Grade 9 Mathematics

CBC NOTES | Terms 1, 2 and 3 - notes for 19 topics

IN EVERY TOPIC

- What you will learn, the key words and key terms explained.
- Clear notes under headings and subheadings, with labelled pictures and step-by-step procedures.
- Comparison tables, and advantages and disadvantages where methods are compared.
- Key points to remember, then multiple-choice and structured questions.
- All the answers and a glossary at the back.

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Strand 1.0 Numbers | Term 1

1.1 Integers

WHAT YOU WILL LEARN

By the end of this topic you should be able to:

- perform basic operations on integers in different situations
- work out combined operations on integers in different situations
- apply integers to real life situations
- use IT or other resources to learn more on integers

KEY WORDS

integer, positive, negative, number line, sign, order of operations, BODMAS.

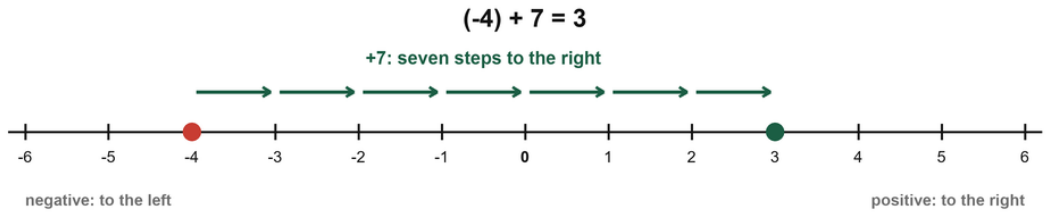
Integers are whole numbers together with their negatives and zero: ..., -3, -2, -1, 0, 1, 2, 3, ... They describe temperatures below zero, money owed, floors below the ground and heights below sea level. In this topic we add, subtract, multiply and divide integers, work out combined operations in the right order, and apply integers to real life.

1. Adding and subtracting integers

Integer

A whole number that is positive, negative or zero.

On a number line, adding a positive number moves right; adding a negative number moves left. Subtracting a number is the same as adding its opposite.



Adding and subtracting on a number line: (-4) + 7 = 3

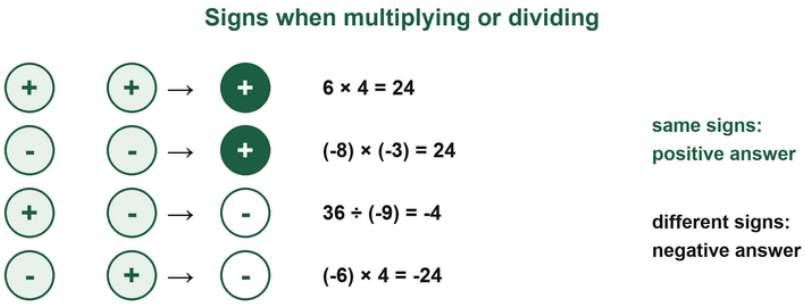
Adding and subtracting

(-4) + 7 = 3: start at -4 and move 7 steps right.
5 + (-9) = -4: adding a negative moves left 9 steps.
(-3) - 5 = -8: subtracting a positive moves left.
6 - (-2) = 6 + 2 = 8: subtracting a negative is adding a positive.

2. Multiplying and dividing integers

Sign rules for multiplication and division

Signs	Answer	Examples
Positive and positive	Positive	6 × 4 = 24; 36 ÷ 9 = 4
Negative and negative	Positive	(-8) × (-3) = 24; (-45) ÷ (-5) = 9
Positive and negative	Negative	(-6) × 4 = -24; (-36) ÷ 9 = -4



Same signs give a positive answer; different signs give a negative answer

REMEMBER

Work out the size of the answer first, then decide the sign. An even number of negative signs in a product gives a positive answer; an odd number gives a negative answer: (-2) × (-3) × (-1) = -6.

3. Combined operations

Use BODMAS: Brackets, Of (powers), Division and Multiplication from left to right, then Addition and Subtraction from left to right.

Work out (-3) × 4 + 10 ÷ (-2)

Multiply and divide first: (-3) × 4 = -12 and 10 ÷ (-2) = -5.

Then add: (-12) + (-5) = -17.

Work out [(-20) ÷ 4 - (-3)] × (-2)

Inside the bracket: (-20) ÷ 4 = -5, then -5 - (-3) = -5 + 3 = -2.

Then multiply: (-2) × (-2) = 4.

4. Integers in real life

Integers in daily life

Situation	Positive	Negative	Example
Temperature	Above 0 °C	Below 0 °C	Room 24 °C, freezer -18 °C: difference 24 - (-18) = 42 degrees
Money	Money you have	Money owed	A Fuliza overdraft of KSh 300 is -300; depositing 500 gives -300 + 500 = 200
Height	Above sea level	Below sea level	A point 25 m below sea level is -25 m
Floors	Above ground	Basement	From floor 3 down to basement level -2 is 3 - (-2) = 5 floors

CALCULATOR

Use the (-) key for a negative number, not the subtraction key: (-) 6 × 4 = -24.

KEY POINTS TO REMEMBER

- Adding a negative moves left on the number line; subtracting a negative is the same as adding a positive.
- Same signs multiply or divide to a positive; different signs give a negative.
- Follow BODMAS in combined operations.
- Integers describe temperature, money owed, heights and floors.

CHECK YOURSELF: MULTIPLE CHOICE

Choose the correct answer: A, B, C or D. The answers are at the back.

1. What is (-7) + 12?

A. -19 B. 5
C. -5 D. 19

2. What is 4 - (-9)?

A. -5 B. 5
C. -13 D. 13

3. What is (-56) ÷ (-8)?

A. 7 B. -7
C. 48 D. -48

4. What is (-2) × 5 + 18 ÷ (-3)?

A. -4 B. -16
C. 16 D. 4

5. Nairobi is at 15 °C and a place on Mount Kenya is at -6 °C. How many degrees warmer is Nairobi?

A. 9 B. -21
C. 21 D. -9

ANSWER THESE

1. Work out (a) (-15) + 8 (b) (-6) - (-11) (c) (-9) × (-7) (d) 72 ÷ (-8). (4 marks)

2. Evaluate (-4) × (-5) - 30 ÷ (-6) + (-8). (3 marks)

3. A diver is at -18 m. She rises 7 m, then dives 12 m. What is her final position? (2 marks)

4. A trader owes KSh 2,500. She sells goods worth KSh 4,300 and pays off her debt. How much does she have left? Write the working with integers. (2 marks)

5. The temperature at 6 a.m. was -3 °C. It rose by 2 °C every hour. What was the temperature at 11 a.m.? (2 marks)

Strand 1.0 Numbers | Term 1

1.2 Cubes and cube roots

WHAT YOU WILL LEARN

By the end of this topic you should be able to:

- work out cubes of numbers by multiplication in real life situations
- determine cubes of numbers from mathematical tables in different situations
- determine cube roots of numbers by factor method in different situations
- determine cube roots of numbers from mathematical tables in different situations
- apply cubes and cube roots in real life situations
- work out cubes and cube roots using IT devices

KEY WORDS

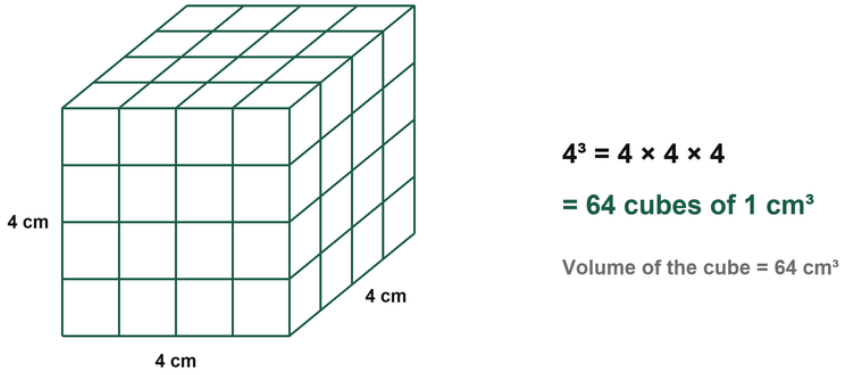
cube, cube root, prime factor, mathematical tables, volume, index.

The cube of a number is the number multiplied by itself three times. Cubes give volumes of cube-shaped tanks and boxes, and cube roots work backwards from a volume to the length of a side. In this topic we find cubes by multiplication, from tables and with a calculator, find cube roots by the factor method and from tables, and use them in real life.

1. Cubes

Cube of a number

The number multiplied by itself three times, written with a small 3: $4^3 = 4 \times 4 \times 4 = 64$.



A cube of side 4 cm is made of 4 × 4 × 4 = 64 one-centimetre cubes

Cubes by multiplication

$4^3 = 4 \times 4 \times 4 = 64$.

$2.5^3 = 2.5 \times 2.5 \times 2.5 = 6.25 \times 2.5 = 15.625$.

$(-3)^3 = (-3) \times (-3) \times (-3) = -27$: the cube of a negative number is negative.

$(2/3)^3 = (2 \times 2 \times 2)/(3 \times 3 \times 3) = 8/27$.

Cubes from tables and calculators

Tables of cubes give the cubes of numbers from 1.0 to 9.99. For other numbers, move the decimal point: each step of the decimal point in the number moves the cube three places.

Using tables

From the table, 4.7^3 is about 103.8.

47 = 4.7 × 10, so 47^3 is about 103.8 × 1,000 = 103,800.

0.47 = 4.7 ÷ 10, so 0.47^3 is about 103.8 ÷ 1,000 = 0.1038.

Calculator check: $4.7^3 = 103.823$.

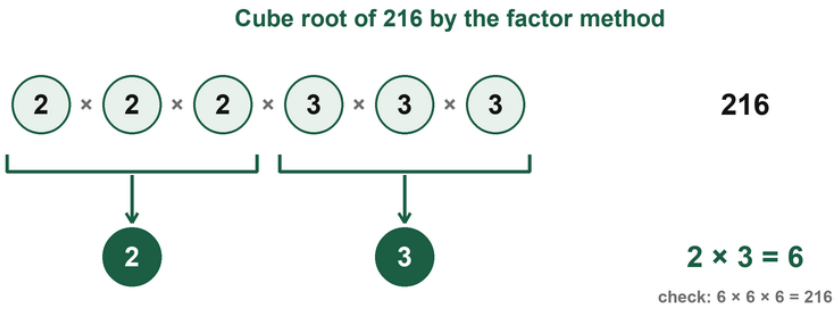
2. Cube roots

Cube root

The number that is cubed to give a given number. The cube root of 216 is 6 because $6^3 = 216$.

Cube root by the factor method

1. Write the number as a product of prime factors.
2. Group the equal factors in threes.
3. Take one factor from each group and multiply them.



Cube root of 216 by grouping prime factors in threes

Cube roots by factors

216 = 2 × 2 × 2 × 3 × 3 × 3 = (2 × 2 × 2)(3 × 3 × 3), so the cube root is 2 × 3 = 6.

1,728 = (2 × 2 × 2)(2 × 2 × 2)(3 × 3 × 3), so the cube root is 2 × 2 × 3 = 12.

The cube root of 0.125 is 0.5, because 0.5 × 0.5 × 0.5 = 0.125.

TABLES AND CALCULATORS

The cube root of 50 is about 3.684 (check: 3.684^3 is close to 50). On a calculator use the cube-root key (often SHIFT then x^3).

3. Cubes and cube roots in real life

A water tank

A cube-shaped tank has sides of 1.2 m.

Volume = $1.2^3 = 1.2 \times 1.2 \times 1.2 = 1.728$ m³.

1 m³ holds 1,000 litres, so the tank holds 1,728 litres.

A box

A cube-shaped box has a volume of 27,000 cm³.

Side = cube root of 27,000 = 30 cm, because 30 × 30 × 30 = 27,000.

4. Squares and cubes compared

Squares and cubes of some numbers

Number	Square	Cube
2	4	8
3	9	27
5	25	125
10	100	1,000
-4	16	-64

A square of a negative number is positive, but a cube of a negative number is negative. So a negative number has a cube root (the cube root of -64 is -4) but no square root among real numbers.

KEY POINTS TO REMEMBER

- The cube of a number is the number multiplied by itself three times.
- The cube of a negative number is negative.
- Find a cube root by grouping prime factors in threes and taking one from each group.
- Moving the decimal point one place in a number moves its cube three places.
- Volume of a cube = side³; side = cube root of the volume.

CHECK YOURSELF: MULTIPLE CHOICE

Choose the correct answer: A, B, C or D. The answers are at the back.

1. What is 6^3?
A. 18 B. 36
C. 216 D. 1,296

2. What is the cube root of 343?
A. 7 B. 9
C. 49 D. 114

3. What is $(-5)^3$?
A. 15 B. 125
C. -15 D. -125

4. Given that 2.3^3 is about 12.17, what is 23^3?
A. 121.7 B. 1,217
C. 12,170 D. 121,700

5. A cube-shaped box has a volume of 512 cm³. How long is each side?
A. 6 cm B. 8 cm
C. 16 cm D. 22 cm

ANSWER THESE

1. Work out (a) 1.5^3 (b) $(-0.2)^3$ (c) $(¾)^3$. (3 marks)

2. Use the factor method to find the cube root of 2,744. (3 marks)

3. Find the cube root of 0.008. (2 marks)

4. A cube-shaped tank holds 8,000 litres when full. Find the length of its side in metres. (3 marks)

5. Evaluate 3^3 + (cube root of 125) - 2^3. (2 marks)