

# TOPIC 12: ALGEBRA



**Algebra** is a branch of mathematics in which symbols/letters are used to represent numbers in arithmetic operation. Algebra is a problem in which one or more numbers is/are unknown.

## Terms used in algebra

### \* **Variables**

A variable is a letter or symbol that stands for a number in an equation or algebraic expression.

### \* **Algebraic expression**

An expression is obtained by combining constants and/or variables using arithmetic operators.

### \* **A constant**

A constant is a number that does not change e.g. 0,1,2,3,4,5 etc.

### \* **Algebraic phrase**

This is the meaningful arrangement of constants (numbers) and variables (letters)

### \* **A term**

A term is a letter or a number in an algebraic expression.

- *Like terms have exactly the same letters.*
- *Unlike terms have different letters; unlike terms cannot be added.*
- *Terms are combined by brackets multiplication or division signs. Therefore, brackets, multiplication or division signs show a single term.*

## Forming algebraic expressions

### Note

- \* If a word like; sum, increase, total, plus, profit, after, older, more, altogether: is used, the problem is on addition.
- \* If a word like; difference, younger, remain, left, decrease, minus, take away, range, before: the problem is on subtraction.
- \* If a word like product, of, times, triple ( $\times 3$ ), twice ( $\times 2$ ), thrice ( $\times 3$ ), double ( $\times 2$ ), square, cube: the problem is on multiplication.
- \* If a word like; share, cut, quotient, scale, mean / average, group, factorize, half ( $\div 2$ ): the problem is on division.

### Examples

1. Add f to 5  $\rightarrow (5+f)$
2. Sum of a and y  $\rightarrow (a + y)$
3. Increase h by 5  $\rightarrow (h + 5)$
4. Take away m from 4  $\rightarrow (4 - m)$
5. Subtract 7y from 5  $\rightarrow (5 - 7y)$
6. Decrease 9 by w  $\rightarrow (9 - w)$

7. Double p  $\rightarrow 2p$
8. Triple d  $\rightarrow 3d$
9. Twice m  $\rightarrow 2m$
10. Product of a and c  $\rightarrow ac$
11. Half of g  $\rightarrow \frac{1}{2}g$  or  $\frac{g}{2}$
12. Two thirds of a number  $\rightarrow \frac{2}{3}n$  or  $\frac{2n}{3}$

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13. Square h  $\rightarrow h^2$
14. Divide h by 4  $\rightarrow \frac{h}{4}$
15. r divided by a number  $\rightarrow \frac{r}{n}$
16. 7 divided by a  $\rightarrow \frac{7}{a}$
17. Average of d, e, r and h  $\rightarrow \frac{d + e + r + h}{4}$
18. Double g and add 6 to the result  $\rightarrow (2g + 6)$
19. Add 4 to a number and triple the result  $\rightarrow 3(n + 4)$
20. Square h and add 5 to the result  $\rightarrow h^2 + 5$
21. The difference between 3d and 2 divided by r  $\rightarrow \frac{3d - 2}{r}$
22. y added to three quarters of a number  $\rightarrow \frac{3}{4}n + y$
23. Product of a and h divided by 5  $\rightarrow \frac{ah}{5}$
24. The sum of 3e and m multiplied by 4y  $\rightarrow 4y(3e + m)$
25. Add the sum of 4a and 3d to twice the difference between b and c  $\rightarrow 2(b-c) + (4a+3b)$
26. Reduce 2d by 6 and add h increased by 20%  $\rightarrow (2d - 6) + \frac{120h}{100}$
27. 4 times the sum of k and 7 divided by k  $\rightarrow \frac{4(k+7)}{k}$

## Exercise

1. Write the algebraic expressions for;
 

i) Add g to 7 ii) Add 8 to m iii) Increase 9 by 2k iv) Increase 4q by 1 v) Reduce p by 6 vi) Reduce m by x vii) Reduce h by y viii) Reduce 13 by p ix) Reduce 15 by a number x) Sum of 3 and h xi) Sum of 8w and 3x xii) Sum of k and r xiii) Sum of 5h and 7 xiv) Take away 2y from 5 xv) Take away 3m from 4p xvi) Subtract 9 from a number xvii) Subtract 13 from 4t.	xviii) Square of m xix) Square of 4w xx) Subtract 4a from 4 xxi) Mean of 3, 4y and n xxii) Average of 7k, 1, 4x and 2y xxiii) Three quarters of m xxiv) Two fifths of w xxv) Four sevenths of h xxvi) Two thirds of 5k xxvii) Seven eighths of a number xxviii) Square root of t xxix) Square root of 3m xxx) Square root of 4p - 1 xxxi) Square root of $\frac{3k}{4}$ xxxii) y times the sum of 2h, 2y and 2p
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- xxxiii) Decrease 4 by  $k$
- xxxiv) Decrease  $g$  by 14
- xxxv) Decrease  $9m$  by 2
- xxxvi) Decrease 6 by  $7x$
- xxxvii) Four times of the sum of 3 and  $h$
- xxxviii) Three times the sum of  $2p$  and 2
- xxxix) Three quarters the sum of  $x^2$  and 1
- xl) Half of the mean of  $2h$ ,  $6w$  and 5
- xli) Double the difference between  $4r$  and 8
- xlii) Triple the sum of 9 and  $2p$
- xliii) Five times the difference between 6 and  $3t$
- xliv) Increase 7 by  $2m$  and double the result
- xlv) 2 added to two fifths of  $p$

**2. Form algebraic expressions:**

- i) Twice a number added to the product of  $m$  and  $y$ .
  - ii) Take away thrice  $p$  from three quarters of a number.
  - iii) The sum of  $4y$  and  $3x$  added to twice the difference between  $7y$  and  $x$ .
  - iv) Reduce the sum of  $y$  and  $2h$  by the square of  $m$
  - v) Square the product of  $m$  and  $x$  added to twice  $w$
  - vi) Divide a number by 4 and add 8 to the result.
  - vii) Divide 7 by a number and decrease the result by the square root of the sum of twice  $m$  plus 3
  - viii) Increase a number by  $\frac{2}{3}$  of it and increase the result by the square of the sum of 8 and thrice  $k$
3. John is 3 years older than Joseph who is  $p$  years old. How old is John?
4. The mother is 5 times as old as her daughter. If the daughter is  $m$  years old, how old is the mother?
5. Mulaalo had 64 cows,  $p$  cows died. Write the expression for the remaining cows.
6. A book costs sh. 200 less than a ruler. If a ruler costs sh. $k$ ,
- a) Find the expression of the cost of one book.
  - b) How much will I pay for a dozen of similar books?
7. Kasule is 6 years younger than Kaswa. Kaswa is  $r$  years old. Write the algebraic expression of Kasule's age in 7 years' time.
8. I am  $2m$  years old now. After how many years will I be 24 years?
9. The cost of two books is sh. 1500 less than the cost of a geometry set. Write the expression for the cost of one book.
10. The diameter of a circle is 30cm less than its circumference. The circumference of the circle is  $t$ . Write the expression for the radius of the circle.
11. Nalongo is 5 years younger than Salongo who is  $g$  years old. Kiza is two thirds of Nalongo's age. Find the expression of Kiza's age 6 years ago.
12. A man bought 90 eggs, some eggs got broken. He sold the remaining eggs at sh. 450 each. Write the expression for the amount of money he sold the eggs.
13. A parent gave 5b exercise books to two sons and a daughter (James, Peter and Jane) in the ratio of 3:5:4 respectively. Jane used 10 books. Write the expression for the number of books Jane remained with.

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14. In a class of  $x$  pupils, 15 are absent and the rest are present. The teacher has given 7 pencils to each who is present. Write the algebraic expression of the total number of pencils the teacher has given out.
15. Nsiti has two children, a son and a daughter. If the son is half her age, the daughter is 4 years older than the son. If Nsiti is  $n$  years old, write the algebraic expression of the daughter's age.
16. A file costs half as much as a geometry set. A geometry set costs sh. 800 more than a book. Write the algebraic expression for the cost of a file.
17. Yowana is  $(k+1)$  years old now. His father is twice as old as him. Find the father's age.
18. In a market, the cost of a pawpaw is sh. 1000 more than the cost of a mango. A mango costs three quarters of the cost of a pineapple. Write the expression for the cost of a pawpaw.
19. Kirya has 4 times as many oranges as Njara and Ssebbuto has thrice of what Kirya and Njara have. Write the algebraic expression of the number of oranges Ssebbuto has.
20. Binojo and Lunkupe shared some goats. The number of goats Binojo got was 4 times more than what Lunkupe got. Write the algebraic expression for the number of goats Binojo got.

## SUBSTITUTION

Substitution means replacement.

Here we remove a letter (variable) and replace it with its value given. In order to substitute, we need to go through the following steps.

- \* Give the meaning of the algebraic expression.
- \* Substitute correctly.
- \* Operate accurately.

## Meaning of algebraic expressions

$r + m$ means $(r) + (m)$	$ab + ac$ means $(a \times b) + (a \times c)$
$g - p$ means $(g) - (p)$	$p^2 - h^3$ means $(p \times p) - (h \times h \times h)$
$ab$ means $(a) \times (b)$	$a(d - c)$ means $a \times (b - c)$ or $(a \times b) - (a \times c)$
$2kx$ means $2 \times (k) \times (x)$	$5a^2b^3 - 3c^2a^3$ means $(5 \times a \times a \times b \times b \times b) - (3 \times c \times c \times a \times a \times a)$
$k^2$ means $(k \times k)$	$\frac{3m \times x - 4y}{myx - y}$ means $\frac{(3 \times m \times x) - (4 \times y)}{(m \times y \times x) - (y)}$

### Example 1

Given that  $y = 3$ ,  $k = 5$  and  $a = 4$ . Find the value of;

- i)  $a + k + y$
- ii)  $2aky$
- iii)  $2ky^2$

$$(a) + (k) + (y)$$

$$4 + 5 + 3$$

$$9 + 3$$

$$12$$

$$2 \times a \times k \times y$$

$$2 \times 4 \times 5 \times 3$$

$$120$$

$$2 \times k \times y \times y$$

$$2 \times 5 \times 3 \times 3$$

$$90$$

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## Example 2

Given that  $p = 3$ ,  $h = 5$  and  $y = -2$ . Find the value of;

i) $y^3 + p^2$	ii) $3py - 2h$	iii) $h - y$
$(y \times y \times y) + (p \times p)$	$3 \times p \times y - 2 \times h$	$(h) - (y)$
$(-2 \times -2 \times -2) + (3 \times 3)$	$(3 \times 3 \times -2) - (2 \times 5)$	$(5) - (-2)$
$(+4 \times -2) + 9$	$-18 - 10$	$5 + 2$
$-8 + 9$	$-28$	$7$
+1		

## Example 3

Given that  $m = 2$  and  $n = -3$ . Find the value of;

i) $\frac{2nm+2}{(m-n)-6}$	ii) $\frac{4n+m^3}{n(mn+4m)}$	iii) $\frac{2mn+m}{n^2-2m}$
$\frac{(2 \times n \times m) + 2}{(m - n) - 6}$	$\frac{(4xn) + (m \times m \times m)}{n(m \times n + 4 \times m)}$	$\frac{(2xmxn) + m}{(n \times n) - (2 \times m)}$
$\frac{(2 \times -3 \times 2) + 2}{(2 - (-3)) - 6}$	$\frac{(4x-3) + (2 \times 2 \times 2)}{-3(2 \times -3 + 4 \times 2)}$	$\frac{(2 \times 2 \times -3) + 2}{(-3 \times -3) - (2 \times 2)}$
$\frac{-12 + 2}{2 + 3 - 6}$	$\frac{-12 + 8}{-3(-6 + 8)}$	$\frac{-12 + 2}{9 - 4}$
$\frac{-10}{-1}$	$\frac{-4}{-3 \times 2}$	$\frac{-10}{5}$
10	$\frac{-4}{-6}$	-2
	$\frac{2}{3}$	

## Exercise

1. Given that  $a = 2$ ,  $b = 4$  and  $c = -3$ . Find the value of;

- |                                                                                 |                      |                                 |
|---------------------------------------------------------------------------------|----------------------|---------------------------------|
| a) $b(a + c)$                                                                   | c) $ac + b$          | e) $\frac{6c+a}{b}$             |
| b) $2a - c$                                                                     | d) $3c + 3b$         | f) $\frac{abc - c}{3c}$         |
| 2. What is the value of $\frac{bc - d}{c}$ when $b = 8$ , $c = 3$ and $d = 6$ ? |                      |                                 |
| 3. If $a = 2$ , $b = 3$ and $c = 5$ , find the value of;                        |                      |                                 |
| a) $3a + b + c$                                                                 | d) $6a - bc$         | g) $\frac{ab}{c} + \frac{4}{c}$ |
| b) $c^2 - 2b^2$                                                                 | e) $a^2 + b^2 + c^2$ | h) $b^3 - c^a$                  |
| c) $a(4b - c)$                                                                  | f) $\frac{2bc}{a}$   | i) $\frac{3}{4}(b + c) - 4a$    |

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4. Find the value of  $\frac{5a - (m - a)}{a}$  when  $a = 3$  and  $m = 6$ .

5. Given that  $a = -6$ ,  $b = 3$ ,  $c = -2$  and  $d = -1$ .

Work out the value of ;

a)  $\frac{ad}{cd}$

c)  $b(a - cd)$

e)  $\frac{abcd}{bc - 3}$

b)  $\frac{a^2 + d}{3b + c}$

d)  $a + c^2$

f)  $\frac{b^2 - a}{ad + bd}$

6. Given that  $x = 3$ ,  $y = 4$  and  $z = 6$ . Find the value of;

a)  $\frac{xy}{z}$

d)  $(z - y)^x$

g)  $\frac{xz - 3y}{2x}$

b)  $\frac{3y + z}{x}$

e)  $y^2 - x^3 + z$

h)  $xy(yz - 7x)$

c)  $2x(z - 2y)$

f)  $\frac{4y - z}{(x^2 + 1)}$

i)  $12x - y(4z - 6x)$

7. If  $a = -3$ ,  $b = 6$  and  $c = -2$ , find the value of;

i)  $\frac{b(a + c)}{c}$

ii)  $bc - a$

iii)  $\frac{a^2 + b}{c^2 + 3}$

8. Given that  $x = -2$ ,  $y = -3$  and  $m = 5$ .

Evaluate;

a)  $\frac{2x - m}{y}$

c)  $\frac{x(m - y)}{3y + m}$

e)  $\frac{xy(mx - 2y)}{2m + 4x}$

b)  $\frac{3ym - 4y}{myx - y}$

d)  $\frac{x^2y + 2m}{2x - y}$

f)  $\frac{y^2 - 2x^2}{2(y + x) + m}$

9. Given that  $a = -4$  and  $b = 3$ , find the value of  $2b + 2a$ .

10. If  $p = -4$ ,  $q = 3$  and  $c = -2$ , find the value of;

a)  $\frac{p + c}{q}$

b)  $\frac{pq}{c}$

c)  $\frac{3q(pc + c^3)}{2c(4p + 7)}$

11. Given that  $n = 3$  and  $r = -2$ . Find the value of;

a)  $\frac{2n + r}{r}$

b)  $2n \div r(3r + 3n)$

c)  $\frac{8r}{r(2n + 4r)}$

12. Given that  $a = -2$ ,  $b = 3$  and  $c = 4$ , Find the value of;

i)  $b(a^2 + c)$

ii)  $\frac{2bc(b + 2a)}{b(4c + 6a)}$

iii)  $\frac{c(a^2 + 2b)}{2ab - 3c}$

13. Find the value of  $c^2 - d^3$  if  $c = 3$  and  $d = -2$ .

14. Given that  $k = b = 3$  and  $y = 2k$ . Evaluate;  $k + y + b$

15. If  $m = n - 3$ ,  $b = 6$  and  $n = 5$ , Find the value of  $2m^3 - 3b$

16. Given that  $k - 1 = 2$  and  $h = k + 2$ . Find the value of  $3h - hk$

17. Given that  $p = 3d$  and  $2d = 4$ . Find the value of  $3d - p$ .

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18. Given that  $n = 3g$  and  $g = 5$ . Find the value of  $2g + 6n$ .
19. Given that  $a = mx + 7$ ,  $m = 3$  and  $x = 5$ . Find the value of  $4m(2x - 3ma)$
20. Given that  $y = mx + c$  then  $c = -2$ ,  $m = 3$  and  $x = 4$ . Find the value of  $y$ .
21. Joseph spent  $k$  sh. 400 on books. If  $k$  = sh. 1200. Find the actual amount of money he spent.
22. In a shop, the cost of a pen is sh.  $(2g - 100)$ . If  $g = 300$ ,
  - a) Find the cost of one pen.
  - b) How much money can I pay for  $1\frac{1}{2}$  dozens of similar pens?
23. Masaka is  $(2p + 80)$ km away from Kampala. Given that  $p = 20$ , find the actual distance between the two places.
24. Muliika is  $4x$  years old. Muddu is 8 years younger than Muliika. How old is Muddu if  $x=7$
25. Kasirye is 50cm taller than Kawagu. Kawagu is  $(3p - 20)$ cm tall. If  $p = 45$ cm, find Kasirye's actual height.

## Collecting like terms

\* Like terms have exactly the same letters.

## Examples of like terms

- |                             |                                                 |
|-----------------------------|-------------------------------------------------|
| * $a, 3a, 2a, 8a, 35a$      | * $8a^2b, a^2b, 4a^2b, 3a^2b, 9a^2b$            |
| * $xy, 7xy, 3xy, 51xy, 4xy$ | * $r^2a^3p, 2r^2a^3p, 6r^2a^3p$ and $98r^2a^3p$ |

## Examples of unlike terms

- \*  $a, b, c, d$
- \*  $3y, 3e, 3t, 3p$
- \*  $4rh, 3r^2h, 6rh^2, 7h$

## **Note:**

- Unlike terms cannot be added or subtracted.
- While collecting like terms in an algebraic expression, a term goes with a sign before it.
- Addition of like terms comes before subtraction.

## **Example 1**

Simplify the following.

i) $4p + 6p$	ii) $4y + 5y + 2y + y$	iii) $a + 3a - 2a$
$4p + 6p$	$4y + 5y + 2y + y$	$a + 3a - 2a$
10p	12y	$4a - 2a$
		2a
iv) $5h - 2h + 3h$	v) $d - 7d + 6d + 3d$	
$5h - 2h + 3h$	$d - 7d + 6d + 3d$	
$5h + 3h - 2h$	$d + 6d + 3d - 7d$	
$8h - 2h$	$10d - 7d$	
6h	3d	

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## Example 2

Collect like terms and simplify.

i)  $y + x + y + y + x$

$$y + x + y + y + x$$

$$y + y + y + x + x$$

$$3x + 2x$$

ii)  $2a + 3b + 4a + b$

$$2a + 3b + 4a + b$$

$$2a + 4a + 3b + b$$

$$6a + 4b$$

iii)  $y - 4x - 3y + 5x$

$$y - 4x - 3y + 5x$$

$$y - 3y + 5x - 4x$$

$$-2y + x$$

iv)  $3p - 4k - p - 3k$

$$3p - 4k - p - 3k$$

$$3p - p - 4k - 3k$$

$$2p - 7k$$

## Exercise

1. Simplify;

a)  $6p - 2p$

d)  $6y + 4y - 5y$

g)  $5m - 6m + 2m$

b)  $n + 2n + 3n$

e)  $3g + g - 2g$

h)  $4x - 3x + x$

c)  $2p + 3p$

f)  $2k + 3k - 7k$

i)  $4b - 7b + b$

2. Collect like terms and simplify.

a)  $18x - 35 - 15x$

d)  $5cd - 2xy - cd + 7xy$

g)  $8t - 9 - 2t - 1$

b)  $3a - 3q + 3a + 2q$

e)  $3a^2b - 7xy + a^2b - xy$

h)  $4r - 12 - 6r - 13$

c)  $6n - 5m + 3n - 4m$

f)  $3d - 12 - 2d - 1$

i)  $6 - 7w + 3w - 5 + 3w$

3. Simplify

a)  $4p - 7y - 5p - y$

f)  $x - 6 - 4x - 4$

j)  $6a - 4p - 2a - 3p$

b)  $3 + 15a - 6 - 9a$

g)  $6a - 4p - 2a - 3p$

k)  $3n - 7 - n - 4$

c)  $6y - 4 + 5y + 12$

h)  $p - 10 - 4p - 8$

l)  $3p - 10 - 4p - 2$

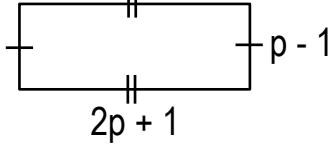
d)  $7p - 3n - 2p - n$

i)  $20t - 12 - 4t - 8$

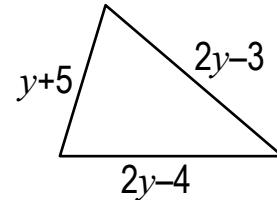
e)  $p + 10 - 4p - 8$

4. Find the perimeter of each of the following figures.

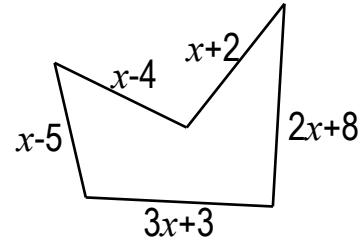
a)



b)



c)



5. Sikiyo is 7 years younger than Mdomo. Mdomo is  $(x - 2)$  years.

a) How old is Sikiyo?

b) Write the simplified algebraic expression for their total age.

c) If  $x = 11$ , how old will Sikiyo be in 9 years' time?

6. The table below shows the cost of different items. Use it to answer questions that follow.

Item	Price
1 pen	sh. $1200 - 2n$
1 book	sh. $1800 - n$
1 geometry set	sh. $4500 - 3n$

a) Nagaga bought all the items, write the algebraic expression for the total amount of money he paid.

b) If  $n = \text{sh. } 300$ , how much money did he spend on a book and a ruler altogether?

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7. Ayen is 4 times as old as Achen and Akiki is 6 years younger than Ayen. Write a simplified algebraic expression for their total age.

## Removing brackets

To multiply a sum or a difference of numbers, multiply each term inside the brackets by the term outside the brackets.

### **Note:**

- A term before the brackets, multiplies all terms in the brackets.
- A negative term before the brackets changes all signs (- or +) in the brackets.
- A positive term does not change any of the signs (- or +) in the brackets.

### **Example 1**

Remove brackets and simplify;

a) $2(y + 3)$	b) $3(y - 4)$	c) $-(y + 3)$	d) $-4(y - 2)$
$2(y + 3)$	$3(y - 4)$	$-(y + 3)$	$-4(y - 2)$
$2y + 6$	$3y - 4$	$-y - 3$	$-4 + 8$

e) $2 - (3 - 2y)$	f) $3 - 2(y + 5)$	g) $5 + 4(y - 2)$
$2 - (3 - 2y)$	$3 - 2(y + 5)$	$5 + 4(y - 2)$
$2 - 3 + 2y$	$3 - 2y - 10$	$5 + 4y - 8$
$-1 + 2y$	$3 - 10 - 2y$	$5 - 8 + 4y$
	$-7 - 2y$	$-3 + 4y$

### **Example 2**

Take away  $3x + 4$  from  $2(3x - 6)$

$$\begin{aligned} & 2(3x - 6) - (3x + 4) \\ & 6x - 12 - 3x - 4 \\ & 6x - 3x - 12 - 4 \\ & 3x - 16 \end{aligned}$$

### **Example 3**

$$\begin{aligned} & \text{Subtract } p - 1 \text{ from } 3p - 5 \\ & (3p - 5) - (p - 1) \\ & 3p - 5 - p + 1 \\ & 3p - p + 1 - 5 \\ & 2p - 4 \end{aligned}$$

### **Exercise**

1. Remove brackets.

a) $3(x + 4)$	e) $8(3 + 2h + y)$	i) $-3(2x - 1)$
b) $2(3x - 6)$	f) $-(p - 1)$	j) $-9(x - 2)$
c) $2(p + 5)$	g) $-(m + 4)$	k) $-2(t + 1)$
d) $5(n + 2)$	h) $-(2m - 8)$	l) $-4(3 - w)$

2. Remove brackets and simplify.

a) $3 - (p - 1)$	d) $5k - 2(3 - k)$	g) $3y - 2 - (2y + 1)$
b) $5 - (m + 4)$	e) $18p - 5(3p + 7)$	h) $8h + 4 - 3(h + 2)$
c) $3 - 2(3 - g)$	f) $5d - 2(d + 1)$	i) $4 + 2xy - 5(xy - 2)$

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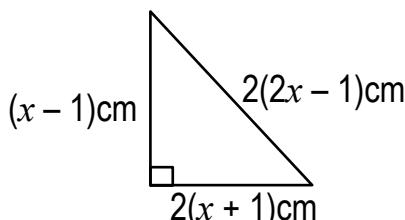


3. Simplify:
- $(5 + 2p) + (2p + 2)$
  - $(2w - 4) + (6w + 3)$
  - Take away  $2y + 5$  from  $4y + 7$
  - Subtract  $6p - 4$  from  $7p + 3$
  - Subtract  $4h - 6$  from  $h - 5$
  - Reduce  $y - 4$  by  $2(3y - 2)$
  - Take away  $5m + 3$  from  $4 - m$
  - There are  $(2p - 3)$  boys and  $(3p + 5)$  girls in a certain school. Find the algebraic expression for the total number of pupils in the school.
  - What must be added to  $3h + 6$  to get  $2h - 7$
  - Take away  $3(p - 7)$  from 15.
  - Simplify  $4 + -(3r - 8)$
  - Simplify  $-a(2a - 2b)$
  - Add  $4n + 3$  to  $2n - 7$
14. Mawerere had  $(6h - 7)$  pens.  $2(h - 3)$  pens got lost. Find the algebraic expression for the remaining pens.
15. A school had  $(5h - 14)$  pupils last year. This year,  $(h + 3)$  pupils have left the school. Write the algebraic expression for the remaining number of pupils in the school.

## More problems involving simplifying algebraic expressions

### **Example 1**

Study the figure below.



- a) Find the perimeter of the figure.

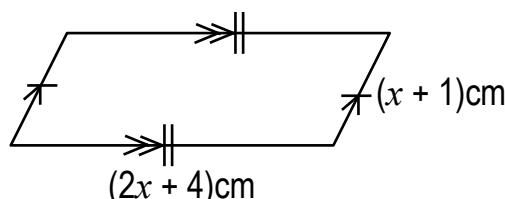
$$\begin{aligned} P &= 2(x + 1) + 2(2x - 1) + (x - 1) \\ P &= 2x + 2 + 4x - 2 + x - 1 \\ P &= 2x + 4x + x + 2 - 2 - 1 \\ P &= 7x - 1 \\ P &= (7x - 1)\text{cm} \end{aligned}$$

- b) If  $x = 2$ , find the actual perimeter.

$$\begin{aligned} P &= (7x - 1)\text{cm} \\ P &= 7 \times 2\text{cm} - 1\text{cm} \\ P &= 14\text{cm} - 1 \\ P &= 13\text{cm} \end{aligned}$$

### **Example 2**

Below is a parallelogram.



- a) Find its perimeter.

$$\begin{aligned} P &= 2(2x + 4) + 2(x - 1) \\ P &= 4x + 8 + 2x - 2 \\ P &= 4x + 2x + 8 - 2 \\ P &= (6x + 6)\text{cm} \end{aligned}$$

- b) If  $p = 5$ , find the actual perimeter of the parallelogram.

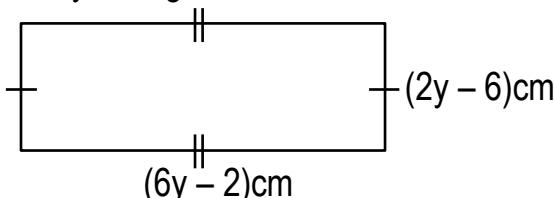
$$\begin{aligned} P &= (6x + 6)\text{cm} \\ P &= (6 \times 5 + 6)\text{cm} \\ P &= (30 + 6)\text{cm} \\ P &= 36\text{cm} \end{aligned}$$

# TOPIC 12: ALGEBRA



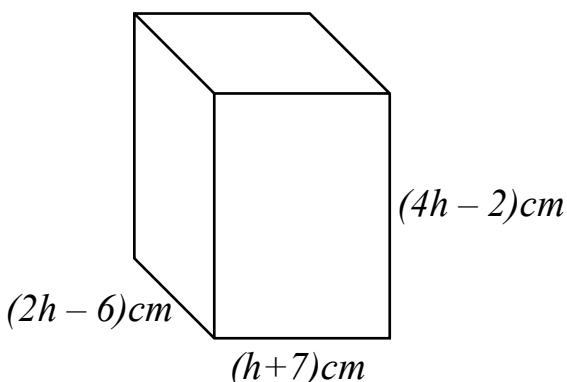
## Exercise

1. Rogers bought 3 biscuits at sh. $(k - 200)$  each and 2 pancakes at sh.  $(2k - 400)$ .
  - a) Write the simplified algebraic expression for the total amount of money he spent altogether.
  - b) If  $k = 300$ , how much money would he pay for 5 pancakes?
2. Kizito is 12 years. His sister is  $(2y - 3)$  years younger.
  - a) How old is her sister?
  - b) Given that  $y = 2$  years, how old will his sister be in 7 years' time?
3. Study the figure below.



- a) Find its perimeter.
- b) Find the area of the figure if  $y = 5$ .

5. Muko is 43 years old now, how old was he  $(2m - 15)$  years ago?
6. Study the figure below.



- a) Find the sum of the length of all edges in simplest form.
- b) If  $h = 5$  cm, calculate the volume of the figure.

7. In class of  $(6y)$  pupils,  $(4p - 10)$  are boys and the rest are girls. Find the algebraic expression for the number of girls in school.
8. Mwanje is  $(4w - 6)$  years younger than Mukibbi. If Mukibbi is  $(7w - 9)$  years,
  - a) How old is Mwanje.
  - b) Find their total age.
9. Study the table below and use it to form and simplify algebraic expressions.

Item	Cost
1 book	sh. $(2m - 100)$
1 pen	sh. $(4m - 1400)$

A man bought 3 books and 2 pens. How much money did he spend altogether?

10. The twins are 3 years younger than their brother who is  $(k - 5)$  years old. Find the algebraic expression of the total age of twins and their brother.

# TOPIC 12: ALGEBRA



## Addition and Subtraction of fraction algebraic expressions

### Example 1

Simplify:  $\frac{n}{2} + \frac{n}{5}$   
 $M_2 = \{2, 4, 6, 8, 10, 12, \dots\}$   
 $M_5 = \{5, 10, 15, \dots\}$   
LCD = 10  

$$\begin{array}{r} \frac{n}{2} + \frac{n}{5} \\ \hline 10 \\ 7n \\ \hline 10 \end{array}$$

### Example 2

Simplify:  $\frac{k}{2} + \frac{k}{3}$   
LCD = 6  

$$\begin{array}{r} 3k + 2k \\ \hline 6 \\ 5k \\ \hline 6 \end{array}$$

### Example 3

Simplify:  $2w - \frac{4w}{5}$   

$$\begin{array}{r} 2w - \frac{4w}{5} \\ \hline 1 \\ 10w - 4w \\ \hline 5 \\ \frac{6w}{5} = 1\frac{1}{5}w \end{array}$$

### Example 4

Simplify:  $\frac{2r}{3} + \frac{r}{2} - \frac{3r}{4}$   

$$\begin{array}{r} \frac{2r}{3} + \frac{r}{2} - \frac{3r}{4} \\ \hline LCD = 12 \\ \frac{8r + 6r - 9r}{12} \\ \hline 14r - 9r \\ \hline 12 \\ 5r \\ \hline 12 \end{array}$$

### Example 5

Simplify:  $3x + \frac{x}{2} - \frac{2x}{3}$   

$$\begin{array}{r} 3x + \frac{x}{2} - \frac{2x}{3} \\ \hline LCD = 6 \\ \frac{18x + 3x - 4x}{6} \\ \hline 21x - 4x \\ \hline 6 \\ \frac{17x}{6} \end{array}$$

### Example 6

Simplify:  $\frac{p}{2} - \frac{p}{3} + \frac{x}{4}$   
LCD = 12  

$$\begin{array}{r} \frac{p}{2} - \frac{p}{3} + \frac{p}{4} \\ \hline \frac{6p - 4p + 3p}{12} \\ \hline 6p + 3p - 4p \\ \hline 12 \\ \frac{9p - 4p}{12} = \frac{5p}{12} \end{array}$$

### Exercise

1. Simplify:

a)  $\frac{y}{5} + \frac{y}{5}$   
b)  $\frac{m}{7} + \frac{2m}{7}$   
c)  $\frac{6p}{13} + \frac{4p}{13}$

d)  $\frac{k}{2} + \frac{k}{3}$   
e)  $\frac{d}{3} + \frac{d}{7}$   
f)  $\frac{3k}{8} + \frac{k}{4}$

g)  $\frac{3w}{2} + \frac{w}{4}$   
h)  $\frac{5a}{6} + \frac{a}{8}$   
i)  $\frac{x}{4} + \frac{5x}{6}$

2. Work out;

a)  $\frac{3m}{4} - \frac{m}{2}$   
b)  $\frac{5p}{8} - \frac{p}{6}$

c)  $\frac{9r}{14} - \frac{3r}{7}$   
d)  $\frac{4y}{9} - \frac{y}{6}$

e)  $\frac{7d}{16} - \frac{3d}{8}$   
f)  $\frac{4c}{5} - \frac{3c}{10}$

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3. Simplify:

a)  $a - \frac{2a}{3}$

b)  $y - \frac{3y}{4}$

c)  $w - \frac{3w}{11}$

d)  $2k - \frac{7k}{8}$

e)  $3m - \frac{m}{4}$

f)  $5p - \frac{2p}{3}$

g)  $p + \frac{2p}{5}$

h)  $n + \frac{n}{6}$

i)  $2x + \frac{3x}{4}$

4. Simplify:

a)  $\frac{p}{2} - \frac{p}{3} + \frac{p}{4}$

b)  $\frac{m}{6} - \frac{m}{4} + \frac{m}{2}$

c)  $\frac{b}{5} + \frac{b}{3} - \frac{b}{15}$

d)  $\frac{3g}{4} + \frac{2g}{3} - \frac{5g}{6}$

e)  $\frac{w}{14} + \frac{5w}{7} - \frac{w}{2}$

f)  $\frac{7e}{9} + \frac{5e}{6} - \frac{11e}{18}$

5. Work out:

a)  $\frac{2a}{3} + \frac{a}{4} + \frac{a}{2}$

b)  $\frac{3y}{5} + \frac{7y}{10} + \frac{9y}{20}$

c)  $\frac{2b}{3} + \frac{3b}{2} + \frac{b}{5}$

d)  $\frac{2y}{3} + \frac{6y}{7} + \frac{3y}{5}$

e)  $\frac{8k}{7} + \frac{7k}{4} + \frac{k}{6}$

f)  $\frac{n}{7} + \frac{n}{3} + \frac{3n}{5}$

6. Simplify.

a)  $g + \frac{g}{5} + \frac{2g}{5}$

b)  $y + \frac{y}{4} + \frac{y}{3}$

c)  $3r + \frac{2r}{3} + \frac{5r}{2}$

d)  $2m - \frac{3m}{4} + \frac{m}{6}$

e)  $4c - \frac{5c}{6} - \frac{2c}{3}$

f)  $3n - \frac{5n}{9} + \frac{5n}{18}$

## Removing brackets involving fractions

### Example 1

Simplify:  $\frac{2}{3}(6y - 21g)$

$$\frac{2}{3}(6y - 21g)$$

$$(\frac{2}{3} \times 6y) - (\frac{2}{3} \times 21g)$$

$$4y - 14g$$

### Example 2

Remove brackets and simplify:

$$\frac{3}{7}(7h + 21a) + \frac{2}{9}(18h - 27a)$$

$$\frac{3}{7}(7h + 21a) + \frac{2}{9}(18h - 27a)$$

$$(\frac{3}{7} \times 7h) + (\frac{3}{7} \times 21a) + (\frac{2}{9} \times 18h) - (\frac{2}{9} \times 27a)$$

$$3h + 9a + 4h - 6a$$

$$3h + 4h + 9a - 6a$$

$$7h + 3a$$

### Example 3

Take away  $\frac{3}{4}(16k + 12)$  from  $\frac{2}{3}(15k - 6)$

$$\frac{2}{3}(15k - 6) - \frac{3}{4}(16k + 12)$$

$$(\frac{2}{3} \times 15k) - (\frac{2}{3} \times 6) - (\frac{3}{4} \times 16k) - (\frac{3}{4} \times 12)$$

$$10k - 4 - 12k - 9$$

$$10k - 12k - 4 - 9$$

$$-2k - 13$$

# TOPIC 12: ALGEBRA



## Exercise

1. Remove brackets.

a)  $\frac{1}{2}(4p + 4k)$

b)  $\frac{1}{5}(10n + 15n)$

g)  $\frac{2}{3}(6x + 9y)$

b)  $\frac{1}{4}(2a + 4b)$

e)  $\frac{3}{4}(4p + 12y)$

h)  $\frac{3}{5}(10r + 20p)$

c)  $\frac{1}{4}(4m + 20x)$

f)  $\frac{1}{3}(12w + 3x)$

i)  $\frac{4}{15}(30m + 75b)$

2. Simplify;

a)  $\frac{1}{5}(15x - 20y)$

d)  $\frac{2}{3}(6r - 21x)$

g)  $\frac{5}{7}(7 - 14p)$

b)  $\frac{2}{7}(14n - 42b)$

e)  $\frac{5}{9}(18xy - 36b)$

h)  $\frac{3}{13}(26a - 65)$

c)  $\frac{3}{4}(4a - 8b)$

f)  $\frac{2}{5}(10t + 25n)$

i)  $\frac{2}{11}(22 - 132y)$

3. Work out the following.

a)  $\frac{1}{2}(4m + 2n) - \frac{1}{3}(9m - 6n)$

i)  $\frac{1}{2}(4m + 6xy) - \frac{2}{3}(9m - 12xy)$

b)  $\frac{2}{7}(7y + 14x) + \frac{2}{9}(18y - 36x)$

j)  $\frac{1}{7}(7x + 14y) - \frac{1}{5}(10x - 15y)$

c)  $\frac{1}{2}(2k + 6p) + \frac{1}{4}(8k - 16p)$

k)  $\frac{1}{3}(9m - 12n) - \frac{1}{2}(2m - 6n)$

d)  $\frac{1}{3}(3n + 6y) + \frac{1}{2}(4n - 8y)$

l)  $\frac{1}{10}(20x - 30n) - \frac{1}{8}(8x - 16n)$

e)  $\frac{1}{2}(2k + 8q) + \frac{2}{3}(6k - 12q)$

m)  $\frac{1}{7}(7x + 14y) - \frac{1}{5}(25x - 35y)$

f)  $\frac{1}{2}(4m - 6y) + \frac{1}{3}(6m - 15y)$

n)  $\frac{1}{5}(10n + 25k) - \frac{3}{4}(12n - 16k)$

g)  $\frac{3}{8}(24y - 32x) + \frac{1}{9}(18y - 27x)$

o)  $\frac{1}{3}(6p - 9ac) - \frac{2}{3}(9p - 15ac)$

h)  $\frac{1}{5}(10m - 5n) - \frac{2}{3}(3n + 6m)$

4. What is a third of  $(9p - 12)$  plus three quarters of  $(4p - 20)$ ?

5. Increase  $\frac{1}{3}(12x + 15)$  by  $\frac{1}{2}(8x - 4)$ .

6. Find the sum of  $\frac{3}{5}(10p - 20y)$  and  $\frac{2}{3}(15p - 3)$ .

7. Add a sixth of  $(12 - 6m)$  to two ninths of  $(18 - 27m)$ .

8. Subtract  $\frac{3}{4}(12k - 8p)$  from  $\frac{2}{3}(6k - 12p)$ .

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9. Take away  $\frac{1}{4}(4x + 12y)$  from  $\frac{1}{6}(6x - 18y)$ .
10. Reduce  $\frac{3}{4}(8m - 12n)$  by  $\frac{2}{3}(6m + 9n)$ .
11. Take away a seventh of  $(21a - 35b)$  from a ninth of  $(45a - 18b)$ .
12. Subtract  $\frac{3}{4}(12ab - 20xy)$  from  $\frac{2}{5}(20a - 10xy)$ .

## Addition and Subtraction of fractional terms with compound numerators

### Example 1

Simplify:  $\frac{2}{3}(4x+1) - \frac{3}{4}(x+2)$

#### Approach 1

$$\begin{aligned} &\frac{2}{3}(4x+1) - \frac{3}{4}(x+2) \quad \text{LCD} = 12 \\ &\frac{12 \times \frac{2}{3}(4x+1) - 12 \times \frac{3}{4}(x+2)}{12} \\ &\frac{8(4x+1) - 9(x+2)}{12} \\ &\frac{32x+8 - 9x-18}{12} \\ &\frac{32x - 9x+8 - 18}{12} \\ &\frac{23x - 10}{12} \end{aligned}$$

#### Approach 2

$$\begin{aligned} &\frac{2}{3}(4x+1) - \frac{3}{4}(x+2) \\ &\frac{8x}{3} + \frac{2}{3} - \frac{3x}{4} - \frac{6}{4} \\ &\frac{\left(\frac{8x}{3} \times 12\right) + \left(\frac{2}{3} \times 12\right) - \left(\frac{3x}{4} \times 12\right) - \left(\frac{6}{4} \times 12\right)}{12} \\ &\frac{32x + 8 - 9x - 18}{12} \\ &\frac{32x - 9x + 8 - 18}{12} \\ &\frac{23x - 10}{12} \end{aligned}$$

### Example 2

Simplify:  $\frac{y+3}{2} - \frac{y+2}{3}$

#### Approach 1

$$\begin{aligned} &\left(\frac{y+3}{2}\right) - \left(\frac{y+2}{3}\right) \\ &\frac{y}{2} + \frac{3}{2} - \frac{y}{3} - \frac{2}{3} \quad \text{LCD} = 6 \\ &\frac{\left(\frac{y}{2} \times 6\right) + \left(\frac{3}{2} \times 6\right) - \left(\frac{y}{3} \times 6\right) - \left(\frac{2}{3} \times 6\right)}{6} \\ &\frac{3y + 9 - 2y - 4}{6} \\ &\frac{3y - 2y + 9 - 4}{6} \\ &\frac{y + 5}{6} \end{aligned}$$

#### Approach 2

$$\begin{aligned} &\frac{y+3}{2} - \frac{y+2}{3} \\ &\frac{6\left(\frac{y+3}{2}\right) - 2\left(\frac{y+2}{3}\right)}{6} \\ &\frac{3(y+3) - 2(y+2)}{6} \\ &\frac{3y + 9 - 2y - 4}{6} \\ &\frac{3y - 2y + 9 - 4}{6} \\ &\frac{y + 5}{6} \end{aligned}$$

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## Example 3

Simplify:  $2x + \frac{2x - 3}{4}$

### Approach 1

$$\begin{aligned} & 2x + \frac{2x - 3}{4} \\ & 2x + \frac{2x}{4} - \frac{3}{4} \quad \text{LCD} = 4 \\ & \underline{(4 \times 2x) + (\frac{2x}{4} \times 4) - (\frac{3}{4} \times 4)} \\ & \quad 4 \\ & \frac{8x + 2x - 3}{4} \\ & \frac{10x - 3}{4} \end{aligned}$$

### Approach 2

$$\begin{aligned} & 2x + \frac{2x - 3}{4} \\ & \underline{(2x \times 4) + 4(\frac{2x - 3}{4})} \\ & \quad 4 \\ & \frac{8x + 2x - 3}{4} \\ & \frac{10x - 3}{4} \end{aligned}$$

## Example 4

Simplify:  $4n - \frac{3n-2}{2} + \frac{2n}{3}$

### Approach 1

$$\begin{aligned} & 4n - \frac{3n-2}{2} + \frac{2n}{3} \quad \text{LCD} = 6 \\ & \underline{(4n \times 6) - \frac{6(3n-2)}{2} + (6 \times \frac{2n}{3})} \\ & \quad 6 \\ & \frac{24n - 3(3n-2) + 4n}{6} \\ & \frac{24n - 9n + 6 + 4n}{6} \\ & \frac{24n + 4n - 9n + 6}{6} \\ & \frac{28n - 9n + 6}{6} \\ & \frac{19n + 6}{6} \end{aligned}$$

### Approach 2

$$\begin{aligned} & 4n - \frac{3n-2}{2} + \frac{2n}{3} \\ & 4n - \frac{3n}{2} + \frac{2}{2} + \frac{2n}{3} \quad \text{LCD} = 6 \\ & \underline{(4n \times 6) - (6 \times \frac{3n}{2}) + (\frac{2}{2} \times 6) + (\frac{2n}{3} \times 6)} \\ & \quad 6 \\ & \frac{24n - 9n + 6 + 4n}{6} \\ & \frac{24n + 4n - 9n + 6}{6} \\ & \frac{28n - 9n + 6}{6} \\ & \frac{19n + 6}{6} \end{aligned}$$

# TOPIC 12: ALGEBRA



## Exercise

1. Simplify;

a)  $\frac{3p-4}{2} + \frac{2p+7}{7}$

e)  $\frac{2x+5}{4} + \frac{2x+3}{3}$

i)  $\frac{x-3}{3} - \frac{x+1}{4}$

b)  $\frac{n+3}{2} + \frac{n+2}{3}$

f)  $\frac{2w+1}{7} + \frac{3w-3}{2}$

j)  $\frac{3x+2}{4} - \frac{x+1}{3}$

c)  $\frac{x+1}{2} + \frac{x-2}{3}$

g)  $\frac{6x+9y}{3} + \frac{2x+8y}{2}$

k)  $\frac{y-2}{3} - \frac{y+1}{4}$

d)  $\frac{m+2}{5} + \frac{m-5}{2}$

h)  $\frac{3x-3}{4} + \frac{2x+5}{3}$

l)  $\frac{2p+3}{3} - \frac{2p-5}{4}$

2. Remove brackets and simplify.

a)  $\frac{2}{3}(2p+1) + \frac{1}{2}(p+3)$

d)  $\frac{1}{2}(3n-1) + \frac{1}{5}(4n-2)$

g)  $\frac{2}{3}(x+4) - \frac{2}{5}(x-1)$

b)  $\frac{1}{3}(x+1) + \frac{1}{2}(x+5)$

e)  $\frac{1}{3}(4x+3) - \frac{1}{2}(x+1)$

h)  $\frac{3}{4}(5p-1) - \frac{2}{3}(2p-5)$

c)  $\frac{1}{4}(2m-3) + \frac{1}{3}(m+2)$

f)  $\frac{1}{4}(3m+1) - \frac{3}{4}(m-3)$

i)  $\frac{5}{7}(3y-2) - \frac{2}{5}(y-2)$

3. Simplify;

a)  $m + \frac{2m+1}{2}$

e)  $2p + \frac{3p+1}{4}$

i)  $\frac{2n+4}{3} + 3$

b)  $2x + \frac{x+2}{3}$

f)  $4 + \frac{2+2y}{3}$

j)  $\frac{2+3r}{2} + 2r$

c)  $5y + \frac{y+3}{2}$

g)  $\frac{m+6}{5} + 2m$

k)  $\frac{2x+3}{4} + 1$

d)  $7 + \frac{1+3m}{2}$

h)  $\frac{k+1}{2} + 3k$

l)  $\frac{4+3p}{5} + p$

4. Work out:

a)  $2x - \frac{m+1}{3}$

e)  $2 - \frac{3y+1}{4}$

i)  $2p - \frac{2p-1}{3}$

b)  $6p - \frac{5p+1}{2}$

f)  $5 - \frac{3+2k}{3}$

j)  $5x - \frac{8x-4}{3}$

c)  $3y - \frac{3y+4}{5}$

g)  $\frac{2w-3}{3} - 2$

k)  $4 - \frac{3-2g}{5}$

d)  $\frac{m-6}{5} - 4$

h)  $\frac{4k-7}{5} - 3$

l)  $8 - \frac{5-6m}{4}$

5. Simplify;

a)  $\frac{2x}{3} + \frac{2x+1}{4} + 3x$

b)  $\frac{2x+1}{3} - \frac{x}{2} + \frac{3x+1}{4}$

c)  $\frac{x+3}{4} + \frac{x}{3} - \frac{x+3}{2}$

# TOPIC 12: ALGEBRA



6. Simplify:

a)  $2m + \frac{m+1}{3} + \frac{m}{2}$

c)  $\frac{3p-2}{5} + \frac{2p}{5} + \frac{p+1}{10}$

e)  $\frac{2p+4}{5} - \frac{p+1}{3} + \frac{4p}{15}$

b)  $\frac{6n+1}{5} + \frac{n}{10} + \frac{n+7}{2}$

d)  $\frac{3m}{4} + \frac{m+1}{6} - 2m$

f)  $\frac{3y-2}{4} - \frac{p}{6} - \frac{2}{3}(1+p)$

6. Find the sum of  $\frac{3x+1}{4}$  and  $\frac{2x-3}{5}$

9. Simplify:  $\frac{2x+4}{3} - 6 - 4x$

7. Take away  $\frac{2(m+1)}{3}$  from  $\frac{3m-1}{4}$

10. Take away  $\frac{3}{4}(m+1)$  from twice  $3m - 2$

8. Subtract  $\frac{3k+2}{4}$  from a third of  $4k + 1$

## EQUATIONS

Before solving any equation, you should take note of the following.

- When collecting like terms in an equation, a positive term that crosses equal signs becomes negative and vice versa.
- Addition, subtraction, multiplication and division is / are done on either side of the equation.

### Solving equations by subtracting

Example 1	Example 2	Example 3	Example 4
Solve: $y+3 = 7$  $y+3 = 7$ $y+3 - 3 = 7 - 3$ $y = 4$	Solve: $4 + m = 12$  $4 + m = 12$ $4 - 4 + m = 12 - 4$ $y = 8$	Solve: $8 = n + 10$  $8 = n + 10$ $8 - 10 = n + 10 - 10$ $-2 = n$ $n = -2$	Solve: $n + 2^3 = 5$  $n + 2^3 = 5$ $n + (2 \times 2 \times 2) = 5$ $n + 8 = 5$ $n + 8 - 8 = 5 - 8$ $n = -3$

### Exercise

1. Solve:

a)  $w + 3 = 10$

e)  $y + 10 = 4$

i)  $m + 3^2 = 4$

b)  $y + 7 = 15$

f)  $e + 20 = 12$

j)  $n + 5^2 = 30$

c)  $n + 4 = 11$

g)  $q + 64 = 100$

k)  $y + 4^2 = 5^2$

d)  $r + 13 = 9$

h)  $r + 25 = 16$

l)  $k + 6 \times 2 = 10$

2. Solve;

a)  $4 + r = 10$

d)  $7 + e = 12$

g)  $2^3 + x = 10$

b)  $6 + m = 8$

e)  $2 \times 3 + m = 9$

h)  $3^2 + y = 15$

c)  $10 + p = 6$

f)  $5 \times 2 + y = 15$

i)  $8 + y = 4^2$

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3. Solve;

a)  $6 = p + 4$

d)  $8 = g + 5$

g)  $4 = r + 3 \times 5$

b)  $12 = 10 + r$

e)  $6 \times 2 = 7 + n$

h)  $3^2 = k + 7$

c)  $4 = 7 + x$

f)  $5 = 4 \times 2 + k$

i)  $9 = 2^3 + g$

## Problems involving solving equations by subtracting

### Example 1

I think of a number, add 7 to it, the result is 12. Find the number.

Let the number be  $y$

$$y + 7 = 12$$

$$y + 7 - 7 = 12 - 7$$

$$y = 5$$

The number is 5

### Example 2

Musa had some books, his father gives him 13 more books. He has 21 books altogether. How many books did Musa have at first?

Let the number of books be  $b$

$$b + 13 = 21$$

$$b + 13 - 13 = 21 - 13$$

$$b = 8$$

He had 8 books at first

## Exercise

1. I think of a number, add 4 to it, the result is 9. Find the number.
2. In the class of 25 pupils, 17 of them are girls and the rest are boys. By forming an equation, find the number of boys in the class.
3. The sum of two numbers is 20. One of the number is 12. Find the other number.
4. Kizza is 7 years old. After how many years will he be 15 years?
5. Yayi bought 16 eggs, 9 of them were rotten. By forming an equation, find the number of good eggs.

## Solving equations by adding

### Example 1

Solve:  $m - 4 = 8$

$$m - 4 = 8$$

$$m - 4 + 4 = 8 + 4$$

$$m = 12$$

### Example 2

Solve:  $y - 15 = 2$

$$y - 15 = 2$$

$$y - 15 + 15 = 2 + 15$$

$$y = 17$$

### Example 3

Solve:  $-3 + k = 10$

$$-3 + k = 10$$

$$-3 + 3 + k = 10 + 3$$

$$k = 13$$

## Exercise

1. Solve:

a)  $k - 6 = 2$

e)  $g - 4 = 11$

i)  $x - 35 = 26$

b)  $a - 3 = 5$

f)  $p - 2 = 9$

j)  $w - 70 = 35$

c)  $n - 10 = 7$

g)  $e - 23 = 4$

k)  $y - 17 = 25$

d)  $y - 13 = 20$

h)  $m - 9 = 5$

l)  $k - 123 = 149$

## TOPIC 12: ALGEBRA



2. Solve;
- a)  $8 = p - 4$
  - b)  $12 = m - 6$
  - c)  $5 = n - 2 \times 7$
  - d)  $15 = k - 3 \times 4$
  - e)  $7 = g - 8^0$
  - f)  $3 \times 6 = n - 6$
  - g)  $x - 5 \times 4 = 17$
  - h)  $p - 2^3 = 1$
  - i)  $w - 4^2 = 3^2$
3. Peter bought some pens, he gave 8 pens to his friend and remained with 7 pens. By forming an equation, find the number of pens Peter bought.
4. In a class of  $m$  pupils, 23 are girls and the rest are boys.
- a) Write an algebraic expression for the number of boys.
  - b) If there are 17 boys in the class, find the value of  $m$ .
5. Yoseri is  $k$  years old.
- a) Write an algebraic expression for Yoseri's age 9 years ago.
  - b) If Yoseri was 5 years old then, find the value of  $k$ .
6. Kiviiri is 6 years younger than his sister. His sister is  $g$  years old.
- a) Write an algebraic expression for Kiviiri's age.
  - b) Find the value of  $g$  if Kiviiri is 13 years old.
  - c) How old will Kiviiri's sister be after 5 years?
7. A book costs sh. 700 less than a geometry set. A geometry set costs sh.  $p$
- a) Find the value of  $p$  if 5 books cost sh. 9,000.
  - b) How much will I pay for  $2\frac{2}{3}$  dozens of geometry sets?
8. Study the prism below and use it to answer questions that follow.
- a) Find the value of  $x$ .
  - b) Find the actual length and width of the prism.
  - c) Find the total surface area of the prism.
  - d) Calculate the volume of the prism.
  - e) Find the sum of the length of all the edges.
9. Below is a quadrilateral ABCD.
- a) Find the value of  $g$ .
  - b) Calculate its;
    - i) area
    - ii) perimeter.
10. The difference between two numbers is 4. If the smaller number is 12, find the other number.
11. A trader bought some books. She sold  $1\frac{1}{2}$  dozens and remained with 6 books. Find the number of books the trader bought.

## TOPIC 12: ALGEBRA



12. Bidiko had a container full of cooking oil. He gave 6 litres to his family. The remaining cooking oil was enough to fill three 5 - litre jerry cans. How many litres of cooking oil did Bidiko have at first?
13. When certain number is reduced by the square of 3, the result is 1. Find the number.

### Solving equations by dividing

Example 1	Example 2	Example 3	Example 4
<p>Solve: <math>2y = 16</math></p> $\begin{aligned} 2y &= 16 \\ \frac{2y}{2} &= \frac{16}{2} \\ y &= 8 \end{aligned}$	<p>Solve: <math>-p = 7</math></p> $\begin{aligned} -p &= 7 \\ \frac{-p}{-1} &= \frac{7}{-1} \\ p &= -7 \end{aligned}$	<p>Solve: <math>-6m = -18</math></p> $\begin{aligned} -6m &= -18 \\ \frac{-6m}{-6} &= \frac{-18}{-6} \\ m &= +3 \end{aligned}$	<p>Solve: <math>-18p = 9</math></p> $\begin{aligned} -18p &= 9 \\ \frac{-18p}{-18} &= \frac{9}{-18} \\ p &= -\left(\frac{1}{2}\right) \end{aligned}$

### Exercise

1. Solve;
 

a) $4n = 24$	e) $-b = 5$	i) $-3r = 12$
b) $7x = 14$	f) $-y = 10$	j) $-7x = 21$
c) $2y = 18$	g) $-d = -6$	k) $-8d = -32$
d) $3w = 9$	h) $-a = -10$	l) $-15q = -5$
2. Solve;
 

a) $20k = 10$	d) $12g = 4$	g) $-14y = -7$
b) $17n = 51$	e) $15q = 6$	h) $-6p = 15$
c) $30m = 5$	f) $-9x = -12$	i) $-12b = 18$
3. Yvone bought 4 packets of markers with  $k$  markers each.
  - a) Write an algebraic expression for the total number of markers she bought.
  - b) If she bought 52 markers altogether, find the value of  $k$ .
4. A school organised a trip to Entebbe airport. Taxis which carried 14 pupils each were used.
  - a) Write an algebraic expression for the total number of pupils who went for the trip.
  - b) If 84 pupils went for a trip, how many taxis were used?
5. Amukeke is thrice as old as Aduko. If Amukeke is 15 years old, how old is Aduko?
6. A geometry set costs 6 times as much as a rubber. The cost of a geometry set is sh. 3000. Find the cost of a rubber.
7. The father is 40 years old and he is twice as old as his son. How old is his son?
8. The number of pupils in P.7 doubles the number of pupils in P.6. There are 86 pupils in P.7. Find the number of pupils in P.6.
9. Simeo has twice as many goats as Daniel. Simeo has 108 goats altogether. How many goats does Daniel have?

## TOPIC 12: ALGEBRA



10. Mpalanyi got 5 times as many votes as Kyeyune. If Mpalanyi got 45,000 votes,
  - How many votes did Kyeyune get?
  - How many more votes did Mpalanyi get than Kyeyune?
11. Benjamin and Jackson shared some money such that Benjamin triples Jackson's share. If Benjamin's share was sh. 105,000.
  - Find Jackson's share.
  - How much more did Benjamin get than Jackson?
12. Bayiro has seven times as many pens as Kalamu. Bayiro has 42 pens.
  - How many pens does Kalamu have?
  - If they sell each pen at sh. 600, how much more will Bayiro get than Kalamu?
13. Kanoni bought  $y$  boxes of chalk at sh. 2500 each. He spent sh. 20,000 altogether.
  - Find the value of  $y$ .
  - If each box had 150 pieces of chalk, how many pieces of chalk did Kanoni buy?
14. Each of the 5 buses carried  $d$  passengers to Mbarara. Altogether they carried 400 passengers.
  - Find the value of  $d$ .
  - If each passenger paid sh. 20,000, how much money was collected from all the passengers?
15. The product of two numbers is 130. If one of the numbers is 26, find the other number.

### More problems involving solving equations by dividing

#### **Example 1**

In a shop, a book costs twice as much as a pen. The total cost of the items is sh. 4500. Find the cost of a book.

Let the cost of a pen be  $y$

Book	Pen	Total cost
2y	y	sh. 4500

#### Value of $y$

$$2y + y = \text{sh. } 4500$$

$$3y = \text{sh. } 4500$$

$$\frac{3y}{3} = \frac{\text{sh. } 4500}{3}$$

$$y = \text{sh. } 1500$$

#### Cost of a book

$$\begin{aligned} 2y &= 2 \times y \\ &= 2 \times \text{sh. } 1500 \\ &= \text{sh. } 3000 \end{aligned}$$

#### **Example 2**

Eddie is thrice as old as Mariam. The difference between their ages is 14 years. How old is Mariam?

Let Mariam's age be  $m$

Eddie	Mariam	Difference
3m	m	14

Value of  $m$

$$3m - m = 14$$

$$\frac{2m}{2} = \frac{14}{2}$$

$$m = 7 \text{ years}$$

Mariam is 7 years old

# TOPIC 12: ALGEBRA



## Example 3

The cost of a pineapple is three times more than the cost of a mango. Their total cost is sh. 1500. Find the cost of a mango.

Let the cost of a mango be  $y$

Mango	Pineapple	Total cost
$y$	$y + 3y$	sh. 1500

### Value of $y$

$$y + (y + 3y) = \text{sh. } 1500$$

$$y + 4y = \text{sh. } 1500$$

$$5y = \text{sh. } 1500$$

$$\frac{5y}{5} = \frac{\text{sh. } 1500}{5}$$

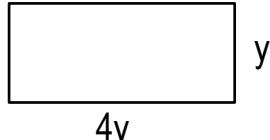
$$y = \text{sh. } 300$$

A mango costs sh. 300

## Example 4

The length of a rectangle is four times its width. If the perimeter is 30cm, find its length.

Let the width be  $y$



### Value of $y$

$$l + w + l + w = P$$

$$4y + y + 4y + y = 30\text{cm}$$

$$10y = 30\text{cm}$$

$$\frac{10y}{10} = \frac{30\text{cm}}{10}$$

$$y = 3\text{cm}$$

$$\text{Length} = 4y$$

$$= 4 \times 3\text{cm}$$

$$= 12\text{cm}$$

## Exercise

- Tina is twice as old as Maria. Their total age 18 years.
  - How old is Maria?
  - How old will Tina be in 9 years' time?
- The cost of a ruler is four times the cost of a pencil. The total cost of the two items is sh. 1000.
  - Find the cost of a pencil.
  - Calculate the cost of 7 rulers.
- Annet has thrice as many oranges as Aminah. They have 32 oranges altogether. How many oranges does each have?
- A pair of shoes costs five times as much as a pair of stockings. Marvin paid sh. 24,000 for the two items. Find the cost of a pair of shoes.
- The length of a rectangle is three times the width. The perimeter of the rectangle is 40cm.
  - Find the length of the rectangle .
  - Calculate its area.
- The perimeter of the figure below is 60cm.
 

(4g)cm
(6g)cm

  - Find the value of  $g$ .
  - Find the actual length and width.
  - Calculate the area of the rectangle.

a) Find the value of  $g$ .

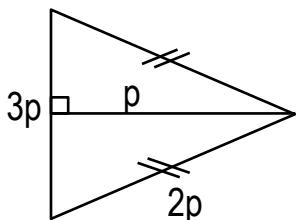
b) Find the actual length and width.

c) Calculate the area of the rectangle.

## TOPIC 12: ALGEBRA



7. Study the figure below carefully and use it to answer questions that follow.



Given that, the perimeter of the figure is 28cm.

- Find the value of  $p$  in centimetres.
- Calculate the area of the figure.

8. Primary seven class has 5 times as many girls as boys. The class has 72 pupils altogether. Find the number of;
- boys
  - girls
9. Vincent is four times as old as his son. The difference between their age is 27 years.
- How old is the son?
  - How old was Vincent 6 years ago?
10. Andrew's car consumes thrice as much petrol as Fatumah's car. One day, Andrew and Fatumah set off for a long journey. Andrew's car consumed 78 litres of petrol more than Fatumah's. Find in litres, the amount of petrol Andrew's car consumed.
11. Kyanzi has thrice as many cows as Kate. They have 80 cows altogether. How many cows does each have?
12. Mpiki is twice as old as Mbajo and Kyato is thrice as old as Mpiki. Their total age is 54 years.
- How old is Mbajo?
  - Find the total age of Mpiki and Kyato after 7 years.
13. In a shop, a ruler costs twice as much as a pen and story book costs thrice as much as a ruler and a pen. Mata paid sh. 5,000 for a story book and a pen. Find the cost of a ruler.
14. Allen is twice as old as Blessing and Blessing is four times as old as Martin. The range of their age is 28 years. How old is Allen?
15. The cost of a goat is 2 times more than the cost of a cock. A man bought a goat and 2 cocks at sh. 200,000 altogether. Find the cost of a cock.
16. A and B shared sh. 18000 such that A gets 4 times more than B. Find A's share.
17. Solve the equations.
- |                       |                       |
|-----------------------|-----------------------|
| a) $4m + m = 25$      | g) $t + 4t = 105$     |
| b) $x + x = 10$       | h) $7x + 6x = 26$     |
| c) $4p + 2p = 18$     | i) $3n + n + 4n = 40$ |
| d) $3m + m + 3m = 14$ | j) $y + 2y + 4y = 21$ |
| e) $k + 5k + 2k = 32$ | k) $5g + 2g + 3g = 5$ |
18. When a number is added to 4 times of itself, the result is 30. Find the number.
19. Three pupils; Joan, Jane and Joseph share 54 oranges. Jane got 4 times as many mangoes as Joseph and this was the same as Joan's share. Find Joan's share.
20. The cost of a novel is 2 times the cost of a geometry set and a geometry set costs thrice as much as a pen. A girl paid sh. 24000 for 3 novels and 2 geometry sets. How much money would she pay for half dozen of pens?

# TOPIC 12: ALGEBRA



## Solving equations by subtracting and dividing

### Example 1

Solve:  $2m + 9 = 15$

$$2m + 9 = 15$$

$$2m + 9 - 9 = 15 - 9$$

$$2m = 6$$

$$\frac{2m}{2} = \frac{6}{2}$$

$$m = 3$$

### Example 2

Solve:  $3 - 4n = 11$

$$3 - 4n = 11$$

$$3 - 3 - 4n = 11 - 3$$

$$-4n = 8$$

$$\frac{-4n}{-4} = \frac{8}{-4}$$

$$n = -2$$

### Example 3

Solve:  $4h + 3h + 2 = 23$

$$4h + 3h + 2 = 23$$

$$7h + 2 = 23$$

$$7h + 2 - 2 = 23 - 2$$

$$7h = 21$$

$$\frac{7h}{7} = \frac{21}{7}$$

$$h = 3$$

### Example 4

Annet and Amos shared sh. 10,000 such that Annet gets sh. 1000 more than Amos. How much money did Annet get?

Let Amos' share be a

Annet	Amos	Total
a + sh. 1000	a	sh. 10000

#### Value of a

$$a + a + \text{sh.} 1000 = \text{sh.} 10000$$

$$2a + \text{sh.} 1000 = \text{sh.} 10000$$

$$2a + \text{sh.} 1000 - \text{sh.} 1000 = \text{sh.} 10000 - \text{sh.} 1000$$

$$2a = \text{sh.} 9000$$

$$\frac{2a}{2} = \frac{\text{sh.} 9000}{2}$$

$$a = \text{sh.} 4500$$

#### Annet's share

$$a + \text{sh.} 1000$$

$$\text{sh.} 4500 + \text{sh.} 1000$$

$$\text{sh.} 5500$$

Annet got sh. 5500

### Exercise

1. Solve;

a)  $2h + 3 = 5$

d)  $3y + 13 = 10$

g)  $11p + 10 = 32$

b)  $4y + 7 = 13$

e)  $4n + 1 = 17$

h)  $8m + 7 = 39$

c)  $5t + 1 = 21$

f)  $6p + 16 = 22$

i)  $30n + 2 = 17$

2. Solve;

a)  $2 + 5n = 7$

c)  $12 + 6x = 15$

e)  $9 + 4k = 29$

b)  $10 + 2r = 6$

d)  $3 + 6p = 21$

f)  $15 + 2n = 1$

3. Solve;

a)  $9 = 1 + 4x$

d)  $4 = 8 - 2n$

g)  $100 = 46 + 9p$

b)  $12 = 6 + 18m$

e)  $3 = 7 - 2y$

h)  $20 = 13 + 7m$

c)  $2 = 12 + 5x$

f)  $10 = 3 - 14k$

i)  $21 = 14 + 14r$

# TOPIC 12: ALGEBRA



4. Solve;
- |                  |                   |                    |
|------------------|-------------------|--------------------|
| a) $3 - 2k = 9$  | d) $11 - 7g = 4$  | g) $12 - 6n = 36$  |
| b) $5 - 5p = 15$ | e) $2 - 18y = 11$ | h) $3 - 4h = 27$   |
| c) $8 - 2r = 2$  | f) $9 - 3m = -3$  | i) $11 - 11q = 33$ |
5. Kokrach is 8 years older than Owor. Their total age is 56 years. How old is each?
6. In a class of 74 pupils. The number of girls is 14 more than the number of boys. Find the number of boys in the class.
7. In a market, a watermelon costs sh. 800 more than an apple. Their total cost is sh. 2800. Find the cost of a watermelon.
8. Andrew and Deo shared sh. 12,000 such that Deo gets sh. 1000 more than Andrew. How much money did Deo get?
9. Nakimuli got 11 more pens than her brother. Altogether they got 47 pens. How many pens did Nakimui get?
10. Namugenyi has 6 more cows than Sseggayi. Altogether they have 78 cows. How many cows does Namugenyi has?
11. A man earns sh. 3,000 more than his wife daily. Their total daily income is sh. 33000. How much money does the man earn daily?
12. Oboi has 350 more chicken than Obonyo. Their total number of chicken is 1550. How many chicken does Oboi has?

## Solving equations by adding and dividing

<b>Example 1</b>	<b>Example 2</b>	<b>Example 3</b>
<p>Solve: <math>7x - 3 = 18</math></p> $7x - 3 = 18$ $7x - 3 + 3 = 18 + 3$ $\frac{7x}{7} = \frac{21}{7}$ $x = 3$	<p>Solve: <math>4 = -6 + 5y</math></p> $4 = -6 + 5y$ $4 + 6 = -6 + 6 + 5y$ $\frac{10}{5} = \frac{5y}{5}$ $2 = y$ $y = 2$	<p>Solve: <math>5 = 3g - 4</math></p> $5 = 3g - 4$ $5 + 4 = 3g - 4 + 4$ $\frac{9}{3} = \frac{3g}{3}$ $3 = g$ $g = 3$

### **Example 3**

Kinwi is 5 years younger than Kule. Their total age is 29 years. How old is Kule?

Let Kule's age be k

Kinwi	Kule	Total
(k - 5) years	k years	29 years

### Value of k

$$k + k - 5 = 29$$

$$2k - 5 = 29$$

$$2k - 5 + 5 = 29 + 5$$

$$\frac{2k}{2} = \frac{34}{2}$$

$$k = 17$$

*Kule is 17 years old.*

# TOPIC 12: ALGEBRA



## Exercise

1. Solve:
  - a)  $2y - 1 = 7$
  - b)  $3g - 4 = 11$
  - c)  $4k - 4 = 12$
  - d)  $5b - 4 = 6$
  - e)  $7y - 1 = 34$
  - f)  $3r - 10 = 17$
  - g)  $8p - 38 = 2$
  - h)  $4p - 3 = -15$
  - i)  $15n - 2 = 3$
2. Solve:
  - a)  $6 = 2p - 4$
  - b)  $13 = 3m - 2$
  - c)  $7 = 10x - 3$
  - d)  $3 = 16y - 5$
  - e)  $-6n - 4 = 20$
  - f)  $16 = -2 + 9k$
3. Kasim is 4 years younger than Ratif. Their total age is 24 years. How old is Ratif?
4. A girl is 15cm shorter than a boy. Their total height is 195cm. Find the girl's height.
5. A geometry set costs sh. 1500 less than a calculator. Their total cost is sh. 10,500.
  - a) Find the cost of a calculator.
  - b) Calculate the cost of 5 geometry sets.
6. Kawira and Kayiwa shared sh. 10,000 such that Kayiwa gets shs. 1000 less than Kawira. How much money did Kayiwa get?
7. Kizza is 5 years younger than Kigongo. Their total age is 31 years.
  - a) How old is Kigongo?
  - b) How old will Kizza be in 8 years' time?
  - c) After how many years will Kigongo be 23 years old?
8. Tumbetu is 8 years younger than his elder sister. Their total age is 38 years. How old will Tumbetu be in 6 years' time?
9. Kikuuta Primary school has 85 pupils less than Ndalage Primary school. The total enrollment is 765 pupils. How many pupils are in Kikuuta Primary school?
10. A pancake costs sh. 800 less than a cake. A girl bought 3 cakes and a pancake and paid sh. 3200. Find the cost of a pancake.
11. Jacob and Henry shared 30 mangoes such that Jacob gets 6 mangoes less than Henry.
  - a) How many mangoes did Henry get?
  - b) If Jacob sold all the mangoes he shared at sh. 500 each. How much money did he get altogether?
12. In a concert, children paid sh. 2000 less than adults. Mr. Kayemba paid sh. 12,000 for his wife and a child. How much money did he pay for his wife?
13. The number of boys in the class is 6 less than the number of girls. The total number of pupils in the class is 54. Find the number of boys.
14. There are 40 less sheep than goats on a farm of 100 animals. Find the number of sheep on the farm.
15. When a number is increased by 8 less than itself, the result is 32. Find the number.
16. Harriet is 9 years younger than her husband. Their total age is 77 years.
  - a) How old is Harriet now?
  - b) How old was her husband 15 years ago?

# TOPIC 12: ALGEBRA



## More equations

### Example 1

Solve:  $3g - 4 - g - 3 = 1$

$$3g - 4 - g - 3 = 1$$

$$3g - g - 4 - 3 = 1$$

$$2g - 7 = 1$$

$$2g - 7 + 7 = 1 + 7$$

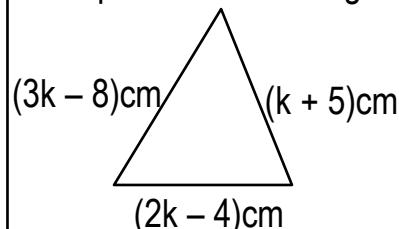
$$2g = 8$$

$$\frac{2g}{2} = \frac{8}{2}$$

$$g = 4$$

### Example 2

The perimeter of the figure below is 23cm.



Find the value of k.

$$2k - 4 + k + 5 + 3k - 8 = 23$$

$$2k + k + 3k + 5 - 4 - 8 = 23$$

$$6k - 7 = 23$$

$$6k - 7 + 7 = 23 + 7$$

$$6k = 30$$

$$\frac{6k}{6} = \frac{30}{6}$$

$$k = 5$$

### Example 3

Arnold is thrice as old as Cate. Linda is 8 years younger than Arnold. Their total age is 41 years. How old is Linda?

Let Cate's age be y

Arnold	Cate	Linda	Total
$3y$	$y$	$3y - 8$	41

Value of y

$$3y + y + 3y - 8 = 41$$

$$7y - 8 = 41$$

$$7y - 8 + 8 = 41 + 8$$

$$\frac{7y}{7} = \frac{49}{7}$$

$$y = 7$$

Linda's age

$$3y - 8$$

$$(3 \times 7) - 8$$

$$21 - 8$$

$$13 \text{ years}$$

### Exercise

1. Solve:

a)  $5x + 5 - 3x + 3 = 14$

e)  $6k + 6 - k + 2 = 13$

i)  $4p - 1 - 2p + 2 = 11$

b)  $5x + 5 + 2x + 16 = 42$

f)  $3p - 6 - 2p + 10 = 7$

j)  $5t - 5 - t + 21 = 0$

c)  $4q + 8 + 3q - 3 = 12$

g)  $3x - 6 + 2x - 2 = 2$

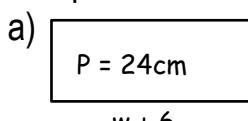
k)  $3q - 6 - 2q + 10 = 7$

d)  $x - 2 + x - 4 = 0$

h)  $4x - 4 - 3x + 6 = 4$

l)  $5x - 5 - 3x + 9 = 20$

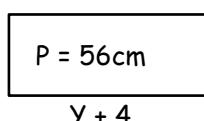
2. The perimeter of each of the figure below is given. Find the value of the unknown.



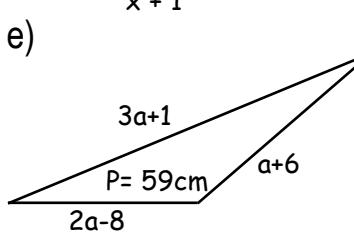
b)

c)

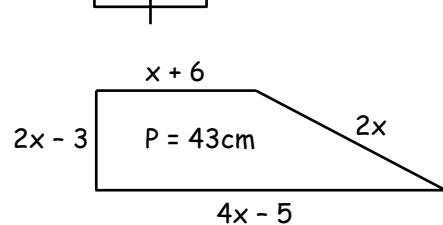
d)



e)



f)



## TOPIC 12: ALGEBRA



3. Sodo is twice as old as Paddy. Apito is 3 years younger than Sodo. The sum of their age is 32. Find their individual ages.
4. Subtract 15 from 5 times a number and then add 9. If the final result is 54. Find the number.
5. In a market, 3 mangoes cost sh. 400 less than an apple. My mother paid sh. 2400 for 12 mangoes.
  - a) Find the cost of an apple.
  - b) Calculate the total cost of 5 apples.
6. Ann, Cate and Bridget shared some money. Cate got 4 times as much as Ann and Bridget got sh. 1500 less than Ann and Cate. Cate and Bridget got sh. 9300.
  - a) How much money did Ann get?
  - b) How much more did Bridget get than Ann?
7. Three people contributed money for the start of a project as shown in the table below.

Lopa	Dan	Ssonko
$3y - \text{sh. } 2000$	$2y - \text{sh. } 8000$	$y + \text{sh. } 7000$

- a) If they contributed sh. 195,000 altogether, find the value of  $y$
- b) How much money did Lopa contribute?
8. Kape is  $(n + 1)$  years old now. His sister is 7 years younger. Their total age is 21 years.
  - a) How old is Kape?
  - b) Find the sister's age in 5 years' time.
9. There are three times as many goats as cows on a farm and there are 8 less sheep than cows on the same farm. The total number of animals on the farm is 77.
  - a) How many cows are on the farm?
  - b) Find the difference between the number of goats and sheep on the farm.
10. John is  $2k$  years old, Peter is  $k$  years older than John and Rema is 6 years younger than Peter. Their total age is 34 years. How old is each of them?
11. A rubber costs sh.  $y$ . A ruler costs sh.  $2y$  more than a rubber and a book costs sh. 700 less than a rubber and a ruler. Their total cost is sh. 3300.
  - a) Find the cost of a rubber.
  - b) Calculate the cost of 8 rulers.
  - c) Find the cost of  $1\frac{1}{2}$  dozens of books.
12. Rashid is  $p$  years old. Joan is 16 years older than Rashid and Alex is  $5p$  years younger than Joan. Their total age is 26 years.
  - a) Find the value of  $P$ .
  - b) How old is Alex?
13. Kiyemba picked 51 mangoes in three consecutive days. On the first day, he picked  $(y - 6)$  mangoes, on the second day he picked 4 mangoes more than the first day and 7 mangoes on the third day less than the second day.
  - a) Find the value of  $y$ .
  - b) How many mangoes did he pick on the third day?

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14. A doughnut costs sh. 400 more than a sweet and a cake costs sh. 500 more than doughnut. My mother bought 7 sweets, 1 cake and 1 doughnut. She paid sh. 2200 altogether.
- Find the cost of a sweet.
  - Calculate the total cost of 3 cakes and 5 doughnuts.
15. A fountain pen costs five times as much as a rubber and a geometry set costs as much as a fountain pen and a rubber. The total cost of the three items is sh 7200. Find the cost of a
- rubber
  - Geometry set

## More equations

### **Example 1**

Pedro is 4 years older than Julius. In five years' time, their total age will be 30 years. How old is Pedro now?

Let Julius' age be  $k$

	Pedro	Julius	Total
Now	$k + 4$	$k$	
5 years' time	$k + 9$	$k + 5$	30

Value of  $k$

$$k + 9 + k + 5 = 30$$

$$k + k + 9 + 5 = 30$$

$$2k + 14 = 30$$

$$2k + 14 - 14 = 30 - 14$$

$$\frac{2k}{2} = \frac{16}{2}$$

$$k = 8$$

Pedro's age

$$k + 4$$

$$8 + 4$$

$$12 \text{ years}$$

### **Example 3**

Sheila is 9 years and Brighton is 15 years old now. After how many years will their total age be 32 years?

	Sheilah	Brighton
Now	9	15
$t$ years	$9 + t$	$15 + t$

### **Example 2**

Birungi is twice as old as Kisakye. 8 years ago, their total age was 20 years. How old was Birungi then?

Let Kisakye's age now be  $n$

	Birungi	Kisakye
Now	$2n$	$n$
8 years ago	$2n - 8$	$n - 8$

Value of  $n$

$$2n - 8 + n - 8 = 20$$

$$2n + n - 8 - 8 = 20$$

$$3n - 16 = 20$$

$$3n - 16 + 16 = 20 + 16$$

$$\frac{3n}{3} = \frac{36}{3}$$

$$n = 12$$

Birungi's age 8 years ago

$$2n - 8$$

$$(2 \times 12) - 8$$

$$24 - 8$$

$$16 \text{ years}$$

Value of  $t$

$$9 + t + 15 + t = 32$$

$$9 + 15 + t + t = 32$$

$$24 + 2t = 32$$

$$24 - 24 + 2t = 32 - 24$$

$$\frac{2t}{2} = \frac{8}{2}$$

$$t = 4 \text{ years}$$

After 4 years

## TOPIC 12: ALGEBRA



### Example 4

Wilson is 16 years old and Winnie is 4 years younger. How many years ago was their total age 22 years?

	Wilson	Winnie
Now	16	12
d years ago	$16 - d$	$12 - d$

Value of d

$$16 - d + 12 - d = 22$$

$$16 + 12 - d - d = 22$$

$$28 - 2d = 22$$

$$28 - 28 - 2d = 22 - 28$$

$$-2d = -6$$

$$\frac{-2d}{-2} = \frac{-6}{-2}$$

$$d = 3 \text{ years}$$

3 years ago

### Exercise

- James is 2 years older than Shakirah. In two years' time, their total age will be 32 years. How old is each now?
- Sheebah is 7 years younger than Cindy. After 6 years, their total age will be 41 years.
  - How old is Cindy now?
  - How old will Sheebah be then?
- Esther is 6 years younger than Barbra. In 5 years' time, their total age will be 36 years. How old will Esther be then?
- Florence is twice as old as Tendo. In 4 years' time, the sum of their age will be 32. How old is Florence now?
- Adam is thrice as old as Eva. Their total age in 8 years' time will be 64 years. How old will Adam be then?
- Aidah is 2 years older than Viola. 3 years ago, their total age was 16 years. How old is each?
- Prosy is 4 years younger than Rose. Their total age 5 years ago was 14 years. How old is Prosy?
- Benard is twice as old as Robert. 7 years ago, their total age was 13 years. How old was Benard then?
- Jacob is 14 years and Maria is 10 years old. In how many years ago was their total age 12?
- Patience is 10 years old. Tracy is 14 years old. After how many years will their total age be 30?
- Jordan is 5 years older than Medard. Medard is 13 years old. In how many years ago was their total age 19 years?

## TOPIC 12: ALGEBRA



12. The previous cost of a book was sh. 300 more than the cost of a pen. The price of each item has been increased by sh. 50. A boy pays sh. 1400 for a pen and book altogether.
- Find the original price of the pen.
  - Calculate the cost of a book now.
13. There were 14 more cows than goats on the farm. When 8 cows and 4 goats were sold, 50 animals remained on the farm.
- How many goats were on the farm before?
  - Calculate the number of cows that remained on the farm.
14. The cost of a bottle of soda was thrice as much as the cost of a bottle of water. To each of the prices of the two items, sh.100 was added. If sh. 2200 is needed to buy 1 bottle of soda and 1 bottle of water altogether, find the cost of a bottle of soda before.
15. In a class, there were 21 boys and 28 girls. When an equal number of boys and girls left the class, only 41 pupils remained.
- How many boys left the class?
  - Find the remaining number of girls.
16. Muhimbo had 7 mangoes less than Natooro. Each ate 5 mangoes. Altogether they remained with 33 mangoes.
- How many mangoes did Natooro have at first ?
  - Calculate the number of mangoes Muhimbo remained with.
17. Lujumba had 17 cocks and 33 hens. He later sold four times as many hens as cocks. Only 35 chicken remained. Find the number of hens Lujumba remained with.
18. To each of the numbers; 18 and 13, 3h is Subtracted. The sum of the resulting numbers is 7.
- Find the value of h.
  - Find the resulting numbers.

### Solving equations with brackets

Example 1	Example 2	Example 3
<p>Solve: <math>2(h + 3) = 14</math></p> $\begin{aligned} 2(h + 3) &= 14 \\ 2h + 6 &= 14 \\ 2h + 6 - 6 &= 14 - 6 \\ \frac{2h}{2} &= \frac{8}{2} \\ h &= 4 \end{aligned}$	<p>Solve: <math>2(x + 1) - 3(2x - 1) = 3</math></p> $\begin{aligned} 2(x + 1) - 3(2x - 1) &= 3 \\ 2x + 2 - 6x + 3 &= 3 \\ 2x - 6x + 2 + 3 &= 3 \\ -4x + 5 &= 3 \\ -4x + 5 - 5 &= 3 - 5 \\ \frac{-4x}{-4} &= \frac{-2}{-4} \\ x &= \frac{1}{2} \end{aligned}$	<p>Solve: <math>6x - 9(x - 2) = 3</math></p> $\begin{aligned} 6x - 9(x - 2) &= 3 \\ 6x - 9x + 18 &= 3 \\ -3x + 18 &= 3 \\ -3x + 18 - 18 &= 3 - 18 \\ \frac{-3x}{-3} &= \frac{-15}{-3} \\ x &= 5 \end{aligned}$

# TOPIC 12: ALGEBRA



## Example 4

Solve:  $5 - 2(g - 4) = 7$

$$5 - 2(g - 4) = 7$$

$$5 - 2g + 8 = 7$$

$$5 + 8 - 2g = 7$$

$$13 - 2g = 7$$

$$13 - 13 - 2g = 7 - 13$$

$$\begin{array}{rcl} -2g & = & -6 \\ -2 & & -2 \\ g & = & 3 \end{array}$$

## Exercise

### 1. Solve;

$$a) 3(w + 2) = 12$$

$$f) 2(4y - 8) = 8$$

$$b) 2(g + 5) = 16$$

$$g) 6(y - 4) = 30$$

$$c) 3(m - 1) = 3$$

$$h) 9(p - 1) = 18$$

$$d) 5(p - 5) = 15$$

$$i) 4(n - 3) = 8$$

$$e) 2(k - 6) = 2$$

### 2. Solve;

$$a) 3a - (2 + a) = 6$$

$$f) 6 - (2p - 3) = 7$$

$$b) 3y - (y + 1) = 10$$

$$g) 8 - (6 - m) = 5$$

$$c) p - (2p - 9) = 5$$

$$h) 10 - (13 + 2k) = 5$$

$$d) 7 - (g + 4) = 1$$

$$i) 1 - (6y - 5) = 13$$

$$e) 13 - (4m + 6) = 15$$

### 3. Solve;

$$a) 3 + 2(g + 2) = 3$$

$$d) 4 - 3(h + 1) = 0$$

$$g) 4 - 5(2 + 3a) = 9$$

$$b) 7 - 3(h + 2) = 10$$

$$e) 6 + 2(2r + 1) = 12$$

$$h) 3m - 4(2 + m) = 9$$

$$c) 12 - 3(1 + y) = 3$$

$$f) 13 - 7(n + 10) = 17$$

$$i) 7y - 3(2y - 1) = 1$$

### 4. Solve;

$$a) 2(x + 1) + 3(3x + 1) = 15$$

$$f) 4(m - 1) - 2(m - 1) = 12$$

$$b) 3(2n + 1) + 4(n + 3) = 25$$

$$g) 2(2p - 1) - 2(y - 3) = 10$$

$$c) 3(m - 2) + 2(m - 1) = 12$$

$$h) 7(2k - 3) - 5(6k - 1) = 32$$

$$d) 4(r + 2) + 2(2r + 1) = 26$$

$$i) 5(3x - 1) - 4(3x + 1) = 12$$

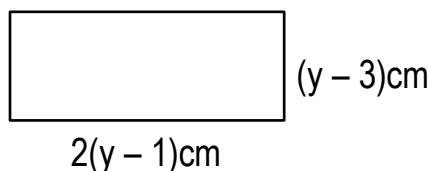
$$e) 6(y - 2) + 3(y + 2) = 3$$

$$j) 3(n - 1) - 3(3 - n) = 30$$

## Word problems related to solving equations with brackets

### Example 1

1. The perimeter of the rectangle below is 32cm. Find its actual area.



Value of  $y$

$$l + w + l + w = P$$

$$2(y - 1) + y - 3 + 2(y - 1) + y - 3 = 32$$

$$2y - 2 + y - 3 + 2y - 2 + y - 3 = 32$$

$$2y + y + 2y + y - 2 - 3 - 2 - 3 = 32$$

$$6y - 10 = 32$$

$$6y - 10 + 10 = 32 + 10$$

$$\frac{6y}{6} = \frac{42}{6}$$

$$y = 7$$

Length

$$2(y - 1) \text{ cm}$$

$$2(7 - 1) \text{ cm}$$

$$(2 \times 6) \text{ cm}$$

$$12 \text{ cm}$$

Width

$$(y - 3) \text{ cm}$$

$$(7 - 3) \text{ cm}$$

$$4 \text{ cm}$$

Area

$$A = L \times W$$

$$A = 12 \text{ cm} \times 4 \text{ cm}$$

$$A = 48 \text{ cm}^2$$

# TOPIC 12: ALGEBRA



## Example 2

Joan is three times as old as Philly and Philly is 6 years younger than Denis. Their total age is 41. How old is Joan?

Let Denis' age be  $d$

Joan	Philly	Denis	Total
$3(d - 6)$ years	$(d - 6)$ years	$d$ years	41 years

Value of  $d$

$$\begin{aligned}
 3(d - 6) + d - 6 + d &= 41 \\
 3d - 18 + d - 6 + d &= 41 \\
 3d + d + d - 18 - 6 &= 41 \\
 5d - 24 &= 41 \\
 5d - 24 + 24 &= 41 + 24 \\
 5d &= 65 \\
 \frac{5d}{5} &= \frac{65}{5} \\
 d &= 13
 \end{aligned}$$

Joan's age now.  
 $3(d - 6)$  years  
 $3(13 - 6)$  years  
 $3 \times 7$  years  
21 years

## Example 3

A pencil costs sh. 800 less than a pen and a book costs thrice as much as a pencil and a pen. Their total cost is sh. 4800. How much money will I pay for 5 books?

Let the cost of a pen be  $p$

Pen	Pencil	Book	Total
$y$	$(y - \text{sh. } 800)$	$3(y + y - \text{sh. } 800)$	sh. 4800

Value of  $y$

$$\begin{aligned}
 y + y - \text{sh. } 800 + 3(y + y - \text{sh. } 800) &= \text{sh. } 4800 \\
 y + y - \text{sh. } 800 + 3(2y - \text{sh. } 800) &= \text{sh. } 4800 \\
 y + y - \text{sh. } 800 + 6y - \text{sh. } 2400 &= \text{sh. } 4800 \\
 2y + 6y - \text{sh. } 800 - \text{sh. } 2400 &= \text{sh. } 4800 \\
 8y - \text{sh. } 3200 &= \text{sh. } 4800 \\
 8y - \text{sh. } 3200 + \text{sh. } 3200 &= \text{sh. } 4800 + \text{sh. } 3200 \\
 8y &= \text{sh. } 8000 \\
 \frac{8y}{8} &= \frac{\text{sh. } 8000}{8} \\
 y &= \text{sh. } 1000
 \end{aligned}$$

Cost of 1 book

$$\begin{aligned}
 3(y + y - \text{sh. } 800) \\
 3(\text{sh. } 1000 + \text{sh. } 1000 - \text{sh. } 800) \\
 3(\text{sh. } 2000 - \text{sh. } 800) \\
 3 \times \text{sh. } 1200 \\
 \text{sh. } 3600
 \end{aligned}$$

Cost of 5 books

$$\begin{aligned}
 \text{sh. } 3600 \times 5 \\
 \text{sh. } 18000
 \end{aligned}$$

## Exercise

- Irene is 3 years older than Claire. Peace is twice as old as Irene. Their total age is 33 years. How old is each?

## TOPIC 12: ALGEBRA

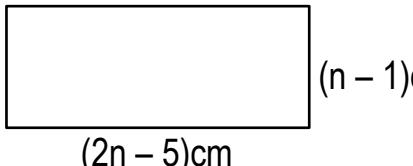


2. The perimeter of the figure below is 28cm.



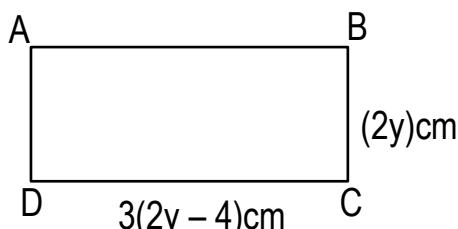
- a) Find the value of  $p$ .
- b) Find the actual length and width of the rectangle.
- c) Calculate the area of the rectangle.

3. The perimeter of the rectangle below is 24cm.



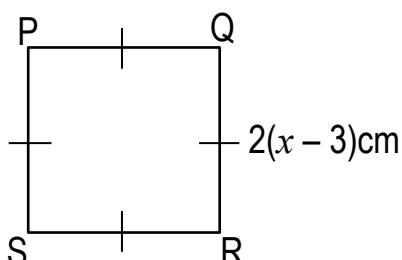
Calculate the area of the figure.

4. Below is rectangle ABCD whose perimeter is 40cm.



- a) Find length AB in cm.
- b) Calculate the area of the rectangle.

5. The perimeter of the quadrilateral PQRS below is 16cm.



- a) Find the value of  $x$ .
- b) Calculate the area of the figure.

6. Paul is 2 years older than Maureen and Cathy is 3 times of Paul's age. The sum of their age is 23 years.

- a) How old is Maureen?
- b) How old was Cathy 6 years ago?

7. Dan is twice as old as Gerald and Gerald is 4 years older than Annet. Their total age is 88 years. How old is Dan?

8. Harriet, Fik and Mark shared 67 mangoes. Fik got 5 more than Mark and Harriet got four times of Fik's share. Find Harriet's share.

9. Three traders; Lucky, Brian and Ben bought 90 dozens of pencils altogether. Brian bought 2 dozens more than twice of what Ben bought and Lucky bought 2 times as many dozens of pencils as Brian.

- a) How many dozens of pencils did Ben buy?
- b) Calculate the amount of money Lucky will get after selling all the pencils at sh. 1500 per dozen.

## TOPIC 12: ALGEBRA



10. There are 9 more cows than sheep on a farm. The number of goats on the same farm is twice the number of sheep and cows. The difference between goats and cows is 51. Find the number of;
  - i) sheep
  - ii) goats
11. A pen costs sh. 2p. A book costs sh. 500 more than two times of the cost of a pen and a rubber. A rubber costs as much as a pen. The total cost of the three items is sh. 3500.
  - a) Find the value of p.
  - b) Calculate the cost of a book.
12. P.7 class has three streams P.7A, P.7B and P.7C. P.7A has 15 candidates less than P.7B and P.7C has twice as many candidates as P.7A. The class has 115 candidates altogether. How many candidates are in P.7C?
13. Blair is twice as old as Aleni and Aleni is 6 years younger than Pervor. Their total age is 42 years.
  - a) How old is Blair?
  - b) How old will Aleni be in 7 years' time?
14. Every day, Newton sells twice as many bottles of soda as Genius and Molly sells 8 bottles less than Newton. In a week Molly sold 154 bottles of soda.
  - a) How many bottles of soda does Genius sell every day?
  - b) How much money does Newton make per day if he sells each bottle of soda at sh. 1500?
15. On a market day, Makumbi sold 12 less tomatoes than Kiberu. Mukasa trebled the number of tomatoes Makumbi sold. Kiberu and Mukasa sold 132 tomatoes altogether. Calculate the number of tomatoes which Makumbi sold.
16. A book costs four times as much as a pencil and a pencil costs sh. 200 less than a pen. The cost of two pens is the same as the cost of a book and pencil. Find the cost of  $1\frac{1}{2}$  dozens of pencils
17. Ssenfuka is thrice as old as his oldest son. His daughter is 30 years younger than him. The difference between the son's age and the daughter's age is 8 years.
  - a) How old is the son now?
  - b) After how many years will the total age of the three be 66 years?
18. A geometry set costs seven times as much as a pen and a book costs sh. 300 less than the cost of 2 pens. The cost of 5 books is the same as the cost of a geometry set. Find the cost of a book.
19. The highest and lowest mark obtained by pupils in a test is  $3(p + 15)$  and  $2(2p - 10)$  respectively. If the range of marks is 50, find the lowest score.
20. Kayiwa is four times as old as his son. Five years ago, the difference between their age was 36.
  - a) How old is the son now?
  - b) Find Kayiwa's age then.

# TOPIC 12: ALGEBRA



## More equations

### Example 1

Solve:  $2p - 7 = p + 1$

$$2p - 7 = p + 1$$

$$2p - p - 7 = p - p + 1$$

$$p - 7 = 1$$

$$p - 7 + 7 = 1 + 7$$

$$p = 6$$

### Example 2

Solve:  $2(m + 4) = m + 10$

$$2(m + 4) = m + 10$$

$$2m + 8 = m + 10$$

$$2m - m + 8 = m - m + 10$$

$$m + 8 = 10$$

$$m + 8 - 8 = 10 - 8$$

$$m = 2$$

### Example 3

Solve:  $3(a - 2) = 2(a - 1)$

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

$$3a - 6 = 2a - 2$$

$$3a - 2a - 6 = 2a - 2a - 2$$

$$a - 6 = -2$$

$$a - 6 + 6 = -2 + 6$$

$$a = 4$$

### Example 4

Solve:  $6 - 2(p - 1) = 3(p + 5)$

$$6 - 2(p - 1) = 3(p + 6)$$

$$6 - 2p + 2 = 3p + 18$$

$$6 + 2 - 2p = 3p + 18$$

$$8 - 2p = 3p + 18$$

$$8 - 2p - 3p = 3p - 3p + 18$$

$$8 - 5p = 18$$

$$8 - 8 - 5p = 18 - 8$$

$$\frac{-5p}{-5} = \frac{10}{-5}$$

$$p = -2$$

### Example 5

Solve :  $4 - 2(p - 1) = 2(p + 5)$

$$4 - 2(p - 1) = 2(p + 5)$$

$$4 - 2p + 2 = 2p + 10$$

$$4 + 2 - 2p = 2p + 10$$

$$6 - 2p = 2p + 10$$

$$6 - 2p - 2p = 2p - 2p + 10$$

$$6 - 4p = 10$$

$$6 - 6 - 4p = 10 - 6$$

$$\frac{-4p}{-4} = \frac{4}{-4}$$

$$p = -1$$

### Exercise

1. Solve;

a)  $3a + 1 = 2a + 6$

e)  $3y - 4 = 2y - 9$

i)  $5x + 7 = x + 19$

b)  $2y + 5 = y + 10$

f)  $7g - 4 = 3g + 8$

j)  $6 - 2p = p - 3$

c)  $7m + 6 = 6m + 13$

g)  $9n - 7 = 5n + 13$

k)  $10 - 4m = 3m + 24$

d)  $2k - 3 = k + 2$

h)  $11y + 3 = y + 43$

l)  $7 - g = 8g - 11$

2. Solve;

a)  $5(y - 2) = 2(y - 2)$

e)  $6(p + 4) = 3(p - 2)$

i)  $2(4c + 4) = 4c - 12$

b)  $3(3y - 2) = 2(y + 1)$

f)  $5(k - 2) = 2(k - 2)$

j)  $10 + 2(y + 3) = 4(2y + 1)$

c)  $4(w - 1) = 2(w + 1)$

g)  $3(a - 2) = 2(a - 1)$

k)  $8 - 4(n + 2) = 2(3n + 1)$

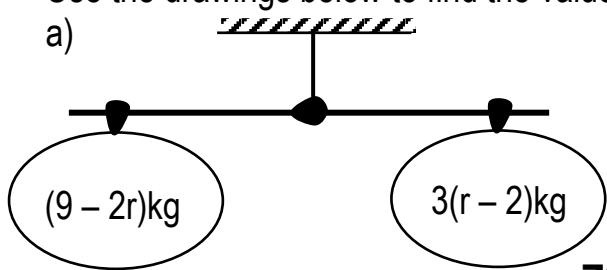
d)  $2(4 - y) = 3(y + 1)$

h)  $6(d - 1) = 4(d - 12)$

l)  $13 - 3(x + 2) = 6(7x - 5)$

3. Use the drawings below to find the value of the unknowns.

a)



(2m - 12)kg



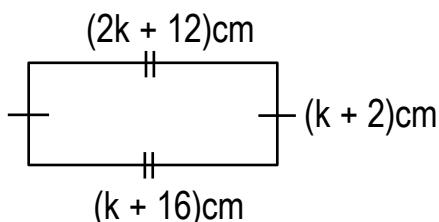
(n + 2)kg



## TOPIC 12: ALGEBRA

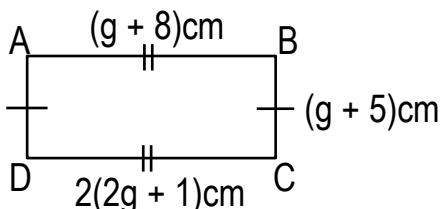


4. Study the figure below carefully and use it to answer questions that follow.



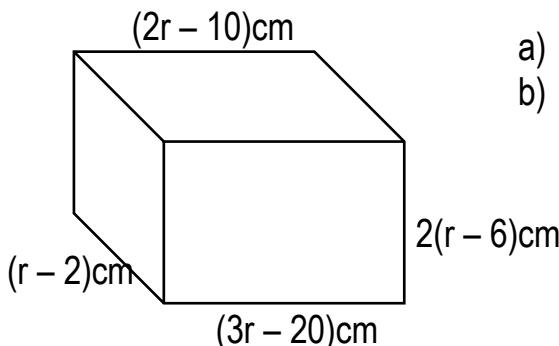
- a) Find the value of  $k$ .
- b) Find the actual length and actual width.
- c) Calculate the;
  - i) area
  - ii) perimeter

5. In the figure below, ABCD is a rectangle.



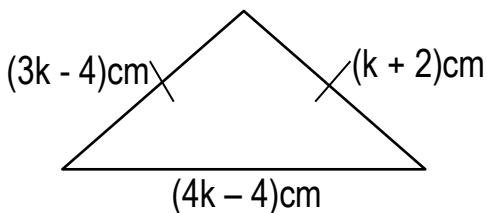
- a) Find the value of  $g$ .
- b) Calculate the area of the rectangle ABCD.

6. Study the prism below and use it to answer questions that follow.



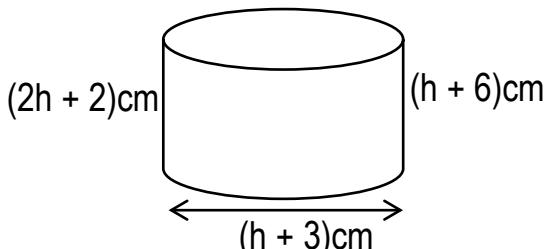
- a) Find the value of  $r$ .
- b) Calculate the volume of the prism.

7. Study the figure below.



- a) Find the value of  $k$ .
- b) Find the height of the triangle.
- c) Calculate the area of the triangle.

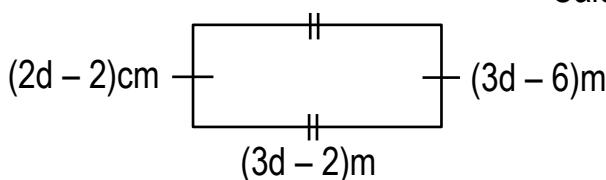
8. Below is a cylinder.



- a) Find the value of  $h$ .
- b) Calculate the volume of the cylinder.  
(Use  $\pi = \frac{22}{7}$ )

9. Below is a rectangular plot of land.

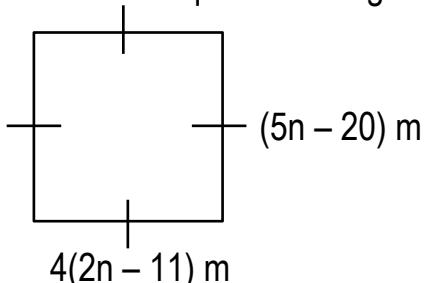
Calculate the area of the plot.



## TOPIC 12: ALGEBRA



10. Below is a square flower garden. Use it to answer questions that follow.



- a) Find the value of  $n$   
b) Find the area of the figure above.

### More word problems involving solving equations with brackets

#### **Example 1**

Joel is 10 years older than Jonah.  
In 2 years' time, Joel will be twice  
as old as Jonah. How old is Joel now?

Let Jonah's age be  $y$

	Joel	Jonah
Now	$y + 10$	$y$
2 years	$y + 12$	$y + 2$

Value of  $y$

$$\begin{aligned} 2(y + 2) &= y + 12 \\ 2y + 4 &= y + 12 \\ 2y - y + 4 &= y - y + 12 \\ y + 4 &= 12 \\ y + 4 - 4 &= 12 - 4 \\ y &= 8 \end{aligned}$$

Joel's age now

$$\begin{aligned} y + 10 \\ 8 + 10 \\ 18 \text{ years} \end{aligned}$$

#### **Example 3**

Nalongo is 28 years older than Nakato. Nakato is 12 years old. After how many years  
Nalongo be three times as old as Nakato?

Let the years be  $d$

	Nakato	Nalongo
Now	12	40
$d$ years	$12 + d$	$40 + d$

Value of  $d$

$$\begin{aligned} 3(12 + d) &= 40 + d \\ 36 + 3d &= 40 + d \\ 36 + 3d - d &= 40 + d - d \\ 36 + 2d &= 40 \\ 36 - 36 + 2d &= 40 - 36 \\ 2d &= 4 \end{aligned}$$

$$\begin{aligned} \frac{2d}{2} &= \frac{4}{2} \\ d &= 2 \end{aligned}$$

After 2 years

# TOPIC 12: ALGEBRA



## Example 4

Cissy is 10 years old and Irene is 22 years old now. In how many years ago was Irene four times as old as Cissy?

### Approach 1

Let the years be k

	Cissy	Irene
Now	10	22
k years ago	$10 - k$	$22 - k$

Value of k

$$\begin{aligned}
 4(10 - k) &= 22 - k \\
 40 - 4k &= 22 - k \\
 40 - 4k + k &= 22 - k + k \\
 40 - 3k &= 22 \\
 40 - 40 - 3k &= 22 - 40 \\
 \frac{-3k}{-3} &= \frac{-18}{-3} \\
 k &= 6
 \end{aligned}$$

6 years ago.

### Approach 2

Difference now

$$22 - 10 = 12 \text{ years}$$

Irene	12	13	14	15	16
Cissy	0	1	2	3	4

$$22 - 16 = 6 \text{ years}$$

## Exercise

- Pito is 18 years older than Tina. In 6 years' time, Pito will be twice as old as Tina.
  - How old is Tinah now?
  - How old will Pito be then?
- Innocent is 12 years older than Emma. In 3 years' time Innocent will be twice as old as Emma. How old is Emma now?
- Matia is 18 years older than Ponsiano. After 4 years, Matia will be four times as old as Ponsiano.
  - How old is Ponsiano?
  - How old will Matia be then?
- Deo is 20 years younger than Resty. In 2 years' time, Resty will be thrice as old as Deo. How old will Resty be then?
- Richard is 8 years younger than Agnes. In 6 years' time, Agnes will be twice as old as Richard. How old will Richard be then?
- Dorothy is 18 years older than Immaculate. 14 years ago, Dorothy was twice as old as Immaculate.
  - How old is Immaculate?
  - Find Dorothy's age then.
- Lozio is 2 years older than Zabeti. 10 years ago, Lozio was thrice as old as Zabeti. How old was Lozio then?

## TOPIC 12: ALGEBRA



8. Collin is 8 years younger than Patrick. 16 years ago, Patrick was thrice as old as Collin. How old is Collin now?
9. Betty is 40 years younger than Bernice. 8 years ago, Bernice was twice as old as Betty. How old was Betty 8 years ago?
10. Biswanka is 8 years younger than Pazo. 6 years ago, Pazo was 5 times as old as Biswanka. How old is Biswanka now?
11. Kalyango is 14 years older than his sister. 17 years ago, Kalyango was three times as old as his sister. How old was his sister then?
12. Blessing is 24 years old. Brenda is 8 years old. After how many years will Blessing be twice as old as Brenda?
13. David is 8 years. Alex is 40 years older than David. How old will Alex be when he is five times as old as David?
14. Catherine is 50 years old. Carol is 34 years younger.
  - a) After how long will Catherine be thrice as old as Carol?
  - b) How old will Carol be then?
15. Yaled is 18 years old and Kato is 30 years.
  - a) In how many years ago was Kato twice as old as Yaled?
  - b) Find Yaled's age then.
16. Maddox is 24 years younger than Robert who is 39 years old.
  - a) How many years ago was Robert four times as old as Maddox?
  - b) How old was Maddox then?
17. A woman is 42 years older than her son. 18 years ago, she was fifteen times as old as the son.
  - a) How old is the woman now?
  - b) After how many year will the woman be twice as old as the son?
18. By Selling a pen for sh. 650, a trader would make profit. If she sells the same pen for sh. 450, she would have made loss. Find the loss she would make if the profit is three times the loss.
19. In a class, 15 pupils and 21 pupils were present on Monday and Tuesday respectively.
  - a) Find the total number of pupils in the class if the number of absentees on Monday was thrice the number of absentees on Tuesday.
  - b) Given that 5 boys were absent on Monday and the class has 12 boys altogether, find the number of girls who were present that day.
20. The number of cows on a farm is 20 less than the number of goats and the number of cows is 12 more than the number of sheep. The number of cows is three times of the number of sheep.  
Calculate the number of;
  - i) goats
  - ii) sheep
21. Masika has 2 less books than Kule. Kipako has 19 more books than Masika. If Kipako has twice as many books as Masika and Kule, how many books do they have altogether?

# TOPIC 12: ALGEBRA



## Solving equations with fractions

### Example 1

$$\text{Solve: } \frac{y}{5} = 4$$

$$\begin{aligned}\frac{y}{5} &= 4 \\ 5 \times \frac{y}{5} &= \frac{4}{1} \times 5 \\ y &= 20\end{aligned}$$

### Example 2

$$\text{Solve: } \frac{p}{3} + 3 = 5$$

$$\begin{aligned}\frac{p}{3} + 3 - 3 &= 5 - 3 \\ 3 \times \frac{p}{3} &= \frac{2}{1} \times 3 \\ y &= 6\end{aligned}$$

### Example 3

$$\text{Solve: } \frac{2w}{5} - 3 = 1$$

$$\begin{aligned}\frac{2w}{5} - 3 + 3 &= 1 + 3 \\ 5 \times \frac{2w}{5} &= \frac{4}{1} \times 5 \\ \frac{2w}{2} &= \frac{20}{2} \\ w &= 10\end{aligned}$$

### Example 4

$$\text{Solve: } \frac{2h}{5} + h = 14$$

$$\begin{aligned}\frac{2h}{5} + h &= 14 \\ (5 \times \frac{2h}{5}) + (\frac{h}{1} \times 5) &= \frac{14}{1} \times 5 \\ 2h + 5h &= 70 \\ \frac{7h}{7} &= \frac{70}{7} \\ h &= 10\end{aligned}$$

### Example 5

$$\text{Solve: } d + \frac{11d}{7} = 18$$

$$\begin{aligned}d + \frac{11d}{7} &= 18 \\ (\frac{d}{1} \times 7) + (\frac{11d}{7} \times 7) &= 18 \times 7 \\ 7d + 11d &= 126 \\ \frac{18d}{18} &= \frac{126}{18} \\ d &= 7\end{aligned}$$

### Example 6

$$\text{Solve: } \frac{n}{6} = \frac{n}{4} - 2$$

$$\begin{aligned}\frac{n}{6} &= \frac{n}{4} - 2 \\ (\frac{n}{6} \times 12) &= (\frac{n}{4} \times 12) - (\frac{2}{1} \times 12) \\ 2n &= 3n - 24 \\ 2n - 3n &= 3n - 3n - 24 \\ \frac{-n}{-1} &= \frac{-24}{-1} \\ n &= 24\end{aligned}$$

### Example 7

$$\text{Solve: } \frac{a}{3} + \frac{a}{4} = a - 5$$

$$\begin{aligned}\frac{a}{3} + \frac{a}{4} &= a - 5 \\ \frac{a}{3} + \frac{a}{4} &= \frac{a}{1} - \frac{5}{1} \\ (\frac{a}{3} \times 12) + (\frac{a}{4} \times 12) &= (\frac{a}{1} \times 12) - (\frac{5}{1} \times 12) \\ 4a + 3a &= 12a - 60 \\ 7a - 12a &= 12a - 12a - 60 \\ \frac{-5a}{-5} &= \frac{-60}{-5} \\ a &= 12\end{aligned}$$

### Example 8

$$\text{Solve: } \frac{2y}{5} + 6 = 2 + y$$

$$\begin{aligned}\frac{2y}{5} + 6 &= 2 + y \\ \frac{2y}{5} + \frac{6}{1} &= \frac{2}{1} + \frac{y}{1} \\ (\frac{2y}{5} \times 5) + (\frac{6}{1} \times 5) &= (\frac{2}{1} \times 5) - (\frac{y}{1} \times 5) \\ 2y + 30 &= 10 + 5y \\ 2y - 2y + 30 &= 10 + 5y - 2y \\ 30 &= 10 + 3y \\ 30 - 10 &= 10 - 10 + 3y \\ \frac{20}{3} &= \frac{3y}{3} \\ 6\frac{2}{3} &= y \\ y &= 6\frac{2}{3}\end{aligned}$$

# TOPIC 12: ALGEBRA



## Exercise

1. Solve;

a)  $\frac{k}{7} = 2$

d)  $\frac{r}{10} = 4$

g)  $\frac{16}{w} = 2$

b)  $\frac{m}{4} = 3$

e)  $\frac{x}{11} = 12$

h)  $\frac{2k}{3} = 12$

c)  $\frac{n}{8} = 5$

f)  $\frac{13}{n} = 26$

i)  $\frac{12h}{7} = 24$

2. Solve;

a)  $1\frac{1}{4}k = 15$

d)  $\frac{2d}{5} + 1 = 7$

g)  $\frac{2x}{7} - 4 = 2$

b)  $\frac{m}{6} + 1 = 5$

e)  $\frac{7a}{15} - 1 = 6$

h)  $\frac{4g}{9} - 3 = 5$

c)  $\frac{n}{9} + 4 = 10$

f)  $4\frac{1}{3}p + 2 = 15$

i)  $1\frac{1}{4}y - 7 = 3$

3. Solve;

a)  $4 - \frac{m}{3} = 2$

d)  $\frac{4y}{7} + y = 11$

g)  $\frac{3g}{7} + 2g = 34$

b)  $k - \frac{2}{3}k = 7$

e)  $\frac{p}{5} + 7p = 15$

h)  $5n - 5\frac{2}{3}n = 18$

c)  $\frac{2m}{5} - m = 6$

f)  $\frac{2m}{5} + m = 7$

i)  $h - \frac{2h}{3} = 7$

4. Solve;

a)  $6 + \frac{4}{n} = 4$

d)  $4d + 7 - \frac{4d}{7} = 31$

g)  $5h + 5 - \frac{2h}{3} = 18$

b)  $\frac{12}{n} - 3 = \frac{3}{n}$

e)  $3e - 7 + \frac{3e}{4} = 23$

h)  $\frac{2a}{3} + 1 = \frac{3a}{2} - 4$

c)  $\frac{2}{3}t - 4 = \frac{1}{2}t + 6$

f)  $3t - 3 - \frac{4t}{7} = 12$

i)  $\frac{x}{3} - \frac{x}{4} = x - 11$

j)  $\frac{18}{x} - 6 = 3$

## More equations

### Example 1

Solve:  $\frac{y+2}{3} + \frac{y}{2} = 4$

$$\frac{y+2}{3} + \frac{y}{2} = 4$$

$$6\left(\frac{y+2}{3}\right) + \frac{y}{2} \times 6 = 4 \times 6$$

$$2(y+2) + 3y = 24$$

$$2y + 4 + 3y = 24$$

$$2y + 3y + 4 = 24$$

$$5y + 4 = 24$$

$$5y + 4 - 4 = 24 - 4$$

$$\begin{aligned} \frac{5y}{5} &= \frac{20}{5} \\ y &= 4 \end{aligned}$$

### Example 2

Solve:  $\frac{2p-4}{4} = \frac{p+1}{3}$

$$\frac{2p-4}{4} = \frac{p+1}{3}$$

$$12\left(\frac{2p-4}{4}\right) = 12\left(\frac{p+1}{3}\right)$$

$$3(2p-4) = 4(p+1)$$

$$6p - 12 = 4p + 4$$

$$6p - 4p - 12 = 4p - 4p + 4$$

$$2p - 12 = 4$$

$$2p - 12 + 12 = 4 + 12$$

$$\begin{aligned} \frac{2p}{2} &= \frac{16}{2} \\ p &= 8 \end{aligned}$$

# TOPIC 12: ALGEBRA



## Example 3

$$\text{Solve: } \frac{1}{2}(x+1) + \frac{1}{3}(x-2) = 4$$

$$\frac{1}{2}(x+1) + \frac{1}{3}(x-2) = 4$$

$$6 \times \frac{1}{2}(x+1) + 6 \times \frac{1}{3}(x-2) = 4 \times 6$$

$$3(x+1) + 2(x-2) = 24$$

$$3x+3+2x-4=24$$

$$3x+2x+3-4=24$$

$$5x-1=24$$

$$5x-1+1=24+1$$

$$\frac{5x}{5}=\frac{25}{5}$$

$$x=5$$

## Example 4

$$\text{Solve: } \frac{3}{p+2} = \frac{4}{p+1}$$

$$(p+2)(p+1) \cdot \frac{3}{p+2} = \frac{4}{p+1}(p+2)(p+1)$$

$$3(p+1) = 4(p+2)$$

$$3p+3 = 4p+8$$

$$3p-4p+3 = 4p-4p+8$$

$$-p+3=8$$

$$-p+3-3=8-3$$

$$\frac{-p}{-1} = \frac{5}{-1}$$

$$p = -5$$

## Exercise

1. Solve the following equations.

$$a) \frac{k+2}{3} + \frac{22}{7} = 4$$

$$e) \frac{p+4}{3} - \frac{p}{5} = 8$$

$$i) \frac{y+6}{8} + \frac{y}{4} = 3$$

$$m) \frac{x+1}{2} - \frac{x-2}{3} = \frac{1}{8}$$

$$b) \frac{n+3}{4} + \frac{n}{2} = 6$$

$$f) \frac{d+3}{2} + \frac{d}{3} = 8$$

$$j) \frac{a+1}{3} + \frac{a}{4} = 2$$

$$n) \frac{3y}{2} - \frac{14y-3}{5} = \frac{y-4}{4}$$

$$c) \frac{d+5}{5} + \frac{d}{5} = 5$$

$$g) \frac{v-2}{8} + \frac{v}{6} = 3$$

$$k) \frac{3a+4}{2} = \frac{7a}{2} - 2$$

$$o) \frac{3x+1}{2} = \frac{4x-3}{3} + 3$$

$$d) \frac{x+5}{4} + \frac{x}{5} = 2$$

$$h) \frac{x+1}{3} + \frac{x}{2} = 4$$

$$l) \frac{p+6}{5} - p = \frac{p-6}{6}$$

$$p) \frac{p-3}{12} + \frac{3(p-1)}{8} = \frac{2}{3}$$

2. Solve:

$$a) \frac{3d+4}{2} = \frac{4d+7}{3}$$

$$d) \frac{7p+1}{6} = \frac{3p-1}{2}$$

$$g) \frac{4n-9}{3} = \frac{3n+5}{7}$$

$$b) \frac{3f+8}{4} = \frac{f+6}{2}$$

$$e) \frac{4d-3}{7} = \frac{6d+4}{9}$$

$$h) \frac{8b-20}{2} = \frac{6d+3}{3}$$

$$c) \frac{3x+1}{4} = \frac{x+3}{2}$$

$$f) \frac{c+11}{7} = \frac{2c+31}{21}$$

$$i) \frac{3m}{4} = \frac{16m-1}{20}$$

3. Solve:

$$a) \frac{5a+6}{8} = \frac{2}{3}(a+1)$$

$$d) \frac{m+3}{2} + 2m = \frac{8m+2}{3}$$

$$g) \frac{t+1}{4} = 2 - \frac{t}{4}$$

$$b) \frac{p+6}{5} - p = \frac{p-8}{2}$$

$$e) \frac{3m}{4} - \frac{2m-2}{3} + 2 = 3$$

$$h) \frac{3}{4}(4p-4) - \frac{2}{3}(2p-1) = 6$$

$$c) \frac{3a+2}{4} + \frac{a+4}{3} = 2a$$

$$f) \frac{3k+2}{4} - \frac{k+3}{3} = 6$$

$$i) \frac{3}{8}(2h+4) + \frac{5}{6}(3h-6) = 16$$

4. Solve:

$$a) \frac{4}{3y+1} = \frac{2}{y+2}$$

$$c) \frac{4}{3n+1} = \frac{2}{n+3}$$

$$b) \frac{2}{3g-1} = \frac{6}{7g+1}$$

$$d) \frac{3}{4k-9} = \frac{7}{3k+5}$$

# TOPIC 12: ALGEBRA



## Word problems involving solving equations with fractions

### Example 1

Muwonge is 6 years younger than Mutyaba. 6 years ago, Muwonge's age was two fifths of Mutyaba's age. How old was Mutyaba then?

Let Mutyaba's age be  $m$

	Mutyaba	Muwonge
Now	$m$	$m - 6$
6 years ago	$m - 6$	$m - 12$

$$\begin{aligned} \frac{2}{5}(m - 6) &= m - 12 \\ 5 \times \frac{2}{5}(m - 6) &= 5(m - 12) \\ 2(m - 6) &= 5(m - 12) \\ 2m - 12 &= 5m - 60 \\ 2m - 5m - 12 &= 5m - 5m - 60 \\ -3m - 12 + 12 &= -6 + 12 \\ \frac{-3m}{-3} &= \frac{-48}{-3} \\ m &= 12 \end{aligned}$$

Mutyaba's age then.  
 $(m - 6)$  years  
 $(12 - 6)$  years  
6 years

### Example 3

The number of boys in a class last year was three quarters of the number of girls. This year, 5 boys and 6 girls have joined the class. The difference between the number of girls and boys is 7. Calculate the current number of girls in the class.

Let the number of girls last year be  $g$

	Boys	Girls
Last year	$\frac{3y}{4}$	$y$
This year	$\frac{3y}{4} + 5$	$y + 6$

$$\begin{aligned} (y + 6) - \left(\frac{3y}{4} + 5\right) &= 7 \\ y + 6 - \frac{3y}{4} - 5 &= 7 \end{aligned}$$

### Example 2

A book costs two thirds as much as a novel and a pen costs sh. 2000 less than a book. Find the cost of a pen if the total cost of the items is sh. 8500.

Let the cost of a novel be  $y$

Novel	Book	Pen
$y$	$\frac{2y}{3}$	$\frac{2y}{3} - \text{sh. } 2000$

$$\begin{aligned} y + \frac{2y}{3} + \frac{2y}{3} - \text{sh. } 2000 &= \text{sh. } 8500 \\ (3 \times y) + (3 \times \frac{2y}{3}) + (3 \times \frac{2y}{3}) - (\text{sh. } 2000 \times 3) &= \text{sh. } 8500 \times 3 \\ 3y + 2y + 2y - \text{sh. } 6000 &= \text{sh. } 25500 \\ 7y - \text{sh. } 6000 &= \text{sh. } 25500 \\ 7y - \text{sh. } 6000 + \text{sh. } 6000 &= \text{sh. } 25500 + \text{sh. } 6000 \\ \frac{7y}{7} &= \frac{\text{sh. } 31500}{7} \\ y &= \text{sh. } 4500 \end{aligned}$$

A pen costs

$$\begin{aligned} \frac{2y}{3} - \text{sh. } 2000 \\ \left(\frac{2 \times \text{sh. } 4500}{3}\right) - \text{sh. } 2000 \\ \left(\frac{\text{sh. } 9000}{7}\right) - \text{sh. } 2000 \\ \text{sh. } 3000 - \text{sh. } 2000 \\ \text{sh. } 1000 \end{aligned}$$

$$\begin{aligned} (4 \times y) + (6 \times 4) - (4 \times \frac{3y}{4}) - (4 \times 5) &= 7 \times 4 \\ 4y + 24 - 3y - 20 &= 28 \\ 4y - 3y + 24 - 20 &= 28 \\ y + 4 &= 28 \\ y + 4 - 4 &= 28 - 4 \\ y &= 24 \end{aligned}$$

Current number of girls  
 $24 + 6 = 30$  girls

# TOPIC 12: ALGEBRA



## Example 4

In a market, a sugarcane costs sh. 1400 less than a pine apple and an avocado costs three eights of the cost of a sugarcane. Ssebuufu paid sh. 9200 for 5 sugarcanes and 2 avocados. Find the cost of an avocado.

Let the cost a pine apple be  $p$

Sugarcane	Pineapple	Avocado
$y - \text{sh. } 1400$	$y$	$\frac{3}{8}(y - \text{sh. } 1400)$

Value of  $y$

$$\begin{aligned}
 5(y - \text{sh. } 1400) + 2 \times \frac{3}{8}(y - \text{sh. } 1400) &= \text{sh. } 9200 \\
 5y - \text{sh. } 7000 + \frac{3}{4}(y - \text{sh. } 1400) &= \text{sh. } 9200 \\
 (4 \times 5y) - (\text{sh. } 7000 \times 4) + 4 \times \frac{3}{4}(y - \text{sh. } 1400) &= \text{sh. } 9200 \times 4 \\
 20y - \text{sh. } 28000 + 3y - \text{sh. } 4200 &= \text{sh. } 36800 \\
 20y + 3y - \text{sh. } 28000 - \text{sh. } 4200 &= \text{sh. } 36800 \\
 23y - \text{sh. } 32200 &= \text{sh. } 36800 \\
 23y - \text{sh. } 32200 + \text{sh. } 32200 &= \text{sh. } 36800 + \text{sh. } 32200 \\
 \frac{23y}{23} &= \frac{\text{sh. } 69000}{23} \\
 y &= \text{sh. } 3000
 \end{aligned}$$

Cost of an avocado

$$\begin{aligned}
 \frac{3}{8}(y - \text{sh. } 1400) \\
 \frac{3}{8}(\text{sh. } 3000 - \text{sh. } 1400) \\
 \frac{3}{8} \times \text{sh. } 1600 \\
 \text{sh. } 600
 \end{aligned}$$

## Exercise

1. Joan is half as old as Kintu. Their total age is 27 years. How old is each?
2. Binti and Bisaka shared 30 mangoes. Binti got two thirds of Bisaka's share. How many mangoes did each get?
3. Paul is two thirds as old as his sister. In 5 years' time, their total age will be 25 years.
  - a) How old is the sister now?
  - b) Find Paul's age then.
4. Badru is three quarters as old as Isma. There total age after 4 years from now will be 43 years. How old is Badru now?
5. My brother is  $\frac{3}{8}$  as old as Daddy. 6 years ago, their total age was 43 years. How old was my brother then?
6. Birasa is 40 years older than Oruguru. In 4 years' time, Oruguru will be  $\frac{1}{6}$  of Birasa's age. How old is Birasa now?
7. Kaminsi is 8 years younger than Olade. Five years ago, Kaminsi was three quarters as old as Olade. How old was Kaminsi then?
8. Kakofu is 15 years old. Kiberu is 9 years old. In how many years will Kiberu's age be two thirds of Kakofu's age?

## TOPIC 12: ALGEBRA



9. Gaaza is 18 years younger than Kawolo. Kawolo is 21 years old. After how many years will Gaaza be two fifths as old as Kawolo?
10. Luutu is 55 years old. Ochora is 48 years old.
  - a) How many years ago was Ochora five sixths of Luutu's age?
  - b) How old was Luutu then?
11. Ichuli is 21 years older than Lumbuye. Lumbuye is 23 years old.
  - a) In how many years ago was Lumbuye two ninths as old as Ichuli?
  - b) Find Ichuli's age then.
12. Three quarters of a number is the same as half of the same number plus 6. Find the number.
13. Kiyingi has two children, a son and a daughter. The son is a quarter of his age and a daughter is a sixth of his age. The total age of the two children is 15 years.
  - a) How old is Kiyingi?
  - b) Calculate the total age of Kiyingi and his son 9 years from now.
14. A man is 30 years old while his daughter is 4. In how many years' time will the daughter be half the age of her father?
15. A number is such that when 3 is subtracted from three quarters of it, the result is two thirds of the number. Find the number.
16. The result of adding a third of a number to itself is 28. What is the number?
17. When 55 is added to a certain number and the sum is divided by 3, the result is 4 times the original number. What is the original number?
18. At a birthday party attended by 126 people, the number of men was half of the number of women and there were 6 more children than men. Calculate the number of children who attended the birthday party.
19. The number of women who attended the village meeting was three quarters of the number of men and 18 more than the number of children. If 72 people attended the meeting altogether, calculate the number of children who attended the meeting.
20. A broom costs a quarter as much as a bucket. A bucket costs sh. 500 less than a basin. Altogether the items cost sh. 9500. Find the cost of a broom.
21. Dorah's age is  $\frac{1}{3}$  of the age of her sister. In six years' time, the sister will be twice as old as Dorah.
  - a) How old is each of them now?
  - b) What was the brother's age 4 years ago?
22. A kilogram of rice costs sh. 2500 less than the cost of a bar of soap. A bar of soap costs two fifths as much as a kilogram of meat. Lokori paid sh. 32,000 for 3 bars of soap and 4 kilograms of rice.
  - a) Find the cost of one kilogram of meat.
  - b) How much would he pay for 5 kilograms of rice?
23. Alex is 3 years older than Arnold. Anne is two thirds as old as Alex. The total age of the three children is 37. How old was Anne when Alex was 4 years old?

## TOPIC 12: ALGEBRA



24. The cost of a shirt is sh.1000 less than the cost of a trouser. A trouser costs two thirds of the cost of a dress. The total cost of the three items is sh. 27000. Find the cost of a dress.
25. A half of Peter's age and  $\frac{1}{3}$  of Betty's age sum up to 21 years. If Peter is 18 years younger than Betty, how old is Peter?
26. A boy took himself for registration at Mpumudde P/S. The boy was asked the following questions by the head teacher.

Head teacher: Boy, how old are you?

**Boy:** *I don't know but my father is 36 years older than me.*

Head teacher: How old is your father?

**Boy:** *I don't know but my sister is one sixth of my father's age.*

Head teacher: Then, how old is your sister?

**Boy:** *I still don't know, but the difference between my sister's and father's age is 40 years.*

Find the boy's age.

27. Maria had 4 biscuits more than James. Alex had half as many biscuits as Maria while James had  $4k$  biscuits and this was twice as many as Allan's. Altogether the four pupils had 54 biscuits.
- Find the value of  $k$ .
  - How many biscuits did Alex have?
28. Victor, Praise and Badru shared goats. Victor got 5 more goats than Praise and Badru got 5 goats fewer than Praise. If  $\frac{1}{3}$  of Victor's share is the same as  $\frac{1}{2}$  of Badru's share, find Praise's share.
29. A farmer deposited some money in a bank. After 3 years 4 months, he found out that the interest equaled a sixth of his original deposit and he had a total amount of sh. 140,000.
- What was the original deposit?
  - Calculate the rate of interest.
30. Nante's age is two thirds of Wangi's age. 6 years ago, the sum of their age was equal to Wangi's age now.
- How old is Wangi now?
  - Find Nante's age then.
31. Sam is now a sixth as old as his father. In 4 years, Sam will be a quarter as old as his father will be then. Find Sam's age then.
32. Divide 150 into two parts such that one part is two – thirds of the other part.
33. Robert is a half as old as his father. Twelve years ago, he was a third as old as his father was then. Find their present ages.
34. The larger of two numbers exceeds the smaller number by 14. If the smaller number is equal to three fifths of the larger, find the numbers.

## TOPIC 12: ALGEBRA



35. The sum of a half of a number and a third of the same number is 50.  
Find the number.
36. The sum of two consecutive odd numbers is divided by 4. The quotient is 10.  
Find the numbers.
37. The larger of two numbers is 12 less than 5 times the smaller. If the smaller number is equal to a third of the larger number, find the numbers.
38. A taxi runs once daily between villages of Kyotera and Bethlehem. The taxi left Kyotera with some passengers. At Nkenge,  $\frac{1}{3}$  of the passengers got off and 6 new ones got on. At Kasambya a half of the passengers got off and this time, only 3 passengers boarded. 8 passengers reached Bethlehem. How many passengers boarded the taxi at Kyotera?
39. A mango costs sh. 300 less than an apple and an apple costs two thirds as much as a pineapple. The range of the cost of the items is sh. 700. Find the cost of a mango.
40. A geometry set costs six times as much as a rubber. A ruler costs sh. 1500 less than a geometry set. A half of the cost of a geometry set is the same as  $\frac{2}{3}$  of the total cost of a ruler and a rubber.
  - a) Find the cost of a rubber.
  - b) Calculate the cost of 5 rulers.
41. Puuli is three quarters as old as Winnie and Winnie's age is two thirds of Muuta's age. 6 years ago, Puuli was a third as old as Muuta. How old was Winnie 6 years ago?
42. A trader bought some eggs at sh. 450 each. She sold a third of the eggs and ate 4. She remained with three fifths of the original number of eggs. How much money did she spend on eggs?
43. The number of women who attended the birthday party was 4 times the number of men and the number of children was 14 less than two thirds of the number of adults. There were 22 more women than children at the birthday party. Calculate the number of children who attended.
44. The twins are 30 years younger than their mother. 6 years ago, the total age of the twins was a third of their mother's age. How old was the mother then?
45. In a shop, a geometry set costs sh. 2500 more than the cost of a book. The cost of 2 books is the same as three quarters of the cost of a geometry set.
  - a) Find the cost of a book.
  - b) How much will I pay for  $1\frac{1}{2}$  dozens of geometry sets?
46. A business woman bought trays of eggs. Each tray holds 30 eggs. She sold a third of the eggs she bought and bought more 40 eggs. Currently she has 100 eggs. How many trays did she buy?
47. A box of chalk costs sh. 2500 more than the cost of a marker. A duster costs two thirds as much as a box of chalk. Altogether they cost sh. 5500.  
Find the cost of a duster.

# TOPIC 12: ALGEBRA



48. A book costs half as much as a box file. A box file costs sh. 2000 more than a geometry set. If the total cost of the three items is sh. 13000, find the cost of a geometry set.
49. In a concert, a teacher pays as much as two pupils. 4 teachers and 20 pupils attended the concert and paid sh. 840,000 altogether. How much money did each pupil pay?
50. In a market, the cost of a pineapple is sh 800 more than the cost of an apple. An apple costs two thirds of the cost of a pawpaw. The total cost of the three fruits is sh 4,300. Calculate the cost of pawpaw.

## Solving equations with decimal fractions

### Example 1

Solve:  $0.4x - 4 = 0.25x$

$$\begin{aligned}
 0.4x - 4 &= 0.25x \\
 \frac{4x}{10} - 4 &= \frac{25x}{100} \\
 (100 \times \frac{4x}{10}) - (4 \times 100) &= 100 \times \frac{25x}{100} \\
 40x - 400 &= 25x \\
 40x - 40x - 400 &= 25x - 40x \\
 \frac{-400}{-15} &= \frac{-15x}{-15} \\
 \frac{80}{3} &= x \\
 x &= 26\frac{2}{3} \text{ or } 26.66
 \end{aligned}$$

### Example 2

Solve:  $1.3y - 3 - 0.8y = 15$

$$\begin{aligned}
 1.3y - 3 - 0.8y &= 15 \\
 1.3y - 0.8y - 3 &= 15 \\
 0.5y - 3 &= 15 \\
 0.5y - 3 + 3 &= 15 + 3 \\
 0.5y &= 18 \\
 10 \times \frac{5y}{10} &= 18 \times 10 \\
 \frac{5y}{5} &= \frac{180}{5} \\
 y &= 36
 \end{aligned}$$

## Exercise

1. Solve:

a) $0.5y = 8$	d) $0.2n + 4 = 8$	g) $0.6y - 7 = 5$
b) $0.25p = 7$	e) $0.75x + 8 = 11$	h) $0.3g - 1 = 2$
c) $0.4m + 3 = 9$	f) $0.8k - 9 = 1$	i) $0.7m - 3 = 11$

2. Solve:

a) $0.4p - 6 - 0.3p = 1$	d) $0.7k - 3 = 0.4k + 9$	g) $2k - 0.4 = 1 + 1.8k$
b) $0.8m + 3 + 0.1m = 21$	e) $1.7w + 1 = 35 - 0.1w$	h) $0.17k - 0.43 = 0.25k + 0.05$
c) $0.3n + 8 - 0.2n = 10$	f) $0.8r + 2 = 26 - 0.4r$	i) $0.27g - 1.6 = 0.32g - 2$

3. Solve:

a) $0.5(2h - 1) = \frac{1}{3}(2h + 0.5)$
b) $0.5(p + 3) = 3(0.1 + 0.16p)$
c) $0.6(10n - 3) = 1.5(n+2) - 0.3$

4. If 0.75 of a number is 15. Find the number.

# TOPIC 12: ALGEBRA



5. Add 3 to 0.25 of a number. If the result is 11, find the number.
6. The result after subtracting 0.4 of a number from 9 is 5. Find the number.
7. Akiki is 0.5 times as old as Kule. Their total age is 18 years. How old is each?
8. Nsereko has 0.75 times as many goats as Lubowa. Altogether they have 28 goats. How many goats does each have?
9. A geometry set costs 0.5 times as much as a file. A file costs sh. 600 more than a book. If the total cost of the three items is sh. 6900, find the cost of a book.
10. Mukasa is 0.5 times as old as Musoke. Muwonge is 7 years younger than Mukasa. Their total age is 41 years.
  - a) How old is Muwonge?
  - b) How old will Mukasa be in 9 years' time?
11. In a market, the cost of a plate is thrice the cost of a book and the cost of a pen is 0.5 of the cost of the book. If their total cost is sh 3600, find the cost of the plate.
12. In an open market, the cost of a jerry can is sh 2800 more than the cost of a basin. A basin costs 0.6 of the cost of a saucepan. Calculate the cost of a saucepan if the total cost of the three items is sh. 29200.

## Solving equations with squares

### Example 1

Solve:  $x^2 = 16$

$$x^2 = 16$$

$$\sqrt{x^2} = \sqrt{16}$$

$$x = 4$$

### Example 2

Solve:  $3p^2 = 75$

$$3p^2 = 75$$

$$\frac{3p^2}{3} = \frac{75}{3}$$

$$p^2 = 25$$

$$\sqrt{p^2} = \sqrt{25}$$

$$p = 5$$

### Example 3

Solve:  $2y \times 3y = 294$

$$2y \times 3y = 294$$

$$6y^2 = 294$$

$$\frac{6y^2}{6} = \frac{294}{6}$$

$$y^2 = 49$$

$$\sqrt{y^2} = \sqrt{49}$$

$$y = 7$$

### Example 4

A father is thrice as old as the son. The product of their age is 300.

a) How old is the father?

Let the son's age be  $y$

Father	Son	Product
$3y$	$y$	300

Value of  $y$

$$3y \times y = 300$$

$$\frac{3y^2}{3} = \frac{300}{3}$$

$$\sqrt{y^2} = \sqrt{100}$$

$$y = 10$$

Father's age

$$3 \times y = 3 \times 10$$

$$= 30 \text{ years}$$

b) In how many years ago was their total 32 years.

Let the years be  $y$

	Father	Son
Now	30	10
$y$ years ago	$30 - y$	$10 - y$

$$30 - y + 10 - y = 32$$

$$30 + 10 - y - y = 32$$

$$40 - 2y = 32$$

$$40 - 40 - 2y = 30 - 40$$

$$-2y = -8$$

$$-2 \quad -2$$

$$y = 4 \text{ years}$$

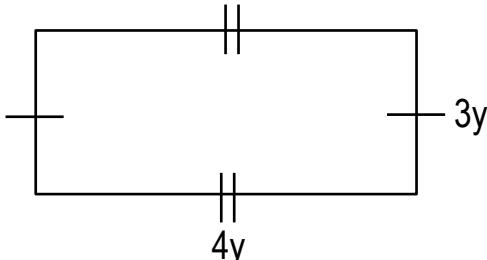
# TOPIC 12: ALGEBRA



## Example 5

The length and width of a rectangle are in the ratio of 4:3 respectively. The area of the rectangle is  $108\text{cm}^2$ . Calculate the perimeter of the rectangle.

Let the common factor be  $y$



$$\begin{aligned} L \times W &= A \\ 4y \times 3y &= 108\text{cm}^2 \\ \frac{12y^2}{12} &= \frac{108\text{cm}^2}{12} \\ \sqrt{y^2} &= \sqrt{9\text{cm}^2} \\ y &= 3\text{cm} \end{aligned}$$

Perimeter

$$\begin{aligned} P &= 2(L + W) \\ P &= 2(4 \times 3\text{cm} + 3 \times 3\text{cm}) \\ P &= 2(12\text{cm} + 9\text{cm}) \\ P &= 2 \times 21\text{cm} \\ P &= 42\text{cm} \end{aligned}$$

## Example 6

Jonah and Akram shared some mangoes such that Jonah gets two thirds of Akram's share. The product of their shares is 96. Find Jonah's share.

Let Akram's share be  $y$

Jonah	Akram	Product
$\frac{2y}{3}$	$y$	96

$$\begin{aligned} \text{Value of } y \\ y \times \frac{2y}{3} &= 96 \\ 3 \times \frac{2y^2}{3} &= 96 \times 3 \\ \frac{2y^2}{2} &= \frac{96 \times 3}{2} \\ y^2 &= 48 \times 3 \\ \sqrt{y^2} &= \sqrt{144} \\ y &= 12 \end{aligned}$$

Jonah's share.

$$\begin{aligned} \frac{2y}{3} \\ \frac{2}{3} \times 12 \\ 8 \text{ mangoes.} \end{aligned}$$

## Exercise

1. Solve:

a)  $p^2 = 81$   
b)  $y^2 = 4$   
c)  $m^2 = 36$

d)  $r^2 = 100$   
e)  $t^2 = 121$   
f)  $g^2 = 25$

g)  $x^2 = 169$   
h)  $w^2 = 196$   
i)  $g^2 = 144$

2. Solve:

a)  $10x^2 = 40$   
b)  $6p^2 = 54$   
c)  $2m^2 = 50$

d)  $3w^2 = 108$   
e)  $4r^2 = 64$   
f)  $7m^2 = 28$

g)  $5k \times 3k = 240$   
h)  $4y \times 2y = 72$   
i)  $6g \times 3g = 162$

3. Solve:

a)  $d^2 + 6 = 42$   
b)  $n^2 - 1 = 3$   
c)  $m^2 + 5 = 21$

d)  $x^2 - 7 = 42$   
e)  $b^2 - 40 = 41$   
f)  $y^2 + 5 = 30$

g)  $d^2 + 4 = 68$   
h)  $8 + c^2 = 108$   
i)  $12 + a^2 = 48$

4. The length and perimeter of a rectangle are in the ratio of 1:3 respectively. Find the actual of the rectangle if its area is  $72\text{cm}^2$ .

# TOPIC 12: ALGEBRA



5. Solve:

a)  $2m^2 + 2 = 20$

d)  $2(p^2 + 1) = 20$

g)  $4(3a^2 - 30) = 72$

b)  $4w^2 - 7 = 9$

e)  $2(p^2 - 20) = 32$

h)  $3(x^2 - 2) = 42$

c)  $2n^2 - 11 = 7$

f)  $3(2y^2 - 15) = 9$

i)  $3(2d^2 - 2) = 18$

6. Solve:

a)  $\frac{x^2}{4} = 16$

d)  $\frac{n^2}{5} + 6 = 26$

g)  $\frac{3g^2}{4} + 8 = 20$

b)  $\frac{a^2}{3} = 27$

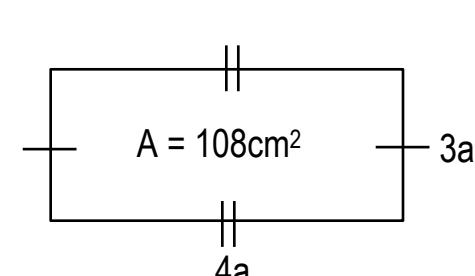
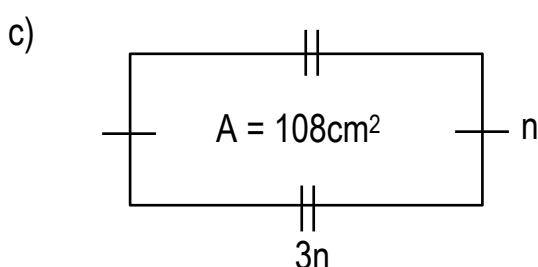
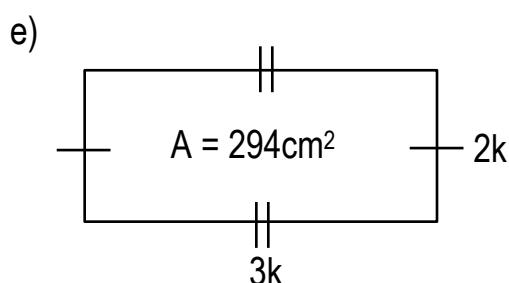
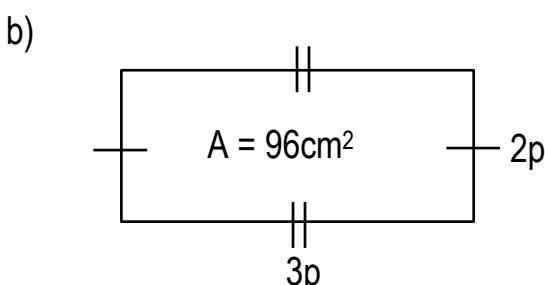
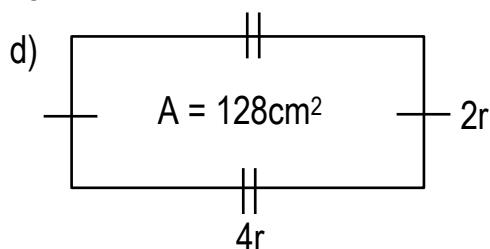
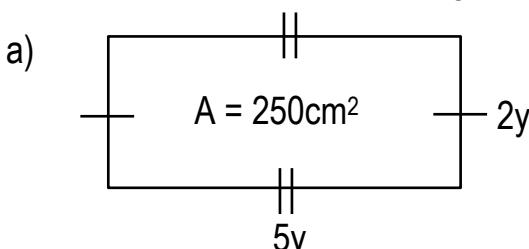
e)  $\frac{2x^2}{3} - 4 = 20$

h)  $3n - \frac{18}{n} = n$

c)  $\frac{d^2}{2} - 1 = 7$

f)  $\frac{3^2}{n} = 4n$

7. The area of each of the rectangles below is given. Find the actual perimeter.



8. Musa is twice as old as Alpha. The product of their age is 32. How old is Musa?

9. A number is 5 times the other. Their product is 125. Find the numbers.

10. Peter is thrice as old as John. The product of their age is 108. How old will Peter be in 5 years' time?

11. A squared table mat is made up of 18 white squares and 18 black squares of equal sizes. Find the number of squares needed to make one side of the table mat.

12. Henry is 2 years younger than Hakim. The product of their age is  $64 - 2y$ .

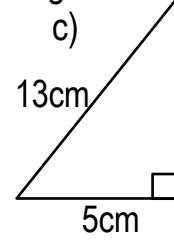
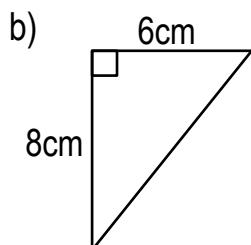
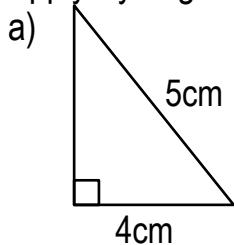
a) How old is Henry if Hakim is  $y$  years old.

b) After how many years will their total age be 40?

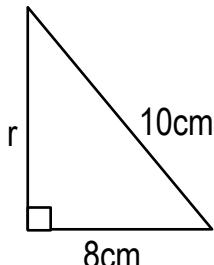
# TOPIC 12: ALGEBRA



13. Apply Pythagoras theorem to find the unknown side of the triangle.



14. Study the figure below carefully and use it to answer questions that follow.



- a) Find the value of r.  
b) Calculate its  
i) area  
ii) perimeter

15. A number is a third of the other. Their product is 48. Find the numbers.  
16. The number of boys in a class is three quarters of the number of girls. The product of their number is 192. Calculate the number of boys in the class.  
17. Two numbers are in the ratio of 2:3 respectively. If their product is 150. Find the numbers.

## Equations with cubic numbers

### Example 1

Solve:  $x^3 = 8$

$$\begin{aligned}x^3 &= 8 \\ \sqrt[3]{x^3} &= \sqrt[3]{8} \\ \sqrt[3]{(x \times x \times x)} &= \sqrt[3]{(2 \times 2 \times 2)} \\ x &= 2\end{aligned}$$

### Example 2

Solve:  $2p^3 - 30 = 24$

$$\begin{aligned}2p^3 - 30 &= 24 \\ 2p^3 - 30 + 30 &= 24 + 30 \\ 2p^3 &= 54 \\ \frac{2p^3}{2} &= \frac{54}{2} \\ \sqrt[3]{p^3} &= \sqrt[3]{27} \\ \sqrt[3]{(p \times p \times p)} &= \sqrt[3]{(3 \times 3 \times 3)} \\ p &= 3\end{aligned}$$

### Exercise

1. Solve:

a) $h^3 = 512$	d) $n^3 = 216$	g) $k^3 = 1000$
b) $m^3 = 125$	e) $y^3 = 8$	h) $q^3 = 64$
c) $d^3 = 27$	f) $w^3 = 729$	

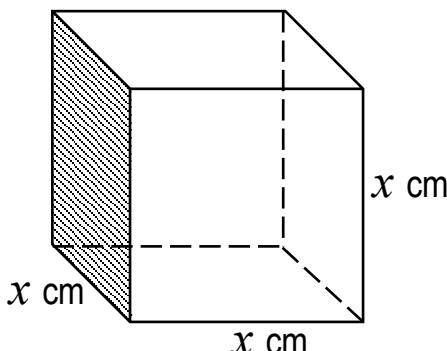
2. Solve:

a) $x^3 + 3 = 30$	c) $p^3 + 5 = 130$	e) $4h^3 - 18 = 14$
b) $y^3 + 7 = 15$	d) $2q^3 = 128$	f) $\frac{3g^3}{4} + 4 = 10$

# TOPIC 12: ALGEBRA



3. The volume of the cube below is  $216\text{cm}^3$ .



- Find the value of  $x$ .
- Calculate the sum of length of all edges of the prism.
- Find the area of the shaded part.

## Inequalities and solution sets

IN = NOT, therefore inequality means NOT equal ( $\neq$ ).

An inequality is like an equation but instead of an equal sign (=), it has one of these signs.

$<$  : less than

$>$  : greater than

$\leq$  : less than or equal to

$\geq$  : greater than or equal to

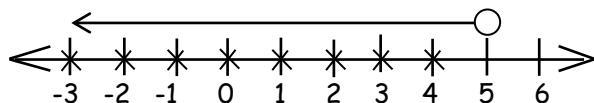
## Graphical rules

Symbol	Circle	Direction of the arrow	
$<$	Open	Left	
$>$	Open	Right	
$\leq$	Closed	Left	
$\geq$	Closed	Right	

## Examples of inequalities and their meaning

- a)  $x$  is less than 5

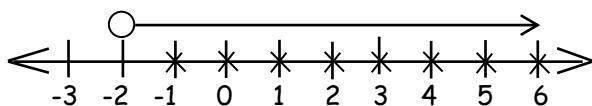
$x < 5$  means that whatever value  $x$  has, it must be less than 5 as shown on the number line below.



The solution of  $x = \{4, 3, 2, \dots\}$

- b)  $x$  is greater than -2

$x > -2$  means that whatever value  $x$  has, it must be greater than -2 as shown on the number line below.



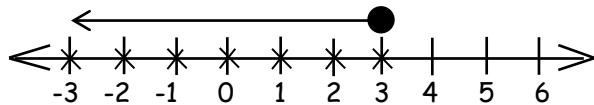
The solution set of  $x$  is  $\{-1, 0, 1, 2, 3, \dots\}$

# TOPIC 12: ALGEBRA



- c)  $x$  is less than or equal to 3

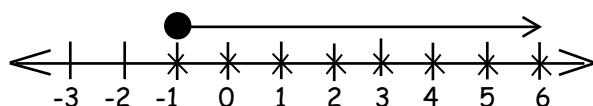
$x \leq 3$  means that whatever value  $x$  has, it must be less than or equal to 3 as shown on the number line below.



The solution set of  $x$  is  $\{3, 2, 1, 0, -1, \dots\}$

- d)  $x$  is greater than or equal to -1

$x \geq -1$  means that whatever value  $x$  has, it must be greater than equal or equal to -1 as shown on the number line below.



The solution set of  $x$  is  $\{-1, 0, 1, 2, 3, \dots\}$

## Meanings of “At most” and “At least”

The phrases “At most” and “At least” are used in Mathematics. In order to use them correctly, you need to understand their meanings.

Phrase	Meaning	Mathematical symbol
at most	- no more than - less than or equal to	$\leq$
at least	- no less than - greater than or equal to	$\geq$

## Application of “at most” and “at least” in real life situation

### **At least**

1. Teachers must earn at least sh. 500,000/= per month.

*Let the teachers' salary be s*

$$s \geq \text{sh. } 500,000$$

2. A candidate should score at least 75% in an examination.

*Let the mark be m*

$$m \geq 75\%$$

### **At most**

1. The speed limit at a junction is 20km/h.

*Let the speed be x*

$$x \leq 20\text{km/h}$$

# TOPIC 12: ALGEBRA



2. A taxi is licensed to carry at most 14 passengers.

Let the number of passengers be  $p$

$$p \leq 14$$

## Exercise

1. Write the following in words .

- |             |             |             |
|-------------|-------------|-------------|
| a) $p > 5$  | e) $n < 0$  | i) $-6 > w$ |
| b) $h > -6$ | f) $x < 6$  | j) $-4 < p$ |
| c) $e > -8$ | g) $g < -3$ | k) $5 < n$  |
| d) $f > +4$ | h) $y < -7$ | l) $1 > a$  |

2. Write in words.

- |                |                |                |
|----------------|----------------|----------------|
| a) $e \geq 10$ | d) $n \geq -1$ | g) $-3 \leq n$ |
| b) $p \leq 4$  | e) $k \leq -9$ | h) $8 \geq g$  |
| c) $y \leq -4$ | f) $y \geq -1$ | i) $-4 \geq m$ |

3. Write the following using symbols.

- |                             |                          |                             |
|-----------------------------|--------------------------|-----------------------------|
| a) $m$ is greater than 6    | d) $y$ is less than $-5$ | g) $g$ is less than 7       |
| b) $k$ is greater than $-3$ | e) $x$ is less than 6    | h) $p$ is greater than 6    |
| c) $n$ is less than 0       | f) $p$ is less than $-1$ | i) number is not equal to 8 |

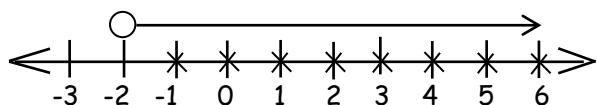
4. Write a mathematical expression using  $\leq$  or  $\geq$

- a) Children must sleep for at least 6 hours a day.
- b) The sum of two numbers is at most 10.
- c) At most 18 pupils in a class like Mathematics.
- d) When  $x$  is added to 20, the result is at least 16 more than twice  $x$ .
- e) When Joan eats 6 mangoes, she remains with at most 8 mangoes.
- f) When 5 is added to a number, the result is less than or equal to 15.
- g) Kato had some cows, he sold 9 and remained with at least 20 cows.
- h) Our school registered at least 50 candidates to sit for PLE.
- i) A trader had some pens. He bought 8 more pens. He has at most 25 pens.
- k) The sum of  $h$  and 3 is at most 12.
- l) A girl paid at most sh. 5000 for a geometry set.
- m) The number of teachers at our school does not exceed 15.
- n) The sum of Alex and Ponsiano's mass does not exceed 65kg.

## Finding the solution for the inequality

### Example 1

Given the solution set for  $x > -2$



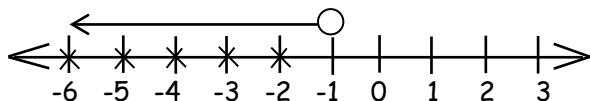
The solution set for  $x$  is  $\{ -1, 0, 1, 2, \dots \}$

# TOPIC 12: ALGEBRA



## Example 2

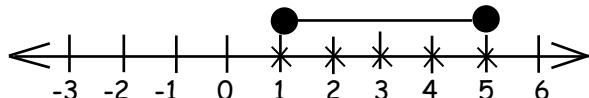
Find the solution set for  $y < -1$



The solution set for  $y$  is  $\{-2, -3, -4, \dots\}$

## Example 3

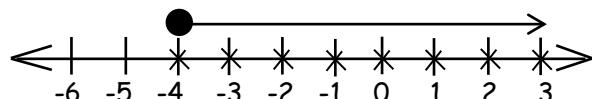
Given that  $p \leq 5$ . Find the solution set of  $p$  if  $p$  is a positive integer.



The solution set for  $p$  is  $\{5, 4, 3, 2, 1\}$

## Example 4

Find the solution set for  $n \geq -4$



The solution set for  $n$  is  $\{-4, -3, -2, -1, 0, \dots\}$

## Exercise

1. Write the solution set for each of the following inequalities.

- |             |             |             |
|-------------|-------------|-------------|
| a) $p > 0$  | f) $w < -4$ | k) $8 < m$  |
| b) $x > -3$ | g) $p < -8$ | l) $-1 > n$ |
| c) $y > -6$ | h) $n < 3$  | m) $+2 > k$ |
| d) $k > 5$  | i) $f < 1$  | n) $-7 < p$ |
| e) $m > 2$  | j) $t < 0$  | o) $-3 < m$ |

2. Find the solution sets of the following.

- |                |                |                |
|----------------|----------------|----------------|
| a) $x \leq 4$  | d) $m \geq -2$ | g) $n \leq -1$ |
| b) $y \leq -3$ | e) $k \geq 1$  | h) $x \leq 2$  |
| c) $p \leq 0$  | f) $h \geq 6$  | i) $y \geq -5$ |

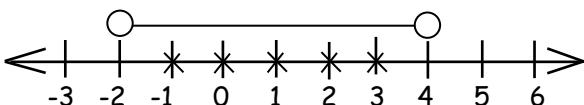
3. Find the solution set for the following.

- |                                          |                                             |
|------------------------------------------|---------------------------------------------|
| a) $y < 5$ ( $y$ is a positive integer)  | d) $q \geq -3$ ( $p$ is a negative integer) |
| b) $w \leq 6$ ( $w$ is a whole number)   | e) $r \leq 7$ ( $r$ is a counting number)   |
| c) $p > -4$ ( $p$ is a negative integer) | f) $x \leq 1$ ( $x$ is a whole number)      |

## Finding solution set for the inequalities

### Example 1

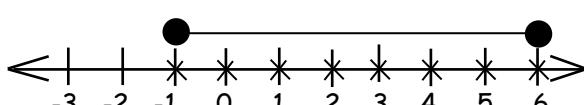
Find the solution set for  $-2 < x < 4$



The solution set for  $x$  is  $\{-1, 0, 1, 2, 3\}$

### Example 2

Find the solution set for  $-1 \leq y \leq 6$



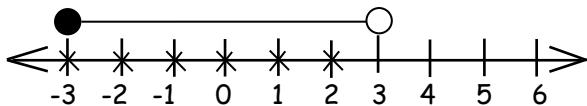
The solution set for  $y$  is  $\{-1, 0, 1, 2, 3, 4, 5, 6\}$

# TOPIC 12: ALGEBRA



## Example 3

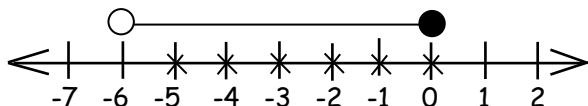
Find the solution set for  $-3 \leq m < 3$



The solution set for  $m$  is  $\{-3, -2, -1, 0, 1, 2\}$

## Example 4

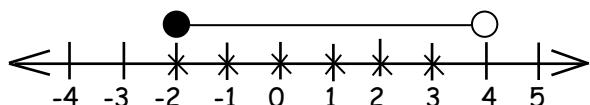
Find the solution set for  $-6 < n \leq 0$



The solution set for  $n$  is  $\{-5, -4, -3, -2, -1, 0\}$

## Example 5

Find the solution set for  $4 > y \geq -2$



The solution set for  $y$  is  $\{3, 2, 1, 0, -1, -2\}$

## Exercise

Use a number line to find the solution set for each of the following inequalities.

- |                       |                       |                       |
|-----------------------|-----------------------|-----------------------|
| a) $-1 < m < 4$       | f) $-3 \leq x < 2$    | k) $-6 < n \leq -1$   |
| b) $-1 \leq m \leq 4$ | g) $-3 < x \leq 2$    | l) $-6 < n < -1$      |
| c) $-1 \leq m < 4$    | h) $-3 \leq x \leq x$ | m) $1 \geq k > -5$    |
| d) $-1 < m \leq 4$    | i) $-6 \leq n < -1$   | n) $1 \geq k \geq -5$ |
| e) $-3 < x < 2$       | j) $-6 < n < -1$      | o) $1 > k \geq -5$    |

## Solving and finding solution sets for inequalities

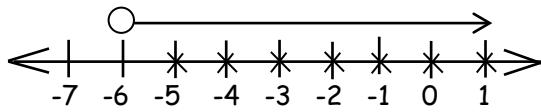
### Example 1

Find the solution set for  $x + 5 > -1$

$$x + 5 > -1$$

$$x + 5 - 5 > -1 - 5$$

$$x > -6$$



The solution set for  $x$  is  $\{-5, -4, -3, \dots\}$

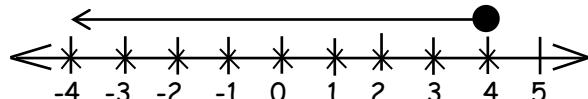
### Example 2

Solve and find the solution set for  $y - 2 \leq 2$

$$y - 2 \leq 2$$

$$y - 2 + 2 \leq 2 + 2$$

$$y \leq 4$$



The solution set for  $y$  is  $\{4, 3, 2, 1, \dots\}$

## Exercise

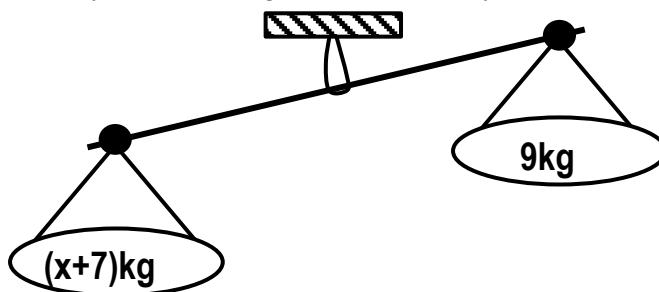
1. Solve and find the solution set for each of the following inequalities.

- |                  |                   |                     |
|------------------|-------------------|---------------------|
| a) $m + 3 < 3$   | f) $n + 1 > 2$    | k) $p + 6 \geq 8$   |
| b) $m + 4 < 7$   | g) $n + 5 > 4$    | l) $p + 25 \geq 23$ |
| c) $m + 5 < 2$   | h) $n + 23 > 19$  | m) $y + 10 \leq 9$  |
| d) $m + 13 < 12$ | i) $p + 2 \geq 1$ | n) $y + 2 \leq -1$  |
| e) $n + 4 > 1$   | j) $p + 5 \geq 2$ | o) $y + 18 \leq 14$ |

## TOPIC 12: ALGEBRA



2. When 5 is added to  $n$ , the result is greater than 7. Find the possible values of  $x$ .
3. When 3 is added to a whole number, the result is less than 8. What are the possible values of the number?
4. A whole number plus 8 is less than or equal to 13. Find the possible values of the number.
5. The number of pupils in a class is less than 45. The number of girls in the class is 20. Find the possible number of boys in the class.
6. Kasawo is saving money for a bag. He has sh. 2,000, but his goal is to save at least sh. 5,000. What is the least amount of money Kasawo needs to save?
7. Kibira went to a market with not more than sh. 3,500. He bought a basket at sh. 2,000 and some mangoes at sh. 300 each. Find the possible amount of money he spent on mangoes.
8. Study the drawing below carefully.



- Form the inequality suitable for the above situation.
- Solve and find the solution set for the inequality.

### Solving inequalities

#### **Example 1**

Solve and find the solution set for  $4x - 1 \geq 7$

$$\begin{aligned} 4x - 1 &\geq 7 \\ 4x - 1 + 1 &\geq 7 + 1 \\ \frac{4x}{4} &\geq \frac{8}{4} \\ x &\geq 2 \end{aligned}$$

The solution set for  $x$  is  $\{2, 3, 4, 5, \dots\}$

#### **Example 2**

Solve and find the solution set for  $3 - 2h < 9$

$$\begin{aligned} 3 - 2h &< 9 \\ 3 - 3 - 2h &< 9 - 3 \\ -2h &< 6 \\ \frac{-2h}{-2} &> \frac{6}{-2} \\ h &> -3 \end{aligned}$$

The solution set for  $h$  is  $\{-2, -1, 0, 1, \dots\}$

#### **Example 3**

Solve and write the solution set for  $5 - 2(g - 4) > 7$

$$\begin{aligned} 5 - 2(g - 4) &> 7 \\ 5 - 2g + 8 &> 7 \\ 5 + 8 - 2g &> 7 \\ 13 - 2g &> 7 \\ 13 - 13 - 2g &> 7 - 13 \\ -2g &> -6 \end{aligned}$$

$$\begin{aligned} \frac{-2g}{-2} &< \frac{-6}{-2} \\ g &< 3 \end{aligned}$$

The solution set for  $g$  is  $\{2, 1, 0, -1, \dots\}$

# TOPIC 12: ALGEBRA



## Example 4

Find the solution set for  $5(x + 1) - 2(x - 1) \leq 4$

$$5(x + 1) - 2(x - 1) \leq 4$$

$$5x + 5 - 2x + 2 \leq 4$$

$$5x - 2x + 5 + 2 \leq 4$$

$$3x + 7 \leq 4$$

$$3x + 7 - 7 \leq 4 - 7$$

$$3x \leq -3$$

$$\frac{3x}{3} \leq \frac{-3}{3}$$

$$x \leq -1$$

The solution set for  $x$  is  $\{-1, -2, -3, -4 \dots\}$

## Exercise

Solve and find the solution set for

- |    |                         |                                |                                     |                      |
|----|-------------------------|--------------------------------|-------------------------------------|----------------------|
| a. | i) $2y < 10$            | v) $12m \leq 24$               | ix) $7x > 14$                       | xiii) $8r \geq -16$  |
|    | ii) $4p < 16$           | vi) $9x \leq 27$               | x) $6n > 12$                        | xiv) $3n \geq 3$     |
|    | iii) $5m < 10$          | vii) $5w \leq 15$              | xi) $18y > 36$                      | xv) $9g \geq 36$     |
|    | iv) $3k < 9$            | viii) $3n \leq 12$             | xii) $13k > -65$                    | xvi) $5y \geq -10$   |
| b. | i) $-3p < 6$            | iii) $-7w \leq 7$              | v) $-9w > 9$                        | vii) $-17n \geq -51$ |
|    | ii) $-2y < -4$          | iv) $-y \leq -1$               | vi) $-10k > -40$                    | viii) $-8y \geq 16$  |
| c. | i) $2y + 1 < 7$         | v) $4y - 4 \leq 12$            | ix) $3m + 10 < 7$                   |                      |
|    | ii) $2x + 5 > 9$        | vi) $7x - 3 \geq 11$           | x) $7y - 4 > -18$                   |                      |
|    | iii) $3m + 8 \leq 11$   | vii) $6n - 10 < 2$             | xi) $6p + 2 \geq -16$               |                      |
|    | iv) $5p + 1 \geq 11$    | viii) $9k - 3 > 15$            | xii) $7x + 18 \leq -3$              |                      |
| d. | i) $1 - 2h < 3$         | v) $2 - 2x \leq -2$            | ix) $6 - 3y \geq 3$                 |                      |
|    | ii) $3 - 2y < 7$        | vi) $5 - 3p \leq 17$           | x) $4 - q > 0$                      |                      |
|    | iii) $5 - k > 6$        | vii) $4 - 4w \geq 8$           | xi) $3 - 2k < 7$                    |                      |
|    | iv) $8 - x > 7$         | viii) $13 - 6d \geq 1$         | xii) $21 - 3n \leq 24$              |                      |
| e. | i) $2(x + 2) > 10$      | vi) $6(p - 4) < 6$             | xi) $2(p - 1) - 4(p - 1) \leq 8$    |                      |
|    | ii) $3(m - 1) > 21$     | vii) $5(2a - 3) \leq 35$       | xii) $3(x - 2) - 4(x + 1) \geq -12$ |                      |
|    | iii) $4(p + 3) \leq 20$ | viii) $4(m - 3) > -8$          | xiii) $(p - 2) - (2p - 4) < 0$      |                      |
|    | iv) $2(n + 4) \geq 2$   | ix) $5(y + 1) - 3(y - 1) < 14$ | xiv) $4x - 3 < x + 6$               |                      |
|    | v) $5(x + 1) \leq 15$   | x) $3(x - 2) + 2(x - 1) > 2$   | xv) $5x + 9 \geq 3x + 5$            |                      |

# TOPIC 12: ALGEBRA



## Inequalities involving fractions

### Example 1

Solve and find the solution set for  $\frac{2x}{3} \geq 2$

$$\frac{2x}{3} \geq 2$$

$$\frac{2x}{3} \times 3 \geq 2 \times 3$$

$$\frac{2x}{2} \geq \frac{6}{2}$$

$$x \geq 3$$

The solution set for  $x$  is  $\{3, 4, 5, 6, \dots\}$

### Example 2

Solve and find the solution set for  $\frac{a}{3} + 2 > 1$

$$\frac{a}{3} + 2 > 1$$

$$\frac{a}{3} + 2 - 2 > 1 - 2$$

$$\frac{a}{3} > -1$$

$$3 \times \frac{a}{3} > -1 \times 3$$

$$a > -3$$

The solution set for  $a$  is  $\{-2, -1, 0, 1, \dots\}$

### Example 3

Solve and find the solution set

$$\text{for } \frac{2p}{3} - p \leq 1.$$

Given that  $p$  is a negative integer.

$$\frac{2p}{3} - p \leq 1$$

$$(\frac{2p}{3} \times 3) - (p \times 3) \leq 1 \times 3$$

$$2p - 3p \leq 3$$

$$-p \leq 3$$

$$\frac{-p}{-1} \geq \frac{3}{-1}$$

$$p \geq -3$$

The solution set for  $p$  is  $\{-3, -2, -1\}$

### Example 4

Solve and find the solution set for

$$\frac{a}{3} - \frac{a}{2} + 1 \geq a - 6 \text{ where } a \text{ is a whole number.}$$

$$\frac{a}{3} - \frac{a}{2} + 1 \geq a - 6 \quad (\text{LCD} = 6)$$

$$(6 \times \frac{a}{3}) - (\frac{a}{2} \times 6) + (1 \times 6) \geq (a \times 6) - (6 \times 6)$$

$$2a - 3a + 6 \geq 6a - 36$$

$$-a + 6 \geq 6a - 36$$

$$-a - 6a + 6 \geq 6a - 6a - 36$$

$$-7a + 6 \geq 36$$

$$-7a + 6 - 6 \geq 36 - 6$$

$$-7a \geq 30$$

$$\frac{-7a}{-7} \leq \frac{30}{-7}$$

$$a \leq -\frac{30}{7}$$

The solution set for  $a$  is  $\{6, 5, 4, 3, 2, 1\}$

### Exercise

Solve and find the solution set for;

1. a)  $\frac{a}{3} > 1$

d)  $\frac{n}{6} \geq -1$

g)  $\frac{k}{5} \leq 1$

b)  $\frac{x}{2} < 3$

e)  $\frac{y}{3} \geq -2$

h)  $\frac{n}{-2} \geq 2$

c)  $\frac{y}{3} \leq 2$

f)  $\frac{m}{-3} < 1$

i)  $\frac{m}{-5} \leq -1$

# TOPIC 12: ALGEBRA



2. a)  $\frac{2k}{3} < 4$       d)  $\frac{2d}{3} \leq -2$       i)  $\frac{3n}{4} \geq -6$

b)  $\frac{3y}{4} \geq 3$       e)  $\frac{3y}{2} \geq -3$       j)  $\frac{8p}{3} \geq -8$

c)  $\frac{2w}{5} > 2$       f)  $\frac{4y}{3} < 12$

3. a)  $\frac{y}{3} + 6 \geq 7$       e)  $\frac{d}{4} + 6 \geq 7$       d)  $\frac{k}{2} - 1 > 1$

b)  $\frac{m}{4} + 4 < 5$       f)  $\frac{n}{2} - 1 \leq 2$       h)  $4 - \frac{n}{3} \leq 5$

c)  $\frac{n}{6} + 8 > 7$       g)  $\frac{a}{3} - 6 > -5$

4. a)  $\frac{m}{2} + m < 3$       d)  $m - \frac{m}{3} > 2$       g)  $\frac{m}{5} + m > -6$

b)  $n + \frac{n}{3} \leq 4$       e)  $\frac{x}{3} - x > 2$       h)  $\frac{y}{4} - y \geq 3$

c)  $y + \frac{y}{2} \leq 6$       f)  $x - \frac{x}{4} < 3$

5. a)  $\frac{3k}{4} - 1 < 2$       c)  $\frac{2p}{3} + p > 5$       b)  $\frac{2y}{3} + 4 \leq 6$       d)  $\frac{3k}{4} - 2k \geq 5$

6. a)  $h - \frac{2h}{3} < 1$       e)  $\frac{3}{4}(4p - 4) - \frac{2}{3}(2p - 2) \geq 5$

b)  $\frac{d-4}{2} + d \leq 4$       f)  $\frac{p+13}{5} - p < \frac{6-p}{4}$

c)  $\frac{a}{3} + \frac{a}{4} < a - 5$       g)  $\frac{p+7}{2} - 2p \geq \frac{12-4p}{3}$

d)  $\frac{y+2}{3} + \frac{y}{2} > 4$       h)  $\frac{2-y}{2} - 2y \leq 7 - y$

## More about inequalities

### **Example 1**

Solve and write the solution set  
for  $4 \geq x + 1 \geq -2$

$$4 \geq x + 1 \geq -2$$

$$4 - 1 \geq x + 1 - 1 \geq -2 - 1$$

$$3 \geq x \geq -3$$

The solution set for  $x$  is  $\{2, 1, 0, -1, -2, -3\}$

### **Example 2**

Solve and find the solution set  
for  $5 < 4y - 3 < 17$

$$5 < 4y - 3 < 17$$

$$5 + 3 < 4y - 3 + 3 < 17 + 3$$

$$8 < 4y < 20$$

$$\frac{8}{4} < \frac{4y}{4} < \frac{20}{4}$$

$$2 < y < 5$$

The solution set for  $y$  is  $\{3, 4\}$

# TOPIC 12: ALGEBRA



## Example 3

Solve and find the solution set for  $3 \leq 7 - 2y < 11$

$$3 \leq 7 - 2y < 11$$

$$3 - 7 \leq 7 - 7 - 2y < 11 - 7$$

$$-4 \leq -2y < 4$$

$$\frac{-4}{-2} \geq \frac{-2y}{-2} > \frac{4}{-2}$$

$$2 \geq y > -2$$

The solution set for  $y$  is  $\{2, 1, 0, -1\}$

## Exercise

1. Solve and find the solution set for;

- |                            |                              |
|----------------------------|------------------------------|
| a) i) $2 > y + 1 > -3$     | v) $2 \leq n + 5 \leq 7$     |
| ii) $3 < y + 4 < 10$       | vi) $-4 \leq p + 1 < 1$      |
| iii) $-3 < m - 1 \leq 4$   | vii) $10 > 4 + y \geq 3$     |
| iv) $-1 \geq x - 4 > -5$   | viii) $8 \geq 10 + k \geq 2$ |
| b) i) $3 < 2y + 1 < 11$    | v) $12 \geq 3 - 3x \geq 3$   |
| ii) $10 \geq 3k - 2 > 1$   | vi) $-7 \leq 1 - 2h < -1$    |
| iii) $-9 < 2g - 1 \leq -1$ | vii) $-9 \leq 6 - 5p \leq 1$ |
| iv) $4 > 3 - n \geq -2$    | viii) $17 > -4k - 3 \geq -3$ |

2. Solve and find the solution set for  $15 \geq -3(x + 2) > 18$

3. Solve the inequality:  $8 > 5k - 2(3 - k)$

4. Solve the inequality:  $15 \leq 3 - 2n$

5. Solve the inequality:  $3p - 2(7 - p) \geq 6$

6. List the solution set that satisfies the inequality;  $5y - 6 < 19$ , if  $y$  is a positive integer.

7. If  $1 - g \geq -3$  and  $g$  is an integer, write the solution set for  $g$ .

8. Solve and write the solution set for  $-15 \leq 3d \leq 24$

9. The mean of  $(x+1)$ ,  $2x$ ,  $(3x+5)$  and  $(x - 3)$  is less than 6. If  $x$  is a whole number, write down all possible values of  $x$ .

10. Solve and find the solution set for;  $17 < 5 - 3m$

11. Solve the inequality:  $3r - 6 \geq 10 + r$

12. Solve the inequality:  $15 + b < 3b - 3$

13. Solve the inequality:  $15 \leq 3(2 - x)$

14. Solve the inequality:  $3 - (e - 1) > 2(e + 5)$

15. Solve the inequality:  $2x + 2 = \frac{x}{2} + 5$