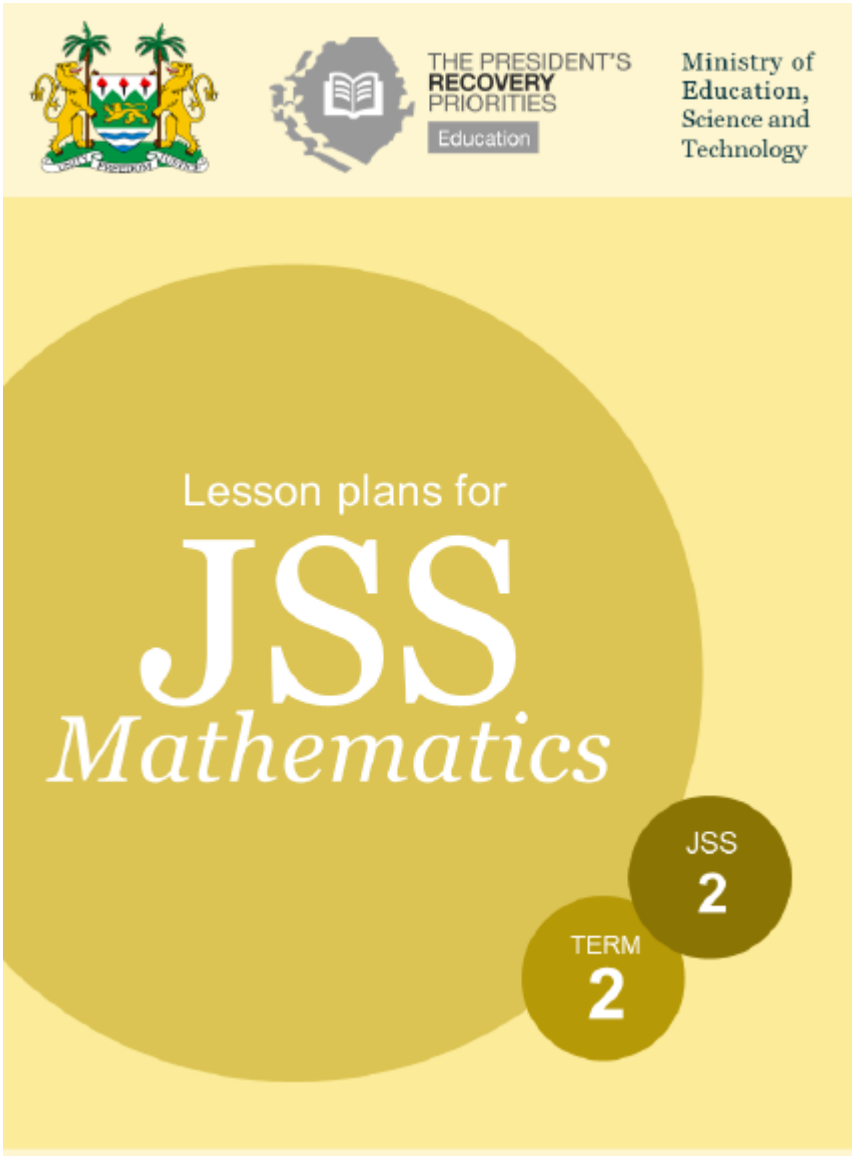
Sierra Leone Mathematics

JSS2 Topic Concept Charts (to support JSS3 pupils) TERM 2



Sierra Leone Mathematics

JSS2 Topic Concept Charts (to support JSS3 pupils) TERM 2

JSS3 Term 2	JSS2 resources for JSS3
Lessons 46 – 49 (JSS3 PHB) Transformations and congruency **Lessons 50 – 55** (JSS3 PHB) Transformations, congruency and similarity	**Topic 9: Transformations** Term 2, Lessons 91 – 98 (JSS2 PHB) Transformations: translation, reflection, rotation; Line symmetry, rotational symmetry; Enlargement Combining transformations
	Term 2, Lessons 99 – 100 (JSS2 PHB) Scale factor (included in Topic 11)
Lessons 56 – 59 (JSS3 PHB) Introduction to trigonometry	*Refer to revision of triangles*
Lessons 60 – 65 (JSS3 PHB) Continued Trigonometry	
Lessons 66 (JSS3 PHB) Changing the subject of the formula **Lessons 67 – 74** (JSS3 PHB) Algebra and linear equations **Lessons 75 – 78** (JSS3 PHB) Quadratic equations **Lessons 79 – 81** (JSS3 PHB) Factors and factorising **Lessons 82 – 85** (JSS3 PHB) More factorising and quadratics **Lessons 86 – 92** (JSS3 PHB) Linear equations in two variables	**Topic 10: Algebraic expressions** **Topic 11: Factorising and substitution** **Topic 12: Linear equations** Term 3, Lessons 116 – 120 (JSS2 PHB) Algebra (expand, factorise, substitute) Lessons 121 – 130 (JSS2 PHB)
Lessons 93 – 94 (JSS3 PHB) Table of values **Lessons 95 – 97** (JSS3 PHB) Cartesian plane **Lessons 98 – 100** (JSS3 PHB) Graphing a line **Lessons 101 – 105** (JSS3 PHB) Slope of a line	**Topic 13: Cartesian Plane** Term 3, Lessons 131 – 135 (JSS2 PHB)

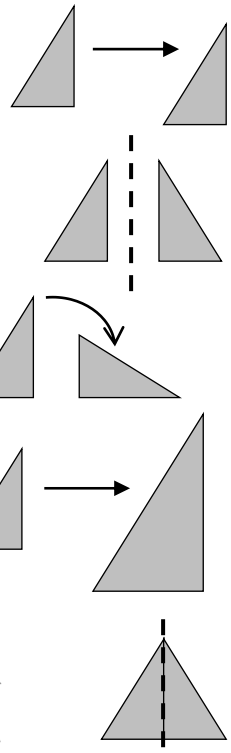
Topic 9: Transformations M-08-091 to M-08-100 p98 – 127

Check that you can:	**Do you understand these words?**
work with shapes on the Cartesian plane	translate, rotate, reflect, enlarge; translation, rotation, reflection, line symmetry, rotational symmetry, enlargement; scale factor.

Refer to JSS2 Term 2

CONCEPTS:

Transformations of shapes are ways of changing their position, or their orientation or their size. Only enlargement changes the size of the shape.



*** Translation:** To move a point or shape in any direction, but keep the same shape in the same orientation (no turning).

*** Reflection:** A shape reflected across a mirror line.
The distance between the reflected shape and the mirror line is the same as between the original shape and the mirror line.

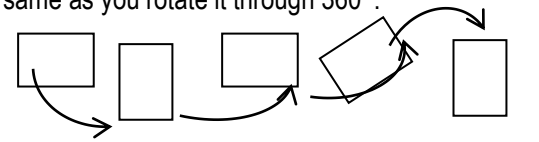
*** Rotation:** Moves or turns a shape around a fixed point, without changing its size.

*** Enlargement:** The size of the shape is changed (made bigger or smaller), but keeps the same shape.
A **scale factor** is used to enlarge dimensions.

*** Symmetry:** A line of symmetry divides a shape into two identical halves.
The two halves are mirror images of each other.
If you fold a shape on the line of symmetry,
The two halves will fit exactly on top of each other.

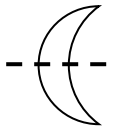
Transformations can also be done on a Cartesian plane.

*** Rotational symmetry:** A shape has rotational symmetry if it looks exactly the same after being rotated.
The **order** of rotation is the number of times it looks the same as you rotate it through 360°.



The rectangle has a rotational symmetry order of 2.

Examples: The original shape below is
- **reflected** over the y-axis to create shape **a**
- **translated** to create shape **b**
- **rotated** around the origin to create shape **c**
- no rotational symmetry
- one line of symmetry

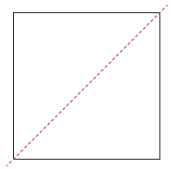


Topic 9: Transformations

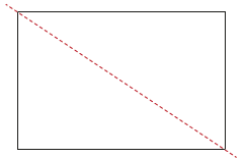
Exercise

1. In each diagram, is the dotted line a line of symmetry? If it is not, draw a line of symmetry if this is possible.

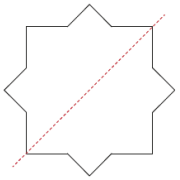
a)



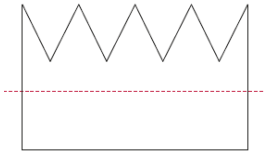
b)



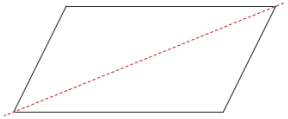
c)



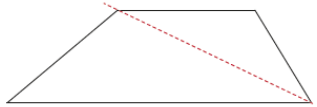
d)



e)

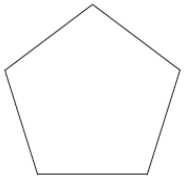


f)

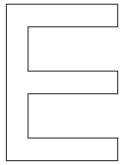


2. Draw all the lines of symmetry for each shape.

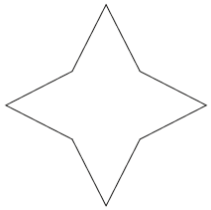
a)



b)

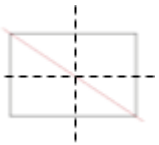


c)



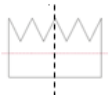
Check your answers:

1. a) yes b) no.



c) yes

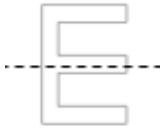
d) no

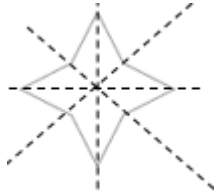


e) no. No lines of symmetry.

f) no. No lines of symmetry.

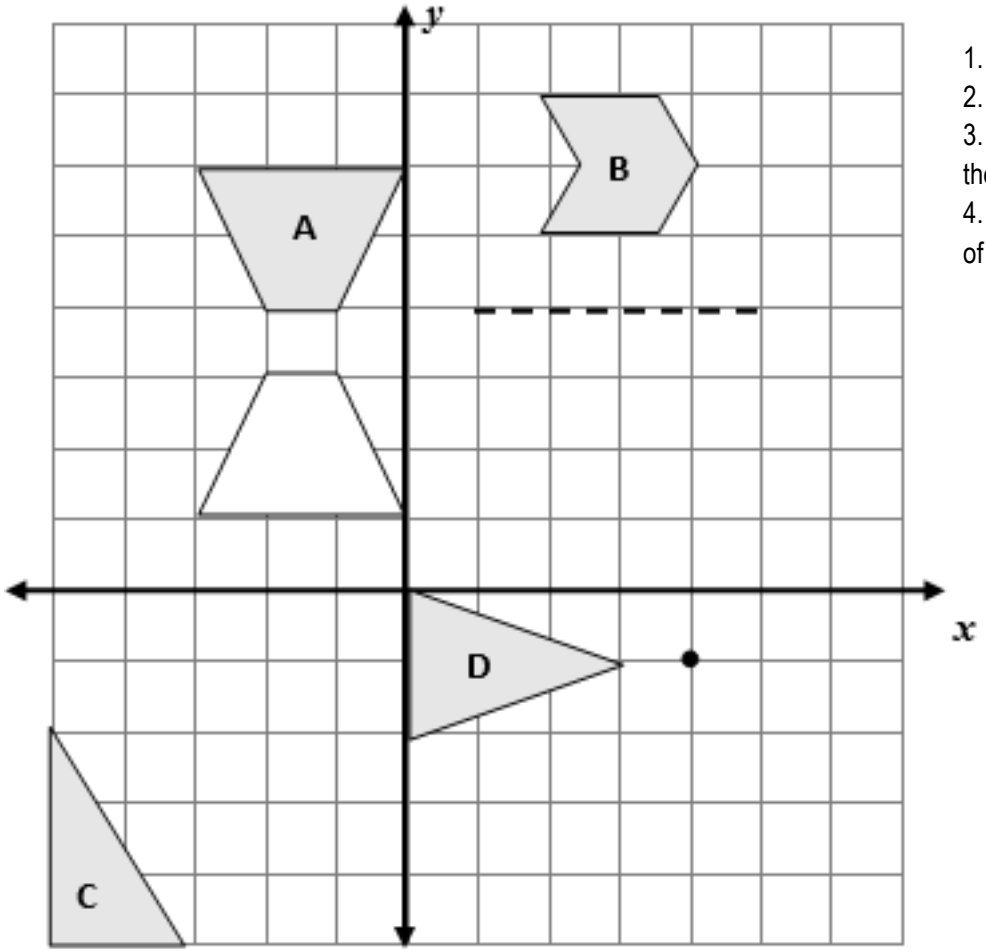
2a)





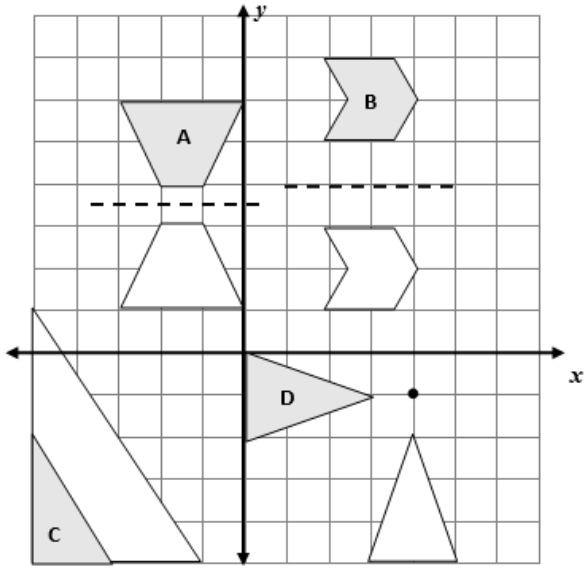
Topic 9: Transformations

Questions continued



1. Draw the mirror line of between shape A and its reflection.
2. Draw the reflection of shape B over the line of symmetry shown.
3. Enlarge shape C by a scale factor of 2. The enlargement should use the same position as shape C.
4. Rotate shape D around the point shown. Use an anticlockwise rotation of 90°

Check your answers:



Topic 10: Algebraic expressions M-08-106 to M-08-115 p139 – 155

Check that you can:	**Do you understand these words?**		*Refer to JSS2 Term 2*
Use letters or variables to represent unknown values	Algebraic expression; order of powers; coefficient; like terms; constant; variables.		

CONCEPTS:

* We can **expand** an expression by multiplying out the brackets. $3(2x^2 + 3x + 2) = 6x^2 + 9x + 6$

* Note: **Factors** of a number are numbers that divide exactly into the first number. Factors of 12 are 1, 2, 3, 4, 6, 12.
The product of two factors gives the first number. $1 \times 12 = 12$; $2 \times 6 = 12$ and $3 \times 4 = 12$.

* We can **factorise** by finding a **common factor**. $3x - 6$ has a common factor of 3, so $3(x - 2)$
$5x^2 - 15x = 5x(x - 3)$ has a common factor of 5x.

Substitution:

We replace variables in an expression with given values of the variables. Find x + 6 if x = 2. Substitute to get 2 + 6 = 8.
The value of x + 6 is 8.
Find $x^2 + 3x - 1$ if $x = -2$. $(-2)^2 + 3(-2) - 1 = -3$
Find $2x^2 + 3y - 1$ if $x = 1$ and $y = 4$. $2(1)^2 + 3(4) - 1 = 13$

Remember what to do when you are multiplying by a **negative number** $3(-2) = -6$; $-3(-2) = 6$; $-3(2) = -6$; $3(2) = 6$

Remember to use the order of operations:
Brackets **O**f **D**ivision & **M**ultiplication; **A**ddition & **S**ubtraction Find $-2x^2 - xy^2$ when $x = -1$ and $y = -4$
$-2x^2 - xy^2 = -2(-1)^2 - (-1)(-4)^2 = -2(1) - (-1)(16) = -2 + 16 = 14$

CONCEPTS:

* An **algebraic expression** is a combination of **terms** without an equals sign.

$3x - 4 + x + 8$ is an algebraic expression with 4 terms.

* 3 is the **coefficient** of x in the first term
and 1 is the **coefficient** of x in the 3rd term

Topic 10: Algebraic expressions

Exercise

1. How many terms in this algebraic expression? $2x^3 - x^2 + 4x - 1$
2. Identify the variable, the coefficient and the constant term in each algebraic expression below:
   a) 5x – 8 b) –2x + 1 c) k – 7 d) 3p
3. Simplify the following expressions:
   a) $4x + 2 + x - 6 + x$ b) $9x - 1 - 3x - 2 + 5x + 5 - 2x$
   c) $2x - 3x + 5 - 5 - 4x + 4$ d) $6x^4 + 2x^2 + 2 - 3x^4 + 2x^2 - 3$
   e) $m^2n - 2mn - 4mn + 3m^2n - mn^2$ f) $2k(k^2 - 5k)$
   g) –pq + 4p – 2q – 3pq + 2q
4. Expand the following expressions:
   a) 3(6x – 1) b) $-2(x^2 + 3x - 4)$
   c) $4(2x^2 - 3x + 1)$ d) –5(x + 7)
   e) $3x^2 - 8 + x(x + 12)$ f) $x(x + 5x + 9) - 12x$
   g) $25y - y(3 + 9)$ h) $x(2 + y) + 6x - y$
5. Simplify
   a) $3 - 10x + 3x^2 - 11x + 13$ b) $-2x^3 + 12x^2 - 5 + x^3 - 20x^2 + 9$
   c) $-2x^2 - 3x - 2 - 5x - x^2$ d) $-3x + 2 + x^2 + x - 2 + x^4 + 2x - 3$
   e) $2y(y^2 + 4y)$
6. Multiply
   a) $3y^2 \times 2y^5$ b) $-x \times 4x^2$ c) $3a^8 \times 8a^3$ d) $5pq \times -2p^2$
   e) $12xy \times x^2$ f) $a(a^3 + a)$ g) b(2a – 3b) h) $m^2(2m + 1)$
7. Write an algebraic expression for the following:
   a) the number of hours in *d* days. b) the number of months in *x* years.
   c) the amount I will pay to use the internet for *m* minutes at an internet café.
   They charge me Le 10,000 to use a computer and Le 5,000 per minute that I spend on the internet.
   d) The area of a square that has a perimeter 4*p*.

Check your answers:

1. 4 terms
2. a) variable x; coefficient 5; constant term –8.
   b) variable x; coefficient –2; constant term 1.
   c) variable k; coefficient 1; constant term –7.
   d) variable p; coefficient 3; constant term 0.
3. a) $6x - 4$ b) $9x + 2$ c) $-5x + 4$
   d) $3x^4 + 4x^2 - 1$ e) $4m^2n - 6mn - mn^2$
   f) $2k^3 - 10k^2$ g) –4pq + 4p
4. a) 18x – 3 b) $-2x^2 - 6x + 8$
   c) $8x^2 - 12x + 4$ d) –5x – 35
   e) $4x^2 + 12x - 8$ f) $6x^2 - 3x$
   g) $13y$ h) $8x + xy - y$
5. a) $3x^2 - 21x + 16$ b) $-x^3 - 8x^2 + 4$
   c) $-3x^2 - 8x - 2$ d) $x^4 + x^2 - 3$
   e) $2y^3 + 8y^2$
6. a) $6y^7$ b) $-4x^3$
   c) $24a^{11}$ d) $-10p^3q$
   e) $12x^3y$ f) $a^4 + a^2$
   g) $2ab - 3b^2$ h) $2m^3 + m^2$
7. a) 24 × *d* hours b) 12*x* months
   c) 10,000 + (5,000 × *m*)
   d) Perimeter is 4p. So one side of the square is p and area = p^2

Topic 11: Factorising and substitution in algebra M-08-114 and M-08-115 p156 – 160 (Term 2) and M-08-116 – M-08-120 p2 – 14 (Term 3)

Check that you can: Find the factors of a number; find the common factors of two numbers	**Do you understand these words?** Factor; factorise; common factor; substitute	*Refer to JSS2 Term 2 & 3*

CONCEPTS:

* We can **expand** an expression by multiplying out the brackets.	$3(2x^2 + 3x + 2) = 6x^2 + 9x + 6$
* Note: **Factors** of a number are numbers that divide exactly into the first number. The product of two factors gives the first number.	Factors of 12 are 1, 2, 3, 4, 6, 12. $1 \times 12 = 12$; $2 \times 6 = 12$ and $3 \times 4 = 12$.
* We can **factorise** by finding a **common factor**.	$3x – 6$ has a common factor of 3, so $3(x – 2)$
	$5x^2 - 15x = 5x(x – 3)$ has a common factor of 5x.
Substitution:	
We replace variables in an expression with given values of the variables.	Find $x + 6$ if $x = 2$. Substitute to get $2 + 6 = 8$. The value of $x + 6$ is 8.
	Find $x^2 + 3x – 1$ if $x = –2$. $(–2)^2 + 3(–2) – 1 = –3$
	Find $2x^2 + 3y – 1$ if $x = 1$ and $y = 4$. $2(1)^2 + 3(4) – 1 = 13$
Remember what to do when you are multiplying by a **negative number**	$3(–2) = –6$; $–3(–2) = 6$; $–3(2) = –6$; $3(2) = 6$
Remember to use the order of operations: **B**rackets **O**f **D**ivision & **M**ultiplication; **A**ddition & **S**ubtraction	Find $–2x^2 – xy^2$ when $x = –1$ and $y = –4$ $–2x^2 – xy^2 = –2(–1)^2 – (–1)(–4)^2 = –2(1) – (–1)(16) = –2 + 16 = 14$

Topic 11: Factorising and substitution in algebra

Exercise

1. Factorise fully

a. $3y + 12$
b. $7x + 28$
c. $14x + 35$
d. $6x^2 + 24x$
e. $3x^2 + 10x + 1 + 4x^2 + 4x + 6$
f. $8x^2 + 2x^2 + 10x$
g. $4a^2b^3 - 2ab^5 + a^2b^4c$
h. $-9x - 12$
i. $9x - 3xy$
j. $9x^3 + 6x^2 + 12x + 15$
k. $4y^2 + 16y - 8$
l. $3a^3 + 4a + 5a + 15a^3$

2. Calculate the value of the expressions if $x = 2$ and $y = 7$

a) $2x^2 + y$ b) $xy - 3x$ c) $\frac{y}{3} + x$

3. Calculate the value of the expressions if $x = 2$ and $x = 3$

a) $4x + 5$ b) $2x^2 + 3x + 6$

4. Find $4x^2y + 3xy^2 + 2xy$ when:

a) $x = 1$ and $y = 2$ b) $x = 3$ and $y = -1$ c) $x = -2$ and $y = 3$

Check your answers:

1. a. $3(y + 4)$
   b. $7(x + 4)$
   c. $7(2x + 5)$
   d. $6x(x + 4)$
   e. $7x^2 + 14x + 7 = 7(x^2 + 2x + 1)$
   f. $10x^2 + 10x = 10x(x + 1)$
   g. $ab^3(4a - 2b^2 + abc)$
   h. $-3(3x + 4)$
   i. $3x(3 - y)$
   j. $3(3x^3 + 2x^2 + 4x + 5)$
   k. $4(y^2 + 4y - 2)$
   l. $18a^3 + 9a = 9a(2a^2 + 1)$
2. a) $2(2)^2 + 7 = 15$
   b) $(2)(7) - 3(2) = 8$
   c) $\frac{7}{3} + 2 = 2\frac{1}{3} + 2 = 4\frac{1}{3}$
3. a) If x = 2, then $4x + 5 = 13$
   If x = 3, then $4x + 5 = 17$
4. a) When x = 1 and y = 2
   $4(1)^2(2) + 3(1)(2)^2 + 2(1)(2) = 8 + 12 + 4 = 24$
   b) When x = 3 and y = –1
   $4(3)^2(-1) + 3(3)(-1)^2 + 2(3)(-1)$
   $= -36 + 9 - 6 = -33$
   c) When x = –2 and y = 3
   $4(-2)^2(3) + 3(-2)(3)^2 + 2(-2)(3)$
   $= 48 - 54 - 12 = -18$

Topic 12: Linear Equations M-08-121 to M-08-130 p15 – 43

Check that you: understand algebraic expressions	**Do you understand these words?** Linear equation; solve the equation	*Refer to JSS2 Term 3*

CONCEPTS:

* **Linear equations:**

We can solve linear equations if we have enough information about the values of the variables in the equation.

Example 1:

Solve for x if x – 8 = 4.

We can work out that x = 12 by trying out different numbers in the equation.

We can also solve the same linear equation by isolating the variable and keeping the sides of the equation balanced this way:

x – 8 = 4	Change the equation to get x on its own. So we want – 8 to be moved. **The two sides of an equation must stay equal.**
x – 8 + 8 = 4 + 8	adding 8 to both sides, we get 0 on the left and 4 + 8 on the right.
x + 0 = 12	Now x is on its own and we see that x = 12. We have solved the equation.

Example 2:

Solve for x if 2x – 3 = 5	Use addition as the inverse relationship of subtraction.
2x – 3 + 3 = 5 + 3	Add 3 to both sides of the equation. The equation is still equal.
2x = 8	Use division as the inverse relationship to multiplication
$\frac{2x}{2} = \frac{8}{2}$	Divide by 2 on both sides so that we can get x on its own.
x = 4	The equation is still equal.

Check your solution by substituting x = 4 into the question given. 2(4) – 3 = 8 – 3 = 5

Example 3:

Solve for x if 6x + 5 = 2x + 9 Change the equation to get the like terms together (x-values on one side and constant values on the other side)

6x – 2x + 5 = 2x – 2x + 9	Subtract 2x from both sides of the equation
4x + 5 = 9	
4x + 5 – 5 = 9 – 5	Subtract 5 from both sides of the equation.

*** Linear equations with fractions:**

Solve for x if $\frac{2}{3}x - \frac{1}{2} = 4$

$\frac{2}{3}x - \frac{1}{2} + \frac{1}{2} = 4 + \frac{1}{2}$	Add $\frac{1}{2}$ to both sides
$\frac{2}{3}x = 4 + \frac{1}{2}$	
$\frac{3}{2} \times \frac{2}{3}x = \frac{3}{2} \times (4 + \frac{1}{2})$	Multiply by the reciprocal of $\frac{2}{3}$
$x = \frac{3}{2} \times \left(\frac{9}{2}\right) = \frac{27}{4}$	

*** Solving problems with linear equations:**

We can write an equation to help us solve word problems.

Example:

Fatmata is 16. She is 4 years older than Binta. How old is Binta?

Let Binta's age be x. So Fatmata is x + 4 = 16. Binta is 12

Topic 12: Linear Equations

Exercise

1. Solve the equations for the variable:

a) $p - 2 = 4$ b) $z + 6 = 16$ c) $x + 1 = 0$

d) $a + 1 = 23$ e) $x + 6 = 10$ f) $a - 3 = 9$

g) $7 + z = 3$ h) $6 = p + 5$ i) $7x = 14$

j) $3x = 18$ k) $x^2 = 4$

2. Find the value of x for each of the following:

a) $8x + 5 = 5x + 14$ b) $7(x + 3) = 28$ c) $10x + 3 = 7x + 18$

d) $4(x + 6) = 32$ e) $-2x - 8 = 10$ f) $-3y = 5y + 16$

3. Solve the linear equations:

a) $2x - 1 = 3x$ b) $2(a - 2) + a - 2 = 6$ c) $5y - 3 = 2y + 9$

d) $\frac{3x}{4} = 2$ e) $3(x - 5) - 2(x - 1) = 7$ f) $5(x + 1) - (x + 2) = 3$

4. I buy a cup of coffee for Le 8,000 and some biscuits that cost Le 2,000 each. I pay Le 20,000 in total. How many biscuits do I buy? Use *b* for the number of biscuits I buy.

5. The sum of two **consecutive** numbers is 77. Let the smaller number be y. Find the other number.

6. A pencil costs Le y. You buy 4 pencils and a book costing Le 5,000. The total cost is Le 13,000. What is the price of one pencil?

7. Six buses were used to take 324 learners on a trip. Use x to find the number of seats on one bus.

8**. Ahmed thinks of a number x. Ben multiplies this number by 6 and Mo multiplies it by 3 and adds 9. Ben and Mo get the same answer. What is Ahmed's number x?

9**. The perimeter of a rectangular field is 40 m. The length of the field is 4 m longer than the breadth of the field. How long is the field?

Check your answers:

1a) p = 6 b) z = 10 c) x = –1

d) a = 22 e) x = 4 f) a = 12

g) z = −4 h) p = 1 i) x = 2

j) x = 6 k) x = +2 or –2

2a) $8x - 5x = 14 - 5$
$3x = 9$
$x = 3$

b) $7x + 21 = 28$
$7x = 7$
$x = 1$

c) $10x - 7x = 18 - 3$
$3x = 15$
$x = 5$

d) $4x + 24 = 32$
$4x = 32 - 24$
$4x = 8$ so $x = 2$

e) $-2x = 10 + 8$
$-2x = 18$
$x = -9$

f) $-3y - 5y = 16$
$-8y = 16$
$y = -2$

3a) $-1 = 3x - 2x$
$-1 = x$

b) $3a - 6 = 6$
$3a = 12$ so $a = 4$

c) $3y = 12$ so $y = 4$

d) $3x = 8$ so $x = \frac{8}{3}$

e) $3x - 15 - 2x + 2 = 7$
$x - 13 = 7$ so $x = 20$

f) $5x + 5 - x - 2 = 3$
$4x + 3 = 3$
$4x = 0$ so $x = 0$

4. $8{,}000 + 2{,}000b = 20{,}000$
$b = \frac{12{,}000}{2{,}000} = 6$ I bought 6 biscuits.

5. The numbers are y and y + 1.
$y + y + 1 = 77$ $2y = 76$ so $y = 38$ and $y + 1 = 39$

6. $4y + 5{,}000 = 13{,}000$ so $4y = 8{,}000$ and $y = 2{,}000$

7. 6 buses; *x* seats each is 6*x* seats.
$324 \div 6 = 54$. There are 54 seats on each bus.

8. Ben's number is 6x. Mo's number is 3x + 9.
$6x = 3x + 9$
$x = 3$. Ahmed's number is 3.

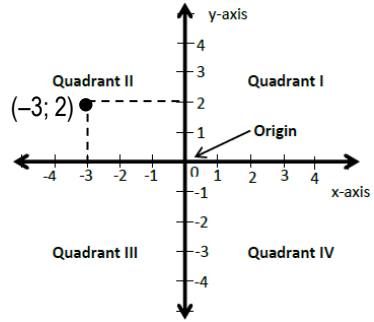
9. P = 100 m. Let breadth = x m, so length = 4 + x.
So $40 = 2(x + 4 + x)$
$40 = 4x + 8$

Topic 13: Cartesian plane M-08-031 to M-08-035 p44 – 58

Check that you can:	**Do you understand these words?**	
Identify integers on a number line; substitute values for variables in a linear equation.	Cartesian plane, x-axis, y-axis, x-coordinate, y-coordinate, ordered pair, origin, straight line graph.	*Refer to JSS2 Term 3*

CONCEPTS:

The Cartesian plane is a system of two number lines perpendicular to each other (the x-axis and the y-axis) crossing at their 0 values (origin).
The plane has 4 quadrants, labelled as shown.
Any point on the Cartesian plane has an x-coordinate and a y-coordinate.
For example, (–3; 2) is an ordered pair to show the point where x = –3 and y = 2.
In an ordered pair, the x-coordinate is always written first; the y-coordinate is always written second.



Plotting ordered pairs:

Find the first number on the x-axis and the second number on the y-axis.
Mark the point where straight lines drawn from the axes where the lines meet.

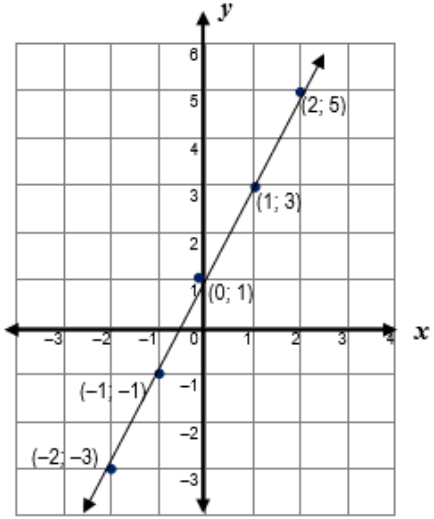
Table of values:

We can make a **table of values** from a linear equation.
For the linear equation, **y = 2x + 1**, we can choose these values:

x	–2	–1	0	1	2	3
y	–3	–1	1	3	5	7

When x = –2, y = 2(–2) + 1 = –3
When x = 0, y = 2(0) + 1 = 1
When x = 2, y = 2(2) + 1 = 5

Then we can plot these points on the Cartesian plane.
We can join the points to make a straight line.
Every point on the line is described by y = 2x + 1 for any real number x.



Straight line graph

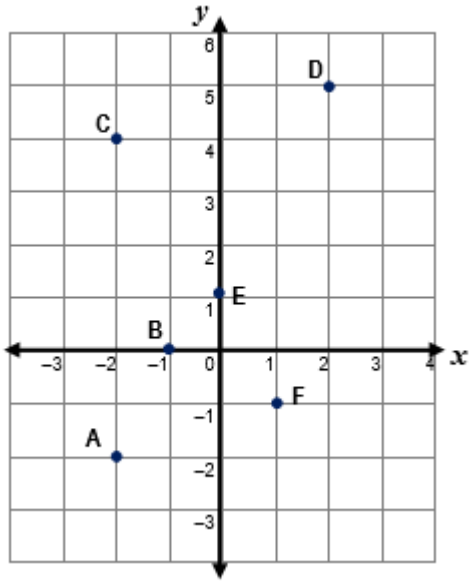
Topic 13: Cartesian plane

Exercise

1. What is the name given to the point (0; 0) on the Cartesian plane?
2. In the ordered pair (–3; 3) what is the value of the x-coordinate? And the y-coordinate?
3. In which quadrant of the Cartesian plane are the following points:
   a) (–5; –2) b) (1; –2) c) (3; 2) d) (–1; 4)
   e) (4; –1) f) (2; 5) g) (–1; 4) h) (–2; –6)
4. On which axis are each of the following points
   a) (–1; 0) b) (7; 0) c) (0; –4) d) (0; 10)
   e) (0; –2) f) (–4; 0) g) (0; 3) h) (10; 0)

(–2; –3)

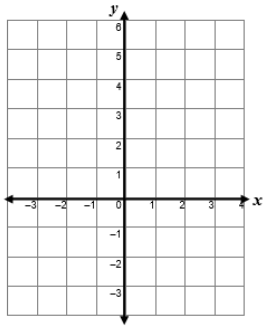
5. Write down the ordered pair for the points A to F plotted on the Cartesian plane.



6. y = –2x + 1 is a linear equation.
   Complete the table of values for this equation

x	–2	–1	0	1	2	3
y						

Make your own Cartesian plane on squared paper.
Plot the points from the table on the Cartesian plane.
Join the points to make the graph for y = –2x + 1.



Check your answers:

1. Origin
2. x-coordinate is –3 and y-coordinate is 3
3. a) Quadrant III b) Quadrant IV
   c) Quadrant I d) Quadrant II
   e) Quadrant IV f) Quadrant I
   g) Quadrant II h) Quadrant III
4. a) x-axis b) x-axis c) y-axis b) y-axis
   e) x-axis f) y-axis g) x-axis h) y-axis
5. A is (–2; –2) B is (–1; 0)
   C is (–2; 4) D is (2; 5)
   E is (0; 1) F is (1; –1)
6. y = –2x + 1

x	–2	–1	0	1	2	3
y	5	3	1	–1	–3	–5