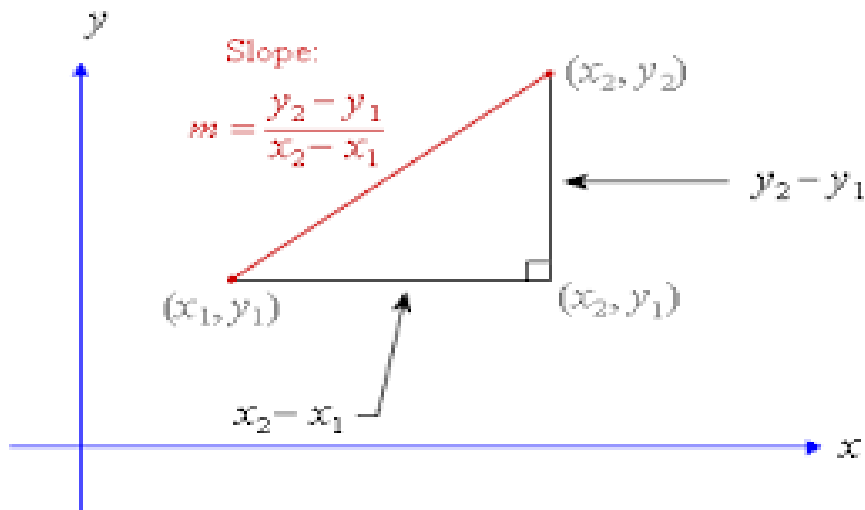
- a.) Gradient of a straight line
- b.) Equation of a straight line
- c.) The equation of a straight line of the form $y = mx + c$
- d.) The x and y intercepts of a line
- e.) The graph of a straight line
- f.) Perpendicular lines and their gradient
- g.) Parallel lines and their gradients
- h.) Equations of parallel and perpendicular lines.

Gradient

The steepness or slope of an area is called the gradient. Gradient is the change in y axis over the change in x axis.



$$\frac{\text{change in } y \text{ co-ordinates}}{\text{change in } x \text{ co-ordinates}} = \frac{y_2 - y_1}{x_2 - x_1}$$



Note:

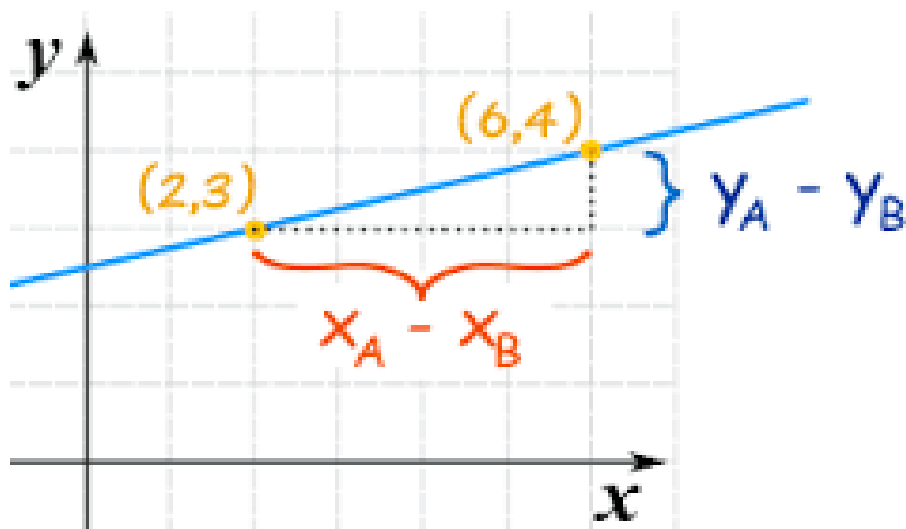
If an increase in the x co-ordinates also causes an increase in the y co-ordinates the gradient is positive.
 If an increase in the x co-ordinates causes a decrease in the value of the y co-ordinate, the gradient is negative.

If, for an increase in the x co-ordinate, there is no change in the value of the y co-ordinate, the gradient is zero.

For vertical line, the gradient is not defined.

Example

Find the gradient.



Solution

$$\text{Gradient} = \frac{\text{change in } y \text{ axis}}{\text{change in } x \text{ axis}}$$

$$= \frac{4 - 3}{6 - 2}$$

$$= \frac{1}{4}$$

Equation of a straight line.

Given two points

Example.

Find the equation of the line through the points A (1, 3) and B (2, 8)

Solution

The gradient of the required line is $\frac{8-3}{2-1} = 5$

Take any point p (x, y) on the line. Using... points P and A, the gradient is $\frac{y-3}{x-1}$

Therefore $\frac{y-3}{x-1} = 5$

Hence $y = 5x - 2$

Given the gradient and one point on the line

Example

Determine the equation of a line with gradient 3, passing through the point (1, 5).

Solution

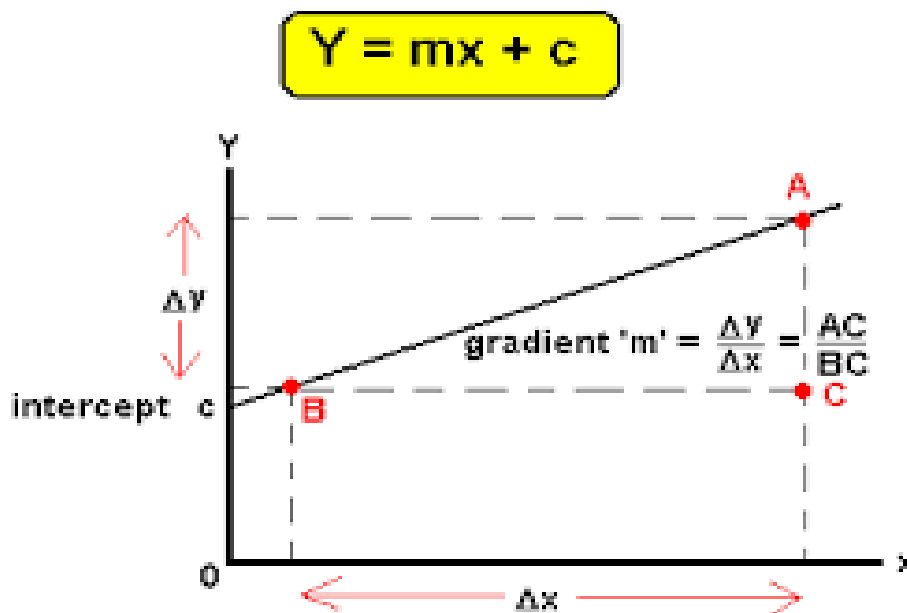
Let the line pass through a general point (x, y). The gradient of the line is $\frac{y-5}{x-1} = 3$

Hence the equation of the line is $y = 3x + 2$

We can express linear equation in the form $y = mx + c$.

Illustrations.

For example $4x + 3y = -8$ is equivalent to $y = -\frac{4}{3}x - \frac{8}{3}$. In the linear equation below gradient is equal to m while c is the y intercept.



Using the above statement we can easily get the gradient.

Example

Find the gradient of the line whose equation is $3y - 6x + 7 = 0$

Solution

Write the equation in the form of $y = mx + c$

$$3y = 6x - 7$$

$$y = 2x - \frac{7}{3}$$

$M = 2$ and also gradient is 2.

The y- intercept

The y – intercept of a line is the value of y at the point where the line crosses the y axis. Which is C in the above figure. The x –intercept of a graph is that value of x where the graph crosses the x axis. To find the x intercept we must find the value of y when $x = 0$ because at every point on the y axis $x = 0$. The same is true for y intercept.

Example

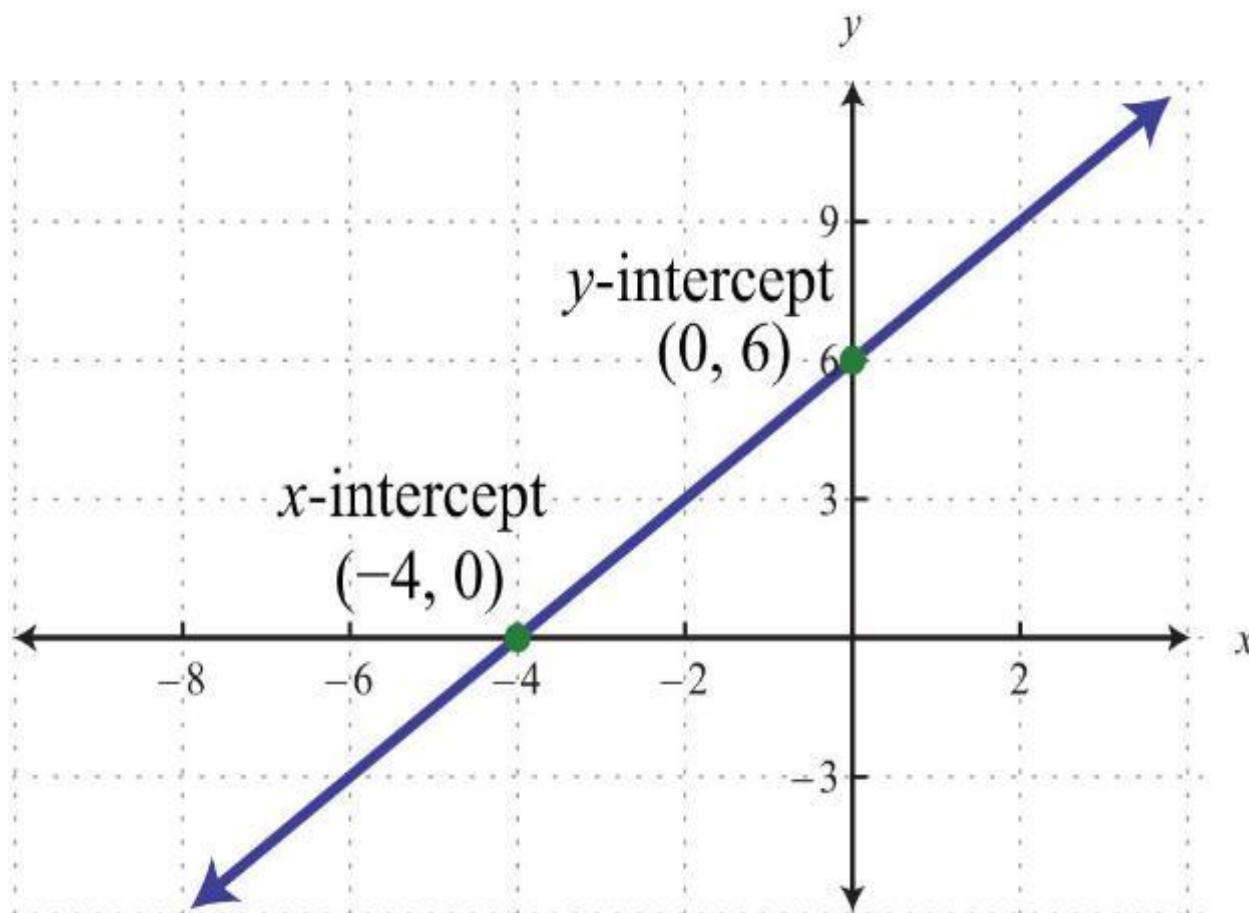
Find the y intercept $y = 2x + 10$ on putting $y = 0$ we have to solve this equation.

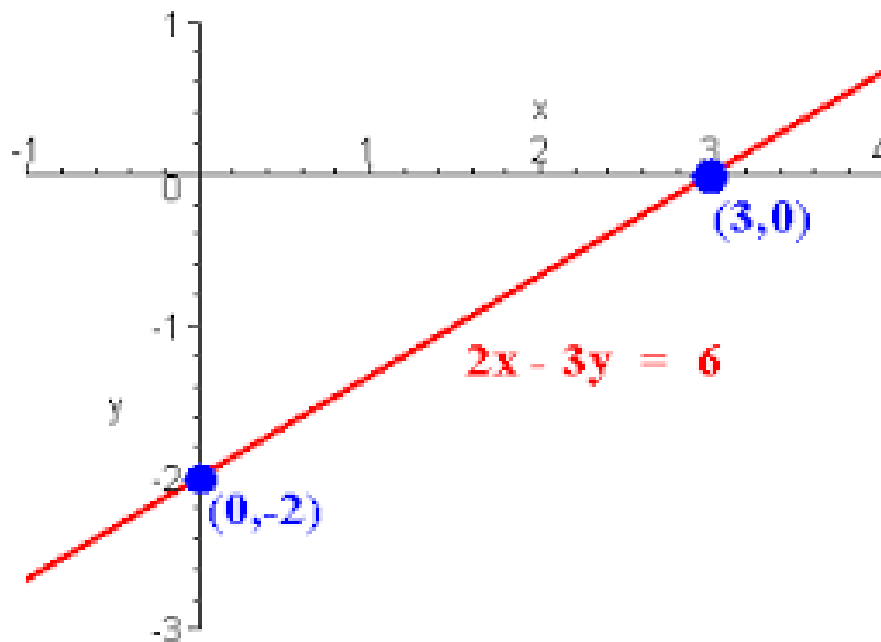
$$2x + 10 = 0$$

$$2x = -10$$

$$X = -5$$

X intercept is equal to -5 .





Perpendicular lines

If the products of the gradient of the two lines is equal to -1 , then the two lines are equal to each other.

Example

Find if the two lines are perpendicular

$$y = \frac{1}{3}x + 1 \quad y = -3x - 2$$

Solution

The gradients are

$$M = \frac{1}{3} \text{ and } M = -3$$

The product is

$$\frac{1}{3} \times -3 = -1$$

The answer is -1 hence they are perpendicular.

Example

$$Y = 2x + 7$$

$$Y = -2x + 5$$

The products are $2 \times -2 = -4$ hence the two lines are not perpendicular.

Parallel lines

Parallel lines have the same gradients e.g.

$$y = 2x + 7$$

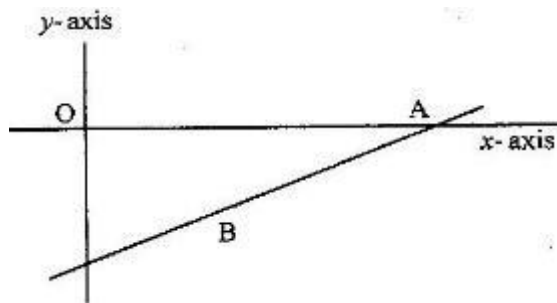
$$y = 2x - 9$$

Both lines have the same gradient which is 2 hence they are parallel

End of topic

Past KCSE Questions on the topic

1. The coordinates of the points P and Q are (1, -2) and (4, 10) respectively.
A point T divides the line PQ in the ratio 2: 1
 - (a) Determine the coordinates of T
 - (b)
 - (i) Find the gradient of a line perpendicular to PQ
 - (ii) Hence determine the equation of the line perpendicular PQ and passing through T
 - (iii) If the line meets the y- axis at R, calculate the distance TR, to three significant figures
2. A line L_1 passes through point (1, 2) and has a gradient of 5. Another line L_2 , is perpendicular to L_1 and meets it at a point where $x = 4$. Find the equation for L_2 in the form of $y = mx + c$
3. P (5, -4) and Q (-1, 2) are points on a straight line. Find the equation of the perpendicular bisector of PQ: giving the answer in the form $y = mx + c$.
4. On the diagram below, the line whose equation is $7y - 3x + 30 = 0$ passes through the points A and B. Point A on the x-axis while point B is equidistant from x and y axes.



Calculate the co-ordinates of the points A and B

5. A line with gradient of -3 passes through the points (3, k) and (k, 8). Find the value of k and hence express the equation of the line in the form $ax + by = c$, where a, b, and c are constants.
6. Find the equation of a straight line which is equidistant from the points (2, 3) and (6, 1), expressing it in the form $ax + by = c$ where a, b and c are constants.
7. The equation of a line $-\frac{3}{5}x + 3y = 6$. Find the:
 - (a) Gradient of the line (1 mk)
 - (b) Equation of a line passing through point (1, 2) and perpendicular to the given line
8. Find the equation of the perpendicular to the line $x + 2y = 4$ and passes through point (2, 1)
9. Find the equation of the line which passes through the points P (3, 7) and Q (6, 1)
10. Find the equation of the line whose x- intercept is -2 and y- intercept is 5
11. Find the gradient and y- intercept of the line whose equation is $4x - 3y - 9 = 0$

CHAPTER TWENTY EIGHT

REFLECTION AND CONGRUENCE

Specific Objectives

By the end of the topic the learner should be able to:

- a.) State the properties of reflection as a transformation
- b.) Use the properties of reflection in construction and identification of images and objects
- c.) Make geometrical deductions using reflection
- d.) Apply reflection in the Cartesian plane
- e.) Distinguish between direct and opposite congruence
- f.) Identify congruent triangles.

Content

- a.) Lines and planes of symmetry
- b.) Mirror lines and construction of objects and images
- c.) Reflection as a transformation
- d.) Reflection in the Cartesian plane
- e.) Direct and opposite congruency
- f.) Congruency tests (SSS, SAS, AAS, ASA and RHS)

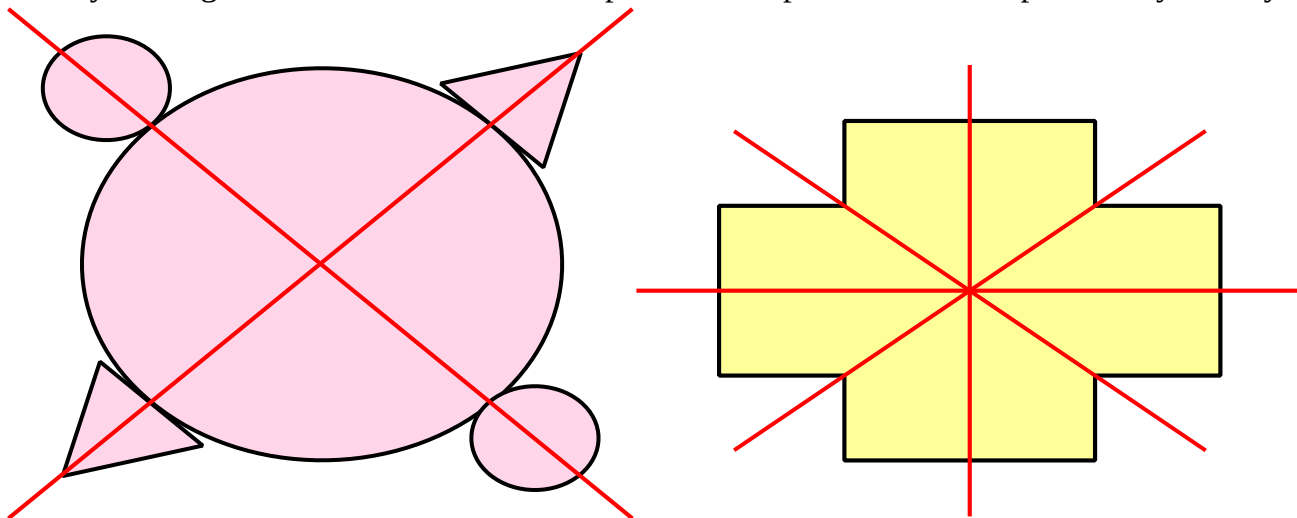
Introduction

The process of changing the position, direction or size of a figure to form a new figure is called **transformation**.

Reflection and congruence

Symmetry

Symmetry is when one shape becomes exactly like another if you turn, slide or cut them into two identical parts. The lines which divides a figure into two identical parts are called lines of symmetry. If a figure is cut into two identical parts the cut part is called the plane of symmetry.



How many planes of symmetry does the above figures have?

There are two types of symmetry. Reflection and Rotational.

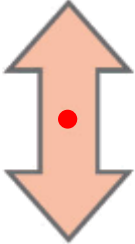
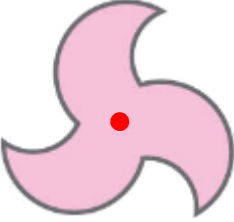
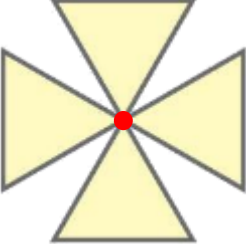
Reflection

A transformation of a figure in which each point is replaced by a point symmetric with respect to a line or plane e.g. mirror line.

Properties preserved under reflection

- ✓ Midpoints always remain the same.
- ✓ Angle measures remain the same i.e. the line joining a point and its image is perpendicular to the mirror line.
- ✓ A point on the object and a corresponding point on the image are equidistant from the mirror line.

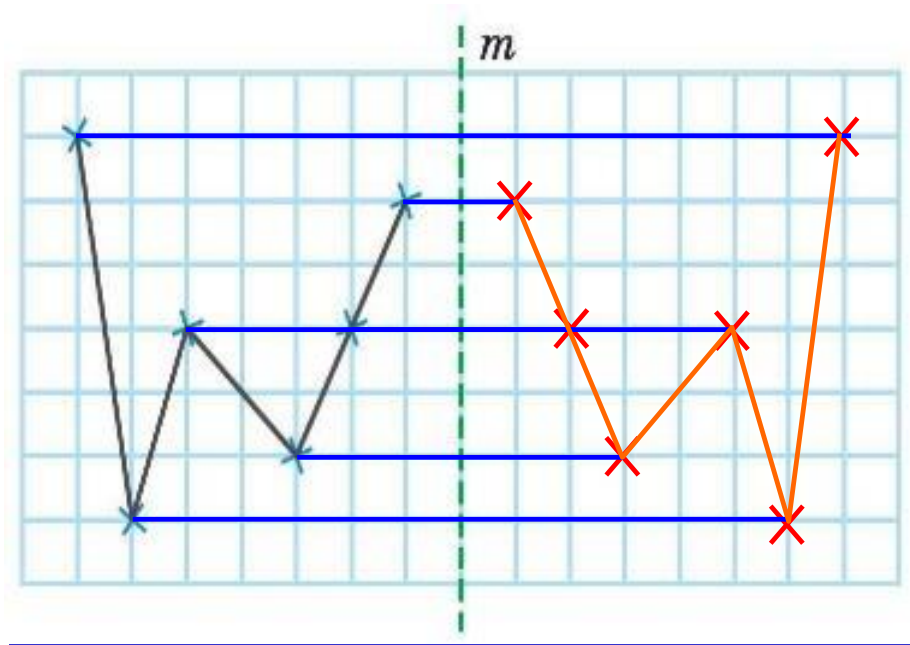
A mirror line is a line of symmetry between an object and its image.

(a) <i>Figures that have rotational symmetry</i>				
b) <i>Order of rotational symmetry</i>	2	3	4	5

Examples

To reflect an object you draw the same points of the object but on opposite side of the mirror. They must be equidistant from each other.

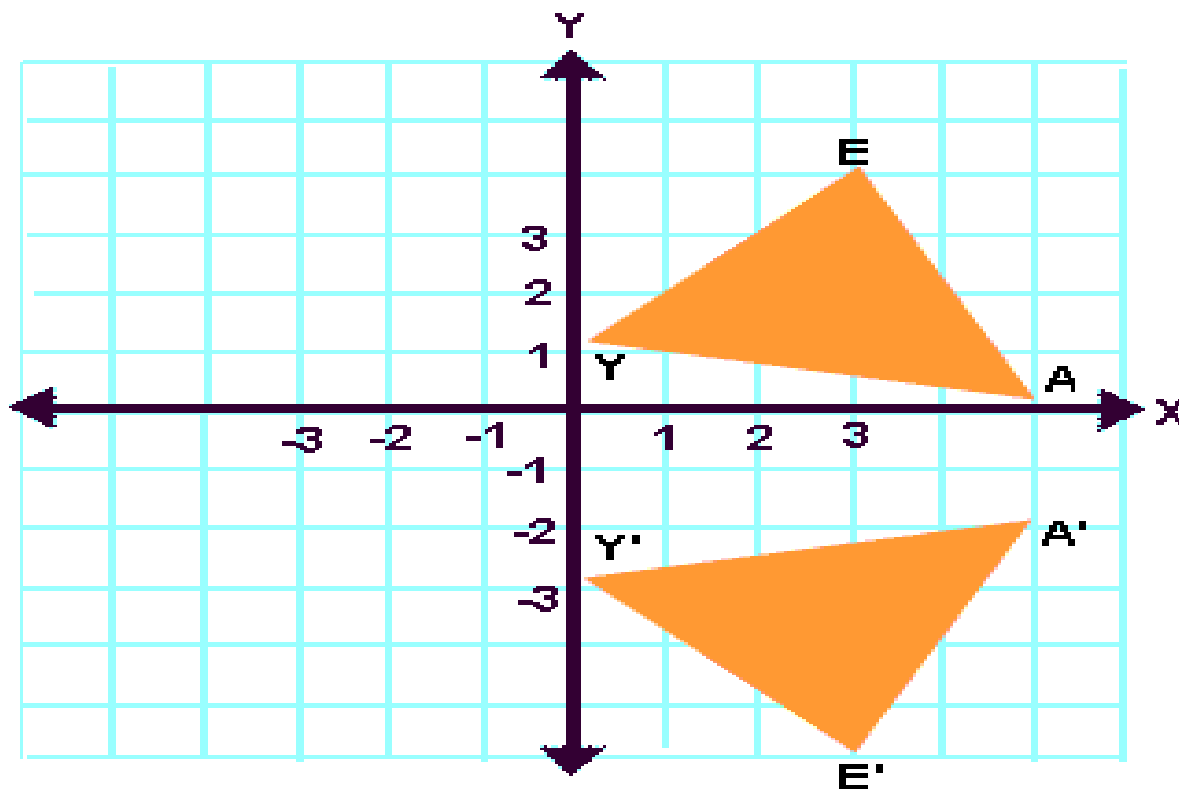
Solution

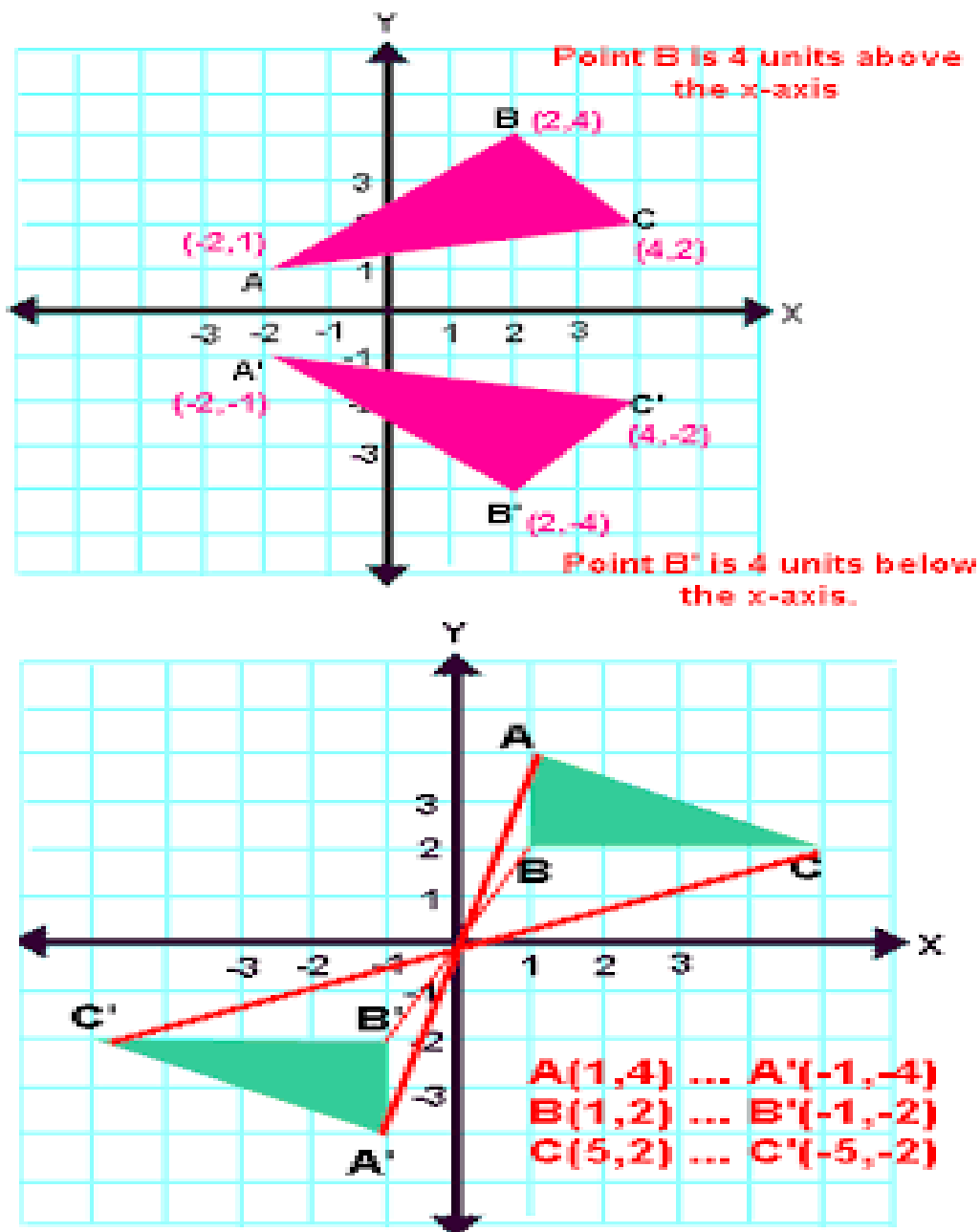


Exercise

Find the mirror line or the line of symmetry.

To find the mirror line, join the points on the object and image together then bisect the lines perpendicularly. The perpendicular bisector gives us the mirror line.





Congruence

Figures with the same size and same shape are said to be congruent. If a figure fits into another directly it is said to be directly congruent.

If a figure only fits into another after it has been turned then it's called opposite congruent or indirect congruence.

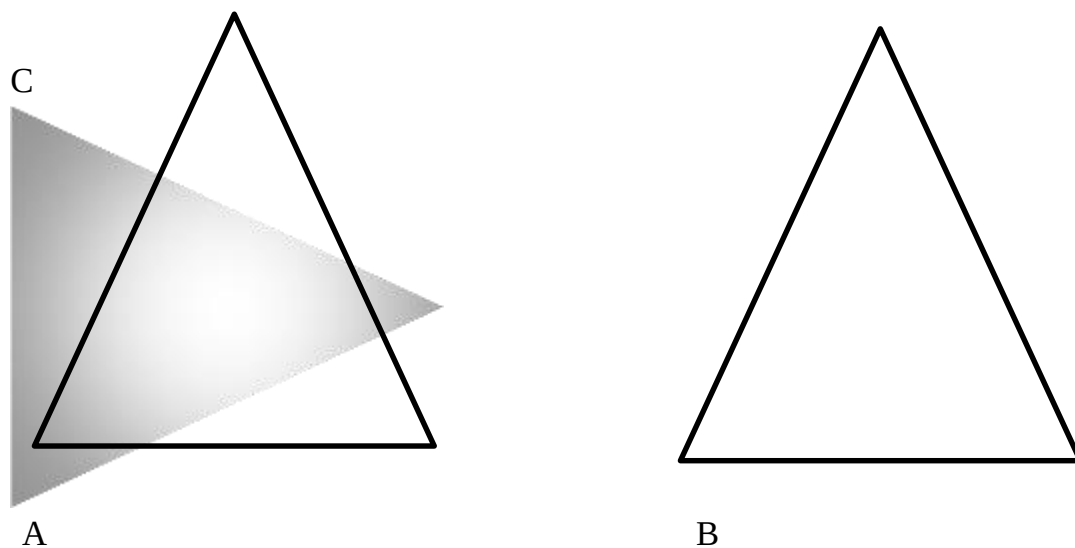


Figure A and B are directly congruent while C is oppositely or indirectly congruent because it only fits into A after it has been turned.

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CHAPTER TWENTY NINE

ROTATION

Specific Objective

By the end of the topic the learner should be able to:

- a.) State properties of rotation as a transformation
- b.) Determine centre and angle of rotation
- c.) Apply properties of rotation in the Cartesian plane
- d.) Identify point of rotational symmetry
- e.) State order of rotational symmetry of plane figure
- f.) Identify axis of rotational symmetry of solids
- g.) State order of rotational symmetry of solids
- h.) Deduce congruence from rotation.

Content

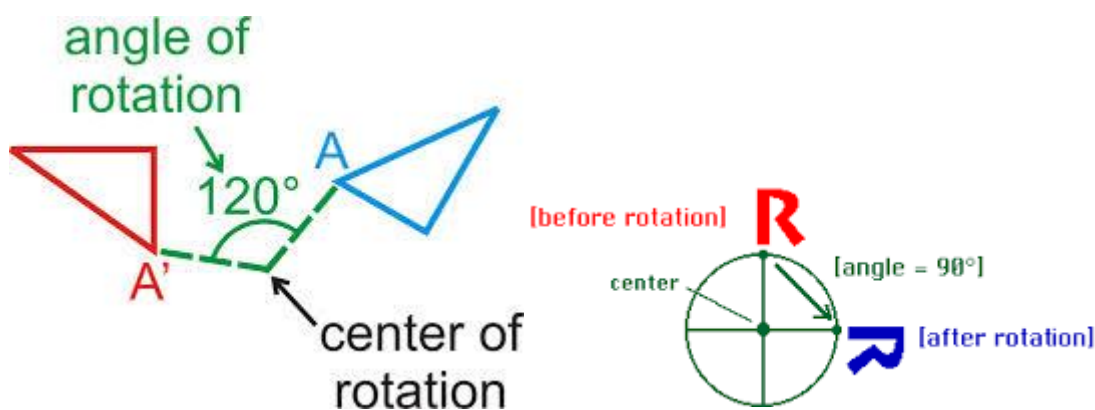
- a.) Properties of rotation
- b.) Centre and angle of rotation
- c.) Rotation in the cartesian plane
- d.) Rotational symmetry of plane figures and solids (point axis and order)
- e.) Congruence and rotation

Introduction

A transformation in which a plane figure turns around a fixed center point called center of rotation. A rotation in the anticlockwise direction is taken to be positive whereas a rotation in the clockwise direction is taken to be negative.

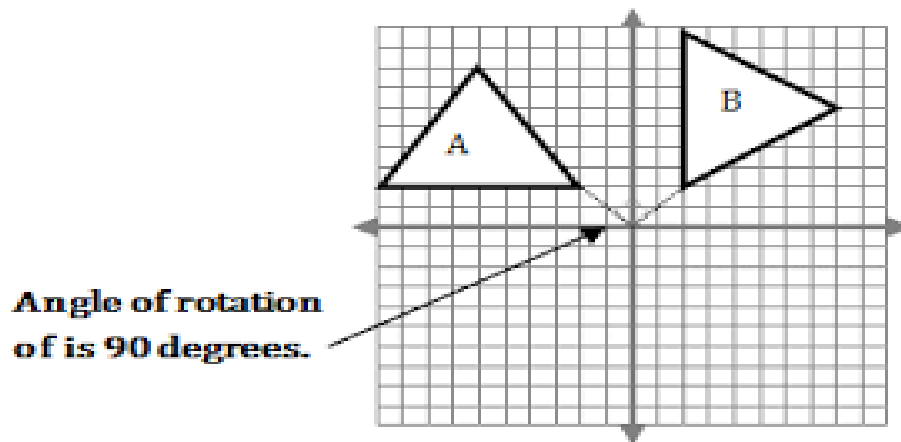
For example a rotation of 90° clockwise is taken to be negative. -90° while a rotation of anticlockwise 90° is taken to be $+90^\circ$.

For a rotation to be completely defined the center and the angle of rotation must be stated.



Illustration

To rotate triangle A through the origin ,angle of rotation $+1/4$ turn.



Draw a line from each point to the center of rotation ,in this case it's the origin. Measure 90° from the object using the protractor and make sure the base line of the protractor is on the same line as the line from the point of the object to the center. The 0 mark should start from the object.

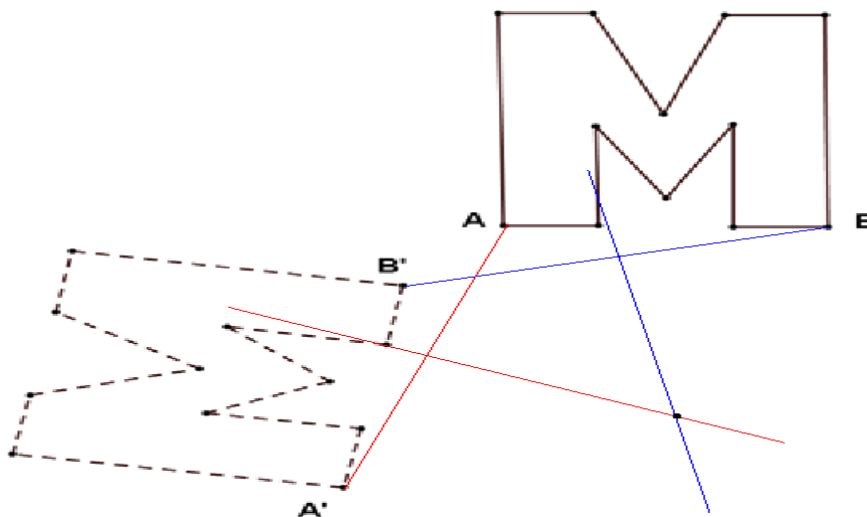
Mark 90° and draw a straight line to the center joining the lines at the origin. The distance from the point of the object to the center should be the same distance as the line you drew. This gives you the image point

The distance between the object point and the image point under rotation should be the same as the center of rotation in this case 90°

Illustration.

To find the center of rotation.

- ✓ Draw a segment connecting point's **A** and **A'**
- ✓ Using a compass, find the perpendicular bisector of this line.
- ✓ Draw a segment connecting point's **B** and **B'**. Find the perpendicular bisector of this segment.
- ✓ The point of intersection of the two perpendicular bisectors is the center of rotation. Label this point **P**.



Justify your construction by measuring angles $\angle APA'$ and $\angle BPB'$. Did you obtain the same measure? The angle between is the angle of rotation. The zero mark of protector should be on the object to give you the direction of rotation.

Rotational symmetry of plane figures

The number of times the figure fits onto itself in one complete turn is called the order of rotational symmetry.

Note;

The order of rotational symmetry of a figure = $360 / \text{angle between two identical parts of the figure}$.
Rotational symmetry is also called point symmetry. Rotation preserves length, angles and area, and the object and its image are directly congruent.

End of topic

CHAPTER THIRTY

SIMILARITY AND ENLARGEMENT

NOTE!

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