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SOLUTIONS BOOK

CLASS 8

Mathematics · Ganita Prakash

CHAPTER 1

A Square and A Cube

Complete Exercise Solutions

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FIO 1

CLASS 8 MATHS · GANITA PRAKASH · CHAPTER 1

Figure it Out · Set 1

Pages 10–11 · 9 questions

QUESTION 1

Which of the following numbers are not perfect squares?
(i) 2032 (ii) 2048 (iii) 1027 (iv) 1089

ANSWER

A perfect square can end only in 0, 1, 4, 5, 6 or 9. If a number ends in 2, 3, 7 or 8, it cannot be a square.

(i) 2032 ends in 2 → not a perfect square
(ii) 2048 ends in 8 → not a perfect square
(iii) 1027 ends in 7 → not a perfect square
(iv) 1089 ends in 9 → may be a square, so we test it

For 1089: $30^2 = 900$ and $40^2 = 1600$, so the square root lies between 30 and 40. The last digit is 9, so the root ends in 3 or 7. Try 33: $33 \times 33 = 1089$.

(i) 2032, (ii) 2048 and (iii) 1027 are not perfect squares. (iv) 1089 = 33^2 is a perfect square.

QUESTION 2

Which one among 64^2, 108^2, 292^2, 36^2 has last digit 4?

ANSWER

The last digit of a square depends only on the last digit of the number that is squared.

64^2: $4 \times 4 = 16$ → last digit 6
108^2: $8 \times 8 = 64$ → last digit 4
292^2: $2 \times 2 = 4$ → last digit 4
36^2: $6 \times 6 = 36$ → last digit 6

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Check: $108^2 = 11664$ and $292^2 = 85264$ both end in 4, while $64^2 = 4096$ and $36^2 = 1296$ end in 6.

108^2 and 292^2 have last digit 4.

QUESTION 3

Given $125^2 = 15625$, what is the value of 126^2?
(i) 15625 + 126 (ii) 15625 + 26^2 (iii) 15625 + 253
(iv) 15625 + 251 (v) 15625 + 51^2

ANSWER

Consecutive squares differ by an odd number: $(n + 1)^2 - n^2 = 2n + 1$. In other words, 126^2 is 125^2 plus the 126th odd number, and the nth odd number is $2n - 1$.

$$126^2 = 125^2 + (2 \times 126 - 1)$$
$$= 15625 + 251$$
$$= 15876$$

Check: $126 \times 126 = 15876$ and $15625 + 251 = 15876$. The other options give 15751, 16301, 15878 and 18226, none of which equals 15876.

126^2 = 15625 + 251, so the correct option is (iv).

QUESTION 4

Find the length of the side of a square whose area is 441 m^2.

ANSWER

Area of a square = side × side, so the side is $\sqrt{441}$. Use prime factorisation.

$$441 = 3 \times 3 \times 7 \times 7$$
$$= (3 \times 7) \times (3 \times 7)$$
$$= 21^2$$

Check: $21 \times 21 = 441$.

The length of the side of the square is 21 m.

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QUESTION 5

Find the smallest square number that is divisible by each of the following numbers: 4, 9, and 10.

ANSWER

The number must be a multiple of the lcm of 4, 9 and 10. Find the lcm from the prime factors.

$4 = 2 \times 2$
$9 = 3 \times 3$
$10 = 2 \times 5$
$\text{lcm} = 2 \times 2 \times 3 \times 3 \times 5 = 180$

In $180 = 2^2 \times 3^2 \times 5$, the prime factor 5 has no partner, so 180 is not a square. Any square that is a multiple of 180 must contain 5 at least twice. Multiplying by 5 pairs up every prime factor:

$$180 \times 5 = 900 = 2^2 \times 3^2 \times 5^2 = (2 \times 3 \times 5)^2 = 30^2$$

Check: $900 \div 4 = 225$, $900 \div 9 = 100$ and $900 \div 10 = 90$.

The smallest square number divisible by 4, 9 and 10 is 900.

QUESTION 6

Find the smallest number by which 9408 must be multiplied so that the product is a perfect square. Find the square root of the product.

ANSWER

Find the prime factorisation of 9408.

$9408 \div 2 = 4704, \div 2 = 2352, \div 2 = 1176, \div 2 = 588, \div 2 = 294, \div 2 = 147$
$147 = 3 \times 49 = 3 \times 7 \times 7$
$9408 = 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 3 \times 7 \times 7 = 2^6 \times 3 \times 7^2$

The prime factors 2 (six times) and 7 (twice) can be paired, but 3 occurs only once and has no partner. Multiplying by 3 completes the pair.

$$9408 \times 3 = 28224 = 2^6 \times 3^2 \times 7^2$$

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$= (2^3 \times 3 \times 7)^2 = 168^2$

Check: 168 × 168 = 28224.

The smallest number is 3, and the square root of the product is √28224 = 168.

QUESTION 7

How many numbers lie between the squares of the following numbers?
(i) 16 and 17 (ii) 99 and 100

ANSWER

Between n^2 and $(n + 1)^2$ there are $(n + 1)^2 - n^2 - 1 = 2n$ numbers.

A **16 and 17**

$16^2 = 256$ and $17^2 = 289$
Numbers between them = 289 − 256 − 1 = 32

This agrees with 2 × 16 = 32.

B **99 and 100**

$99^2 = 9801$ and $100^2 = 10000$
Numbers between them = 10000 − 9801 − 1 = 198

This agrees with 2 × 99 = 198.

(i) 32 numbers lie between 16^2 and 17^2. (ii) 198 numbers lie between 99^2 and 100^2.

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QUESTION 8

In the following pattern, fill in the missing numbers:

$1^2 + 2^2 + 2^2 = 3^2$
$2^2 + 3^2 + 6^2 = 7^2$
$3^2 + 4^2 + 12^2 = 13^2$
$4^2 + 5^2 + 20^2 = (__)^2$
$9^2 + 10^2 + (__)^2 = (__)^2$

ANSWER

Look at the numbers in each row. The third number is the product of the first two ($1 \times 2 = 2$, $2 \times 3 = 6$, $3 \times 4 = 12$), and the number on the right-hand side is one more than this product (3, 7, 13).

A $4^2 + 5^2 + 20^2 = (__)^2$

$4 \times 5 = 20$ and $20 + 1 = 21$
$4^2 + 5^2 + 20^2 = 16 + 25 + 400 = 441 = 21^2$

B $9^2 + 10^2 + (__)^2 = (__)^2$

$9 \times 10 = 90$ and $90 + 1 = 91$
$9^2 + 10^2 + 90^2 = 81 + 100 + 8100 = 8281 = 91^2$

Why the pattern works: for any n, $n^2 + (n + 1)^2 + [n(n + 1)]^2 = 2n^2 + 2n + 1 + n^2(n + 1)^2$, and $[n(n + 1) + 1]^2 = n^2(n + 1)^2 + 2n(n + 1) + 1 = n^2(n + 1)^2 + 2n^2 + 2n + 1$. Both are equal.

$4^2 + 5^2 + 20^2 = (21)^2$ and $9^2 + 10^2 + (90)^2 = (91)^2$.

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QUESTION 9

How many tiny squares are there in the following picture? Write the prime factorisation of the number of tiny squares.

ANSWER

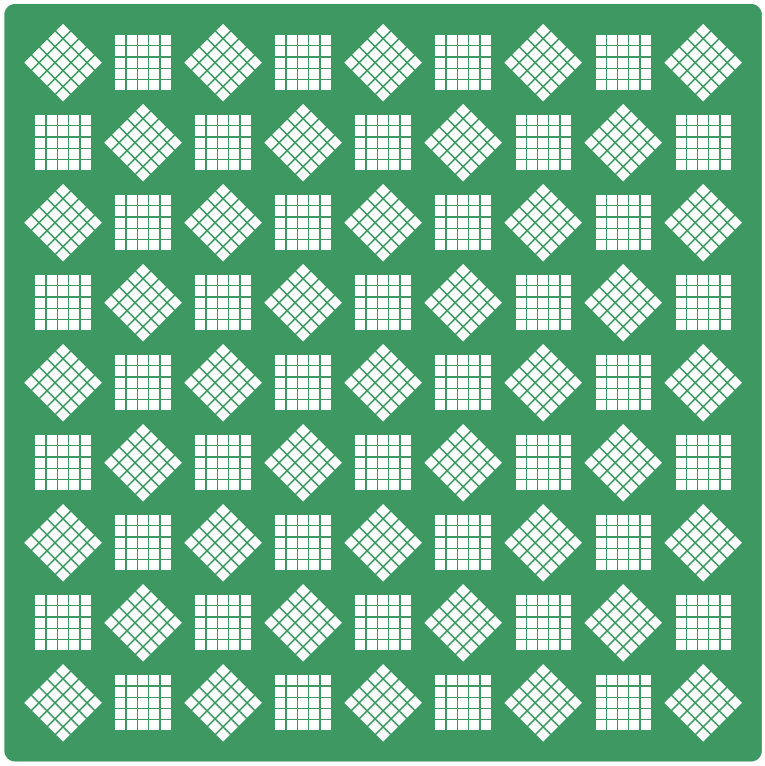

Figure: 9 rows and 9 columns of tiles (tilted and upright), each tile made of 5 × 5 tiny squares

The picture has 9 rows with 9 tiles in each row, so there are 9 × 9 = 81 tiles (41 tilted and 40 upright). Every tile, tilted or upright, is a 5 × 5 grid of tiny squares, so each tile contains 5 × 5 = 25 tiny squares.

$$\text{Number of tiles} = 9 \times 9 = 81$$
$$\text{Tiny squares in one tile} = 5 \times 5 = 25$$
$$\text{Total tiny squares} = 81 \times 25 = 2025$$

Prime factorisation of 2025: $81 = 3^4$ and $25 = 5^2$, so

$$2025 = 3 \times 3 \times 3 \times 3 \times 5 \times 5 = 3^4 \times 5^2$$

Check: 2025 ÷ 3 = 675, ÷ 3 = 225, ÷ 3 = 75, ÷ 3 = 25 = 5 × 5. Also, $2025 = (3^2 \times 5)^2 = 45^2$, a perfect square.

There are 2025 tiny squares, and $2025 = 3^4 \times 5^2$.

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FIO 2

CLASS 8 MATHS · GANITA PRAKASH · CHAPTER 1

Figure it Out · Set 2

Pages 16–17 · 5 questions

QUESTION 1

Find the cube roots of 27000 and 10648.

ANSWER

A **Cube root of 27000**

$27000 = 2 \times 2 \times 2 \times 3 \times 3 \times 3 \times 5 \times 5 \times 5$

$= (2 \times 3 \times 5) \times (2 \times 3 \times 5) \times (2 \times 3 \times 5) = 30^3$

B **Cube root of 10648**

$10648 \div 2 = 5324, \div 2 = 2662, \div 2 = 1331 = 11 \times 11 \times 11$

$10648 = 2 \times 2 \times 2 \times 11 \times 11 \times 11$

$= (2 \times 11)^3 = 22^3$

Check: $30 \times 30 \times 30 = 27000$ and $22 \times 22 \times 22 = 484 \times 22 = 10648$.

$\sqrt[3]{27000} = 30$ and $\sqrt[3]{10648} = 22$.

QUESTION 2

What number will you multiply by 1323 to make it a cube number?

ANSWER

A number is a perfect cube if its prime factors can be grouped into triplets. Factorise 1323.

$1323 \div 3 = 441, \div 3 = 147, \div 3 = 49 = 7 \times 7$

$1323 = 3 \times 3 \times 3 \times 7 \times 7 = 3^3 \times 7^2$

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The three 3's form a triplet, but 7 occurs only twice. One more 7 is needed to complete a triplet.

$$1323 \times 7 = 9261 = 3^3 \times 7^3 = (3 \times 7)^3 = 21^3$$

Check: $21 \times 21 \times 21 = 441 \times 21 = 9261$.

Multiply 1323 by 7 to get the cube number $9261 = 21^3$.

QUESTION 3

State true or false. Explain your reasoning.
(i) The cube of any odd number is even.
(ii) There is no perfect cube that ends with 8.
(iii) The cube of a 2-digit number may be a 3-digit number.
(iv) The cube of a 2-digit number may have seven or more digits.
(v) Cube numbers have an odd number of factors.

ANSWER

A (i) False

The product of odd numbers is always odd, so odd × odd × odd is odd. For example, $3^3 = 27$, $5^3 = 125$ and $7^3 = 343$ are all odd.

B (ii) False

Since $2 \times 2 \times 2 = 8$, the cube of a number ending in 2 ends in 8. For example, $2^3 = 8$ and $12^3 = 1728$ both end in 8.

C (iii) False

The smallest 2-digit number is 10 and $10^3 = 1000$, which already has 4 digits. Larger 2-digit numbers have still larger cubes, so the cube of a 2-digit number is never a 3-digit number.

D (iv) False

The largest 2-digit number is 99 and $99^3 = 970299$, which has 6 digits. So the cube of a 2-digit number has at most 6 digits (between 4 and 6 digits), never 7 or more.

E (v) False

Factors occur in pairs, so a number has an odd number of factors only when it is a square. A cube need not be a square. For example, $8 = 2^3$ has the factors 1, 2, 4, 8 (four factors) and $27 = 3^3$ has the factors 1, 3, 9, 27 (four factors), an even number in each case.

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(i) False (ii) False (iii) False (iv) False (v) False

QUESTION 4

You are told that 1331 is a perfect cube. Can you guess without factorisation what its cube root is? Similarly, guess the cube roots of 4913, 12167, and 32768.

ANSWER

Two facts help us guess. First, the last digit of a cube decides the last digit of its cube root:

Number ends in	0	1	2	3	4	5	6	7	8	9
Its cube ends in	0	1	8	7	4	5	6	3	2	9

Second, comparing with known cubes fixes the tens digit: $10^3 = 1000$, $20^3 = 8000$, $30^3 = 27000$, $40^3 = 64000$.

Number	Lies between	Last digit of the number	Cube root ends in	Cube root
1331	1000 and 8000	1	1	11
4913	1000 and 8000	3	7	17
12167	8000 and 27000	7	3	23
32768	27000 and 64000	8	2	32

Check: $11^3 = 1331$, $17^3 = 289 \times 17 = 4913$, $23^3 = 529 \times 23 = 12167$ and $32^3 = 1024 \times 32 = 32768$.

$\sqrt[3]{1331} = 11$, $\sqrt[3]{4913} = 17$, $\sqrt[3]{12167} = 23$ and $\sqrt[3]{32768} = 32$.

QUESTION 5

Which of the following is the greatest? Explain your reasoning.
(i) $67^3 - 66^3$ (ii) $43^3 - 42^3$ (iii) $67^2 - 66^2$ (iv) $43^2 - 42^2$

ANSWER

For consecutive numbers b and b + 1: $(b+1)^2 - b^2 = 2b + 1$ and $(b+1)^3 - b^3 = 3b^2 + 3b + 1$.

(i) $67^3 - 66^3 = 3 \times 66^2 + 3 \times 66 + 1 = 13068 + 198 + 1 = 13267$
(ii) $43^3 - 42^3 = 3 \times 42^2 + 3 \times 42 + 1 = 5292 + 126 + 1 = 5419$
(iii) $67^2 - 66^2 = 67 + 66 = 133$
(iv) $43^2 - 42^2 = 43 + 42 = 85$

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Check directly: $67^3 = 300763$ and $66^3 = 287496$, so the difference is 13267. Also $43^3 = 79507$ and $42^3 = 74088$, so the difference is 5419.

Reasoning: a difference of two consecutive cubes grows like $3b^2$, while a difference of two consecutive squares grows only like $2b$. So the cube differences are much larger, and the larger the numbers, the larger the difference.

13267 > 5419 > 133 > 85, so (i) $67^3 - 66^3$ is the greatest.

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TRY

CLASS 8 MATHS · GANITA PRAKASH · CHAPTER 1

Try This & Puzzle Time

Pages 13 and 18 · 3 questions

TRY THIS · PAGE 13 · T1

The next two taxicab numbers after 1729 are 4104 and 13832. Find the two ways in which each of these can be expressed as the sum of two positive cubes.

ANSWER

For each number, subtract a cube from it and check whether what is left is also a cube.

A **4104**

$4104 - 16^3 = 4104 - 4096 = 8 = 2^3$
$4104 - 15^3 = 4104 - 3375 = 729 = 9^3$

So $4104 = 2^3 + 16^3 = 9^3 + 15^3$. Check: 8 + 4096 = 4104 and 729 + 3375 = 4104.

B **13832**

$13832 - 24^3 = 13832 - 13824 = 8 = 2^3$
$13832 - 20^3 = 13832 - 8000 = 5832 = 18^3$

So $13832 = 2^3 + 24^3 = 18^3 + 20^3$. Check: 8 + 13824 = 13832 and 5832 + 8000 = 13832.

$4104 = 2^3 + 16^3 = 9^3 + 15^3$ and $13832 = 2^3 + 24^3 = 18^3 + 20^3$.

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PUZZLE TIME · PAGE 18 · P1

Square Pairs! Try arranging the numbers 1 to 17 (without repetition) in a row in a similar way — the sum of every adjacent pair of numbers should be a square. Can you arrange them in more than one way? If not, can you explain why?

ANSWER

Two different numbers from 1 to 17 add up to at most 16 + 17 = 33, so the only possible square sums are 4, 9, 16 and 25. The numbers that each number can sit next to are:

Number	Possible neighbours	Number	Possible neighbours
1	3, 8, 15	**10**	6, 15
2	7, 14	**11**	5, 14
3	1, 6, 13	**12**	4, 13
4	5, 12	**13**	3, 12
5	4, 11	**14**	2, 11
6	3, 10	**15**	1, 10
7	2, 9	**16**	9
8	1, 17	**17**	8
9	7, 16		

The numbers 16 and 17 have only one possible neighbour each (9 and 8). So 16 and 17 must be at the two ends of the row. Start from 16 and follow the only possible neighbours:

$$16 \to 9 \to 7 \to 2 \to 14 \to 11 \to 5 \to 4 \to 12 \to 13 \to 3$$

At 3 there are two choices, 1 or 6. If we go to 1, the row can only continue 1 → 8 → 17 (leaving 6, 10, 15 unused) or 1 → 15 → 10 → 6 and then it is stuck (leaving 8 and 17 unused). So we must go to 6, and the rest is forced: 6 → 10 → 15 → 1 → 8 → 17.



Figure: the only arrangement of 1 to 17 (read it backwards for the same arrangement from 17)

Check every adjacent sum:

$16 + 9 = 25,\ 9 + 7 = 16,\ 7 + 2 = 9,\ 2 + 14 = 16,\ 14 + 11 = 25,\ 11 + 5 = 16,\ 5 + 4 = 9,\ 4 + 12 = 16,$

$12 + 13 = 25,\ 13 + 3 = 16,\ 3 + 6 = 9,\ 6 + 10 = 16,\ 10 + 15 = 25,\ 15 + 1 = 16,\ 1 + 8 = 9,\ 8 + 17 = 25.$

All sums are 9, 16 or 25, which are 3^2, 4^2 and 5^2.

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There is only one arrangement (apart from reading it backwards): 16, 9, 7, 2, 14, 11, 5, 4, 12, 13, 3, 6, 10, 15, 1, 8, 17.

PUZZLE TIME · PAGE 18 · P2

Can you do the same with numbers from 1 to 32 (again, without repetition), but this time arranging all the numbers in a circle?

ANSWER

Yes, it can be done. In a circle every number has two neighbours and the last number must also add up with the first to a square. Now the possible square sums are 4, 9, 16, 25, 36 and 49 (the largest sum is 31 + 32 = 63). One arrangement that works, going clockwise from 1:

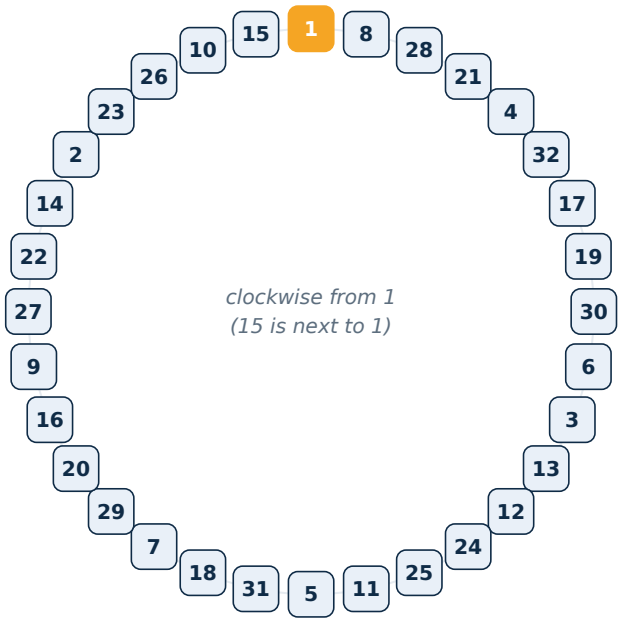

Figure: the numbers 1 to 32 arranged in a circle so that every adjacent pair adds up to a square

Check every adjacent sum, including the last pair 15 + 1:

1 + 8 = 9, 8 + 28 = 36, 28 + 21 = 49, 21 + 4 = 25, 4 + 32 = 36, 32 + 17 = 49, 17 + 19 = 36, 19 + 30 = 49, 30 + 6 = 36, 6 + 3 = 9, 3 + 13 = 16, 13 + 12 = 25, 12 + 24 = 36, 24 + 25 = 49, 25 + 11 = 36, 11 + 5 = 16, 5 + 31 = 36, 31 + 18 = 49, 18 + 7 = 25, 7 + 29 = 36, 29 + 20 = 49, 20 + 16 = 36, 16 + 9 = 25, 9 + 27 = 36, 27 + 22 = 49, 22 + 14 = 36, 14 + 2 = 16, 2 + 23 = 25, 23 + 26 = 49, 26 + 10 = 36, 10 + 15 = 25, 15 + 1 = 16.

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Every number from 1 to 32 is used exactly once, and every sum is one of 9, 16, 25, 36 or 49, all of which are squares.

Yes. The numbers 1 to 32 can be arranged in a circle so that every adjacent pair adds up to a square.

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IT 1

CLASS 8 MATHS · GANITA PRAKASH · CHAPTER 1

In-Text Questions · Squares

Pages 1–10 · 35 questions

IN-TEXT · PAGE 1 · T1

Before the process begins, Khoisnam realises that he already knows which lockers will be open at the end. How did he figure out the answer?
Hint: Find out how many times each locker is toggled.

ANSWER

Locker number k is touched by Person j exactly when j is a factor of k. So the number of times locker k is toggled equals the number of factors of k. For example, locker 6 is toggled by Persons 1, 2, 3 and 6 (four times), so it ends up closed.

A locker ends up open only if it is toggled an odd number of times. Factors come in partner pairs (d, k ÷ d), so the number of factors is even — unless some factor is paired with itself, i.e. k = d × d. Such a number is a perfect square. For example, 36 has the factors 1, 2, 3, 4, 6, 9, 12, 18, 36 (nine factors, an odd number).

Khoisnam knows that exactly the lockers whose numbers are perfect squares stay open: 1, 4, 9, 16, 25, 36, 49, 64, 81 and 100.

IN-TEXT · PAGE 2 · T2

Does every number have an even number of factors?

ANSWER

1: factor 1 only → 1 factor (odd)
4: factors 1, 2, 4 → 3 factors (odd)
6: factors 1, 2, 3, 6 → 4 factors (even)
9: factors 1, 3, 9 → 3 factors (odd)

No. Numbers such as 1, 4 and 9 have an odd number of factors.

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IN-TEXT · PAGE 2 · T3

Can you use this insight to find more numbers with an odd number of factors? For instance, 36 has a factor pair 6 × 6 where both numbers are 6. Does this number have an odd number of factors? If every factor of 36 other than 6 has a different factor as its partner, then we can be sure that 36 has an odd number of factors. Check if this is true.

ANSWER

Write the factor pairs of 36:

$1 \times 36,\ 2 \times 18,\ 3 \times 12,\ 4 \times 9,\ 6 \times 6$

Every factor other than 6 has a different partner, and 6 is its own partner. So the factors are 1, 2, 3, 4, 6, 9, 12, 18, 36 — nine factors, an odd number. The same happens for every square number: 16 has 5 factors, 25 has 3, 49 has 3, 64 has 7, 81 has 5 and 100 has 9.

Yes. All square numbers (1 × 1, 2 × 2, 3 × 3, 4 × 4, …) have an odd number of factors.

IN-TEXT · PAGE 3 · T4

Write the locker numbers that remain open.

ANSWER

The lockers that remain open are the square numbers from 1 to 100 (they are highlighted below).

1	2	3	**4**	5	6	7	8	**9**	10
11	12	13	14	15	**16**	17	18	19	20
21	22	23	24	**25**	26	27	28	29	30
31	32	33	34	35	**36**	37	38	39	40
41	42	43	44	45	46	47	48	**49**	50
51	52	53	54	55	56	57	58	59	60
61	62	63	**64**	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	**100**

Figure: lockers 1 to 100; the open lockers are highlighted

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$1 = 1^2$, $4 = 2^2$, $9 = 3^2$, $16 = 4^2$, $25 = 5^2$, $36 = 6^2$, $49 = 7^2$, $64 = 8^2$, $81 = 9^2$, $100 = 10^2$

Open lockers: 1, 4, 9, 16, 25, 36, 49, 64, 81, 100 (ten lockers).

IN-TEXT · PAGE 3 · T5

Khoisnam immediately collects word clues from these 10 lockers and reads, “The passcode consists of the first five locker numbers that were touched exactly twice.” Which are these five lockers?

ANSWER

A locker is touched exactly twice when its number has exactly two factors, 1 and the number itself. These are the prime numbers (1 has only one factor).

2: factors 1, 2 3: factors 1, 3 5: factors 1, 5

7: factors 1, 7 11: factors 1, 11

4 has three factors and 6 has four factors, so they are skipped

The first five such lockers are 2, 3, 5, 7 and 11, so the code is 2-3-5-7-11.

IN-TEXT · PAGE 3 · T6

Why are the numbers, 1, 4, 9, 16, …, called squares?

ANSWER

The number of unit squares in a square (its area) is the product of its sides. A square of side 1, 2, 3, 4, … units has area 1 × 1 = 1, 2 × 2 = 4, 3 × 3 = 9, 4 × 4 = 16, … square units.

1, 4, 9, 16, … are the areas of squares with whole-number sides, so they are called squares. In general, $n \times n = n^2$ is read ‘n squared’.

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IN-TEXT · PAGE 3 · T7

Can we have a square of sidelength 3/5 or 2.5 units?

ANSWER

Yes. Area = side × side, whatever the side is.

$(3/5)^2 = (3/5) \times (3/5) = 9/25$ square units
$(2.5)^2 = 2.5 \times 2.5 = 6.25$ square units

Yes, squares with side 3/5 or 2.5 units exist; their areas are 9/25 and 6.25 square units.

IN-TEXT · PAGE 4 · T8

Find the squares of the first 30 natural numbers and fill in the table below.

ANSWER

n	n^2	n	n^2	n	n^2
1	1	11	121	21	441
2	4	12	144	22	484
3	9	13	169	23	529
4	16	14	196	24	576
5	25	15	225	25	625
6	36	16	256	26	676
7	49	17	289	27	729
8	64	18	324	28	784
9	81	19	361	29	841
10	100	20	400	30	900

Check: $25^2 = 625$ (since $25 \times 25 = 625$) and $30^2 = 900$.

The squares of 1 to 30 are 1, 4, 9, 16, 25, 36, 49, 64, 81, 100, 121, 144, 169, 196, 225, 256, 289, 324, 361, 400, 441, 484, 529, 576, 625, 676, 729, 784, 841, 900.

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IN-TEXT · PAGE 4 · T9

What patterns do you notice? Share your observations and make conjectures.

ANSWER

Some patterns visible in the table:

1. Units digits of squares are only 0, 1, 4, 5, 6 or 9. None ends in 2, 3, 7 or 8.
2. Squares of 1 to 10 end in 1, 4, 9, 6, 5, 6, 9, 4, 1, 0 — a pattern that repeats for every ten numbers.
3. Squares of even numbers are even and squares of odd numbers are odd.
4. The gap between consecutive squares grows by 2 each time: 3, 5, 7, 9, 11, …

Conjecture: the last digit of n^2 depends only on the last digit of n. Numbers ending in 1 or 9 have squares ending in 1; in 2 or 8, squares ending in 4; in 3 or 7, squares ending in 9; in 4 or 6, squares ending in 6; in 5, squares ending in 5; in 0, squares ending in 0.

Squares end only in 0, 1, 4, 5, 6 or 9, and the last digit of n^2 is decided by the last digit of n.

IN-TEXT · PAGE 4 · T10

If a number ends in 0, 1, 4, 5, 6 or 9, is it always a square?

ANSWER

No. The numbers 16 and 36 are squares ending in 6, but 26 also ends in 6 and is not a square ($5^2 = 25$ and $6^2 = 36$). Similarly 11, 14, 15 and 19 are not squares.

No. The units digit cannot tell us that a number is a square. But if a number ends in 2, 3, 7 or 8, it is definitely not a square.

IN-TEXT · PAGE 4 · T11

Write 5 numbers such that you can determine by looking at their units digit that they are not squares.

ANSWER

Any number whose units digit is 2, 3, 7 or 8 is not a square. For example:

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12 (ends in 2), 33 (ends in 3), 57 (ends in 7), 98 (ends in 8), 1003 (ends in 3)

12, 33, 57, 98 and 1003 are not squares.

IN-TEXT · PAGE 4 · T12

The squares, 1^2, 9^2, 11^2, 19^2, 21^2, and 29^2, all have 1 in their units place. Write the next two squares. Notice that if a number has 1 or 9 in the units place, then its square ends in 1.

ANSWER

The next numbers ending in 1 or 9 are 31 and 39.

$31^2 = 31 \times 31 = 961$
$39^2 = 39 \times 39 = 1521$

The next two squares are $31^2 = 961$ and $39^2 = 1521$.

IN-TEXT · PAGE 4 · T13

Let us consider square numbers ending in 6: $16 = 4^2$, $36 = 6^2$, $196 = 14^2$, $256 = 16^2$, $576 = 24^2$, and $676 = 26^2$.

ANSWER

In each case the number being squared ends in 4 or 6 (4, 6, 14, 16, 24, 26), because $4 \times 4 = 16$ and $6 \times 6 = 36$ both end in 6.

A square ends in 6 when the number squared ends in 4 or 6.

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IN-TEXT · PAGE 5 · T14

Which of the following numbers have the digit 6 in the units place?
(i) 38^2 (ii) 34^2 (iii) 46^2 (iv) 56^2 (v) 74^2 (vi) 82^2

ANSWER

A square ends in 6 only when the number ends in 4 or 6.

(i) 38^2: $8 \times 8 = 64 \rightarrow$ ends in 4 ($38^2 = 1444$)
(ii) 34^2: $4 \times 4 = 16 \rightarrow$ ends in 6 ($34^2 = 1156$)
(iii) 46^2: $6 \times 6 = 36 \rightarrow$ ends in 6 ($46^2 = 2116$)
(iv) 56^2: $6 \times 6 = 36 \rightarrow$ ends in 6 ($56^2 = 3136$)
(v) 74^2: $4 \times 4 = 16 \rightarrow$ ends in 6 ($74^2 = 5476$)
(vi) 82^2: $2 \times 2 = 4 \rightarrow$ ends in 4 ($82^2 = 6724$)

(ii) 34^2, (iii) 46^2, (iv) 56^2 and (v) 74^2 have 6 in the units place.

IN-TEXT · PAGE 5 · T15

Find more such patterns by observing the numbers and their squares from the table you filled earlier.

ANSWER

1. Squares of numbers ending in 5 end in 25: $5^2 = 25$, $15^2 = 225$, $25^2 = 625$.
2. Reversing digits: $12^2 = 144$ and $21^2 = 441$ are reverses of each other.
3. Squares of numbers ending in 0 end in 00: $10^2 = 100$, $20^2 = 400$, $30^2 = 900$.
4. From 1^2 to 10^2 the units digits read 1, 4, 9, 6, 5, 6, 9, 4, 1, 0, which is symmetric around 5^2.

Several patterns appear in the squares — in their last digits, in their digits and in the number of zeros.

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IN-TEXT · PAGE 5 · T16

If a number contains 3 zeros at the end, how many zeros will its square have at the end?

ANSWER

Try some numbers: $1000^2 = 1000000$ and $3000^2 = 9000000$. In both cases the square has six zeros.

The square has 6 zeros at the end.

IN-TEXT · PAGE 5 · T17

What do you notice about the number of zeros at the end of a number and the number of zeros at the end of its square? Will this always happen? Can we say that squares can only have an even number of zeros at the end?

ANSWER

$10^2 = 100$ (1 zero → 2 zeros), $100^2 = 10000$ (2 zeros → 4 zeros), $700^2 = 490000$ (2 zeros → 4 zeros). The square has double the number of zeros.

Why it always happens: write the number as $m \times 10^k$ where m does not end in 0. Then its square is $m^2 \times 10^{2k}$. Since m does not end in 0, m^2 ends in 1, 4, 5, 6 or 9, not 0. So the square has exactly 2k zeros at the end.

The square has twice as many zeros at the end as the number. So yes, a square can only have an even number of zeros at the end.

IN-TEXT · PAGE 5 · T18

What can you say about the parity of a number and its square?

ANSWER

An even number times an even number is even, and an odd number times an odd number is odd. For example, $12^2 = 144$ (even) and $13^2 = 169$ (odd).

A number and its square have the same parity: the square of an even number is even and the square of an odd number is odd.

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IN-TEXT · PAGE 5 · T19

Let us explore the differences between consecutive squares. What do you notice?
$4 - 1 = 3$ $9 - 4 = 5$ $16 - 9 = 7$ $25 - 16 = 9$
See if this pattern continues for the next few square numbers.

ANSWER

$$36 - 25 = 11$$
$$49 - 36 = 13$$
$$64 - 49 = 15$$
$$81 - 64 = 17$$
$$100 - 81 = 19$$

In general, $(n + 1)^2 - n^2 = 2n + 1$. Equivalently, $1 = 1$, $1 + 3 = 4$, $1 + 3 + 5 = 9$, $1 + 3 + 5 + 7 = 16$, … The sum of the first n odd numbers is n^2.

The differences of consecutive squares are the consecutive odd numbers 3, 5, 7, 9, 11, … and the pattern continues.

IN-TEXT · PAGE 6 · T20

Using the pattern above, find 36^2, given that $35^2 = 1225$.

ANSWER

$1225 = 35^2$ is the sum of the first 35 odd numbers. To get 36^2, add the 36th odd number.

$$\text{36th odd number} = 2 \times 36 - 1 = 71$$
$$36^2 = 1225 + 71 = 1296$$

Check: $36 \times 36 = 1296$.

$36^2 = 1296$.

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IN-TEXT · PAGE 6 · T21

How do we find the 36th odd number?

ANSWER

The 1st odd number is 1, the 2nd is 3, the 3rd is 5, …, the 6th is 11. Each odd number is 2 more than the previous one.

$$36\text{th odd number} = 1 + 35 \times 2 = 71$$

The 36th odd number is 71.

IN-TEXT · PAGE 6 · T22

What is the nth odd number?

ANSWER

Starting from 1 and adding 2 each time, the nth odd number is $1 + (n - 1) \times 2 = 2n - 1$. Check: $n = 1$ gives 1, $n = 6$ gives 11, $n = 36$ gives 71.

The nth odd number is $2n - 1$.

IN-TEXT · PAGE 7 · T23

Find how many numbers lie between two consecutive perfect squares. Do you notice a pattern?

ANSWER

Between n^2 and $(n + 1)^2$ the number of whole numbers is $(n + 1)^2 - n^2 - 1 = 2n$.

Between 1 and 4: 2, 3 → 2 numbers
Between 4 and 9: 5, 6, 7, 8 → 4 numbers
Between 9 and 16: 10, …, 15 → 6 numbers
Between 16 and 25: 17, …, 24 → 8 numbers

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Between n^2 and $(n + 1)^2$ there are 2n numbers (2, 4, 6, 8, …). If p and q are consecutive squares, there are q − p − 1 numbers between them.

IN-TEXT · PAGE 7 · T24

How many square numbers are there between 1 and 100? How many are between 101 and 200? Using the table of squares you filled earlier, enter the values below, tabulating the number of squares in each block of 100. What is the largest square less than 1000?

ANSWER

1–100	101–200	201–300	301–400	401–500
10	4	3	3	2
501–600	**601–700**	**701–800**	**801–900**	**901–1000**
2	2	2	2	1

1–100: 1, 4, …, 100 (10 squares); 101–200: 121, 144, 169, 196 (4); 201–300: 225, 256, 289 (3); 301–400: 324, 361, 400 (3); 401–500: 441, 484 (2); 501–600: 529, 576 (2); 601–700: 625, 676 (2); 701–800: 729, 784 (2); 801–900: 841, 900 (2); 901–1000: 961 (1).

Since $31^2 = 961$ and $32^2 = 1024$ is more than 1000, the largest square less than 1000 is 961. Check: 10 + 4 + 3 + 3 + 2 + 2 + 2 + 2 + 2 + 1 = 31 squares, namely 1^2 to 31^2.

There are 10 squares from 1 to 100 and 4 from 101 to 200. The largest square less than 1000 is 961 = 31^2.

IN-TEXT · PAGE 7 · T25

Can you see any relation between triangular numbers and square numbers? Extend the pattern shown and draw the next term.
$1 + 3 = 4 = 2^2$ $3 + 6 = 9 = 3^2$ $6 + 10 = 16 = 4^2$

ANSWER

The triangular numbers are 1, 3, 6, 10, 15, …. Adding two consecutive triangular numbers always gives a square number. The next term of the pattern uses the next two triangular numbers, 10 and 15:

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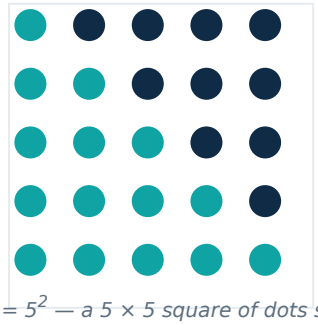

Figure: 10 + 15 = 25 = 5^2 — a 5 × 5 square of dots split into two triangles

In general, the nth triangular number is n(n + 1)/2, and n(n + 1)/2 + (n + 1)(n + 2)/2 = (n + 1)(2n + 2)/2 = $(n + 1)^2$.

The sum of two consecutive triangular numbers is a perfect square. Next term: 10 + 15 = 25 = 5^2.

IN-TEXT · PAGE 7 · T26

The area of a square is 49 sq. cm. What is the length of its side?

ANSWER

Area = side × side. We know that 7 × 7 = 49, or 7^2 = 49.

The side of the square is 7 cm. We call 7 the square root of 49.

IN-TEXT · PAGE 8 · T27

What is the square root of 64?

ANSWER

8 × 8 = 64, so 8 is a square root of 64. Also (−8) × (−8) = 64.

$8^2 = 64$ and $(-8)^2 = 64$

The square roots of 64 are +8 and −8, so √64 = ±8. In this chapter we consider only the positive square root: √64 = 8.

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IN-TEXT · PAGE 8 · T28

Given a number, such as 576 or 327, how do we find out if it is a perfect square? If it is a perfect square, how can we find its square root?

ANSWER

First look at the units digit. 327 ends in 7, so it is definitely not a perfect square. 576 ends in 6, so it may be a square. Several methods can settle 576:

A List the squares

$20^2 = 400$, $21^2 = 441$, $22^2 = 484$, $23^2 = 529$, $24^2 = 576$

B Prime factorisation

$576 \div 2 = 288, \div 2 = 144, \div 2 = 72, \div 2 = 36, \div 2 = 18, \div 2 = 9 = 3 \times 3$

$576 = 2^6 \times 3^2 = (2^3 \times 3)^2 = 24^2$

C Estimation

$400 < 576 < 900$, so the root is between 20 and 30. The last digit 6 means the root ends in 4 or 6, so it is 24 or 26. Since $25^2 = 625 > 576$, the root is 24.

$576 = 24^2$ is a perfect square with $\sqrt{576} = 24$; 327 is not a perfect square.

IN-TEXT · PAGE 8 · T29

Can we find the square root of 729 using this method (subtracting consecutive odd numbers)?

ANSWER

Yes, but it is time-consuming. Subtracting 1, 3, 5, ... from 729 reaches 0 only after 27 subtractions (the 27th odd number is 53), because $729 = 1 + 3 + 5 + \ldots + 53 = 27^2$.

A faster way is prime factorisation: $729 = 3^6 = (3^3)^2 = 27^2$. Check: $27 \times 27 = 729$.

Yes, it can be done, but it takes 27 steps. $\sqrt{729} = 27$.

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IN-TEXT · PAGE 9 · T30

Is 324 a perfect square?

ANSWER

Find the prime factorisation: 324 ÷ 2 = 162, ÷ 2 = 81 = 3 × 3 × 3 × 3.

$$324 = 2 \times 2 \times 3 \times 3 \times 3 \times 3$$
$$= (2 \times 2) \times (3 \times 3) \times (3 \times 3)$$
$$= (2 \times 3 \times 3)^2 = 18^2$$

Yes. $324 = 18^2$, so $\sqrt{324} = 18$.

IN-TEXT · PAGE 9 · T31

Is 156 a perfect square?

ANSWER

156 ÷ 2 = 78, ÷ 2 = 39 = 3 × 13.

$$156 = 2 \times 2 \times 3 \times 13$$

The factors 3 and 13 cannot be paired up. Check: $12^2 = 144$ and $13^2 = 169$, and 156 lies between them.

No. 156 is not a perfect square.

IN-TEXT · PAGE 9 · T32

Find whether 1156 and 2800 are perfect squares using prime factorisation.

ANSWER

A **1156**

$$1156 \div 2 = 578, \div 2 = 289 = 17 \times 17$$
$$1156 = (2 \times 2) \times (17 \times 17) = (2 \times 17)^2 = 34^2$$

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B **2800**

$2800 = 28 \times 100 = (2 \times 2 \times 7) \times (2 \times 2 \times 5 \times 5)$
$= 2 \times 2 \times 2 \times 2 \times 5 \times 5 \times 7$

The factor 7 occurs only once and has no partner.

$1156 = 34^2$ is a perfect square ($\sqrt{1156} = 34$). 2800 is not a perfect square.

WORKED EXAMPLE · PAGE 9 · T33

We can estimate the square root of larger perfect squares by looking at the closest perfect squares we are familiar with and then narrowing down the interval to search. For example, to find √1936, we can reason as follows.

ANSWER

(i) $1600 = 40^2$ and $2500 = 50^2$, so $40 < \sqrt{1936} < 50$
(ii) 1936 ends in 6, so the root ends in 4 or 6: it is 44 or 46
(iii) $45^2 = (40 + 5)^2 = 1600 + 2 \times 40 \times 5 + 25 = 2025$
(iv) $2025 > 1936$, so $40 < \sqrt{1936} < 45$
(v) the root ends in 4 or 6 and is below 45, so it is 44

Check: $44 \times 44 = 1936$.

$\sqrt{1936} = 44$.

WORKED EXAMPLE · PAGE 10 · T34

Aribam asks Bijou if he can at least provide a number that is close to the square root of 250. For this, Bijou needs to estimate the square root of 250.

ANSWER

$100 < 250 < 400$ and $\sqrt{100} = 10$, $\sqrt{400} = 20$, so $10 < \sqrt{250} < 20$
$15^2 = 225$ and $16^2 = 256$, so $15 < \sqrt{250} < 16$

Since 256 is much closer to 250 than 225 is, √250 is close to 16, but a little less than 16.

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√250 lies between 15 and 16 and is approximately 16 (slightly less than 16).

WORKED EXAMPLE · PAGE 10 · T35

Akhil has a square piece of cloth of area 125 cm^2. He wants to know if he can cut out a square handkerchief of side 15 cm. If not, he wants to know the maximum size handkerchief that can be cut out from this piece of cloth with an integer side length.

ANSWER

A handkerchief of side 15 cm needs an area of 15^2 = 225 cm^2, which is more than 125 cm^2. So it cannot be cut out.

125 is not a perfect square. The nearest perfect squares are 11^2 = 121 and 12^2 = 144, and 121 < 125 < 144.

No, a handkerchief of side 15 cm cannot be cut. The largest square handkerchief with integer side has side 11 cm.

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IT 2

CLASS 8 MATHS · GANITA PRAKASH · CHAPTER 1

In-Text Questions · Cubes

Pages 11–16 · 16 questions

IN-TEXT · PAGE 11 · T1

How many cubes of side 1 cm make a cube of side 2 cm?

ANSWER

A cube of side 2 cm has 2 layers, each layer being a 2 × 2 square of unit cubes.

$$2 \times 2 \times 2 = 8$$

8 cubes of side 1 cm make a cube of side 2 cm.

IN-TEXT · PAGE 11 · T2

How many cubes of side 1 cm will make a cube of side 3 cm?

ANSWER

A cube of side 3 cm has 3 layers, each layer being a 3 × 3 square of 9 unit cubes.

$$3 \times 3 \times 3 = 27$$

27 cubes of side 1 cm make a cube of side 3 cm.

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IN-TEXT · PAGE 12 · T3

Consider the numbers 1, 8, 27, … These numbers are called perfect cubes. Can you see why they are named so?

ANSWER

Each of them is obtained by multiplying a number by itself three times, like the volume of a cube whose edge is that number.

$1 = 1 \times 1 \times 1 = 1^3$
$8 = 2 \times 2 \times 2 = 2^3$
$27 = 3 \times 3 \times 3 = 3^3$

They are the numbers of unit cubes in cubes of side 1, 2, 3, …, so they are called perfect cubes.

IN-TEXT · PAGE 12 · T4

Is 9 a cube?

ANSWER

$2 \times 2 \times 2 = 8$ and $3 \times 3 \times 3 = 27$, and $8 < 9 < 27$.

No, 9 is not a perfect cube. Nor is any number from 10 to 26.

IN-TEXT · PAGE 12 · T5

Can you estimate the number of unit cubes in a cube with an edge length of 4 units?

ANSWER

Each layer of the cube has $4 \times 4 = 16$ unit cubes, and there are 4 such layers.

$4 \times 4 \times 4 = 64$

Similarly, $5^3 = 5 \times 5 \times 5 = 125$, so 125 is a cube.

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The cube has 64 unit cubes.

IN-TEXT · PAGE 12 · T6

Complete the table below.

ANSWER

n	n^3	n	n^3
1	1	11	1331
2	8	12	1728
3	27	13	2197
4	64	14	2744
5	125	15	3375
6	216	16	4096
7	343	17	4913
8	512	18	5832
9	729	19	6859
10	1000	20	8000

The new entries are $12^3 = 1728$, $15^3 = 3375$, $16^3 = 4096$, $6^3 = 216$, $7^3 = 343$, $8^3 = 512$, $9^3 = 729$, $10^3 = 1000$ and $20^3 = 8000$. Check: $12 \times 12 \times 12 = 144 \times 12 = 1728$; $15 \times 15 \times 15 = 225 \times 15 = 3375$; $16 \times 16 \times 16 = 256 \times 16 = 4096$.

The completed table of cubes from 1^3 to 20^3 is shown above.

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IN-TEXT · PAGE 12 · T7

What patterns do you notice in the table above?

ANSWER

1. Cubes of even numbers are even and cubes of odd numbers are odd.
2. The last digits of 1^3 to 10^3 are 1, 8, 7, 4, 5, 6, 3, 2, 9, 0 — every digit from 0 to 9 appears exactly once.
3. A cube ends in the same digit as the number if that digit is 0, 1, 4, 5, 6 or 9.
4. Numbers ending in 2 have cubes ending in 8, and numbers ending in 3 have cubes ending in 7 (and the other way round for 7 and 8).
5. $10^3 = 1000$ and $20^3 = 8000$: the cube of a multiple of 10 ends in three zeros.

The last digit of n^3 depends only on the last digit of n, and cubes grow much faster than squares.

IN-TEXT · PAGE 12 · T8

We know that 0, 1, 4, 5, 6, 9 are the only last digits possible for squares. What are the possible last digits of cubes?

ANSWER

Number ends in	0	1	2	3	4	5	6	7	8	9
Its cube ends in	0	1	8	7	4	5	6	3	2	9

A cube can end in any digit 0, 1, 2, 3, 4, 5, 6, 7, 8 or 9.

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IN-TEXT · PAGE 13 · T9

Similar to squares, can you find the number of cubes with 1 digit, 2 digits, and 3 digits? What do you observe?

ANSWER

1-digit cubes: 1, 8 → 2 cubes

2-digit cubes: 27, 64 → 2 cubes

3-digit cubes: 125, 216, 343, 512, 729 → 5 cubes

For squares the corresponding counts are 3 (1, 4, 9), 6 (16 to 81) and 22 (100 to 961). Cubes grow faster, so there are fewer of them in each range, and the counts 2, 2, 5 show no simple pattern. (The next range has 4-digit cubes $10^3 = 1000$ to $21^3 = 9261$, which is 12 cubes.)

There are 2 one-digit, 2 two-digit and 5 three-digit cubes.

IN-TEXT · PAGE 13 · T10

Can a cube end with exactly two zeroes (00)? Explain.

ANSWER

Write the number as $m \times 10^k$ where m does not end in 0. Its cube is $m^3 \times 10^{3k}$, and m^3 does not end in 0. So the cube ends in exactly 3k zeros — a multiple of 3. For example, $10^3 = 1000$ (three zeros) and $100^3 = 1000000$ (six zeros).

No. The number of zeros at the end of a cube is always a multiple of 3, so a cube cannot end with exactly two zeros.

IN-TEXT · PAGE 14 · T11

Later in this series, we get the following set of consecutive numbers: 91 + 93 + 95 + 97 + 99 + 101 + 103 + 105 + 107 + 109. Can you tell what this sum is without doing the calculation?

ANSWER

In the pattern $1 = 1^3$, $3 + 5 = 2^3$, $7 + 9 + 11 = 3^3$, ... the nth row has n odd numbers and adds up to n^3. The given sum has 10 numbers, so it is the 10th row.

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Check: rows 1 to 9 use 1 + 2 + ... + 9 = 45 odd numbers, so the 10th row starts with the 46th odd number 2 × 46 − 1 = 91 and ends with the 55th odd number 109. Also 10 numbers with average 100 add up to 1000.

The sum is $10^3 = 1000$.

IN-TEXT · PAGE 14 · T12

Let us check if 3375 is a perfect cube.

ANSWER

$3375 \div 3 = 1125, \div 3 = 375, \div 3 = 125 = 5 \times 5 \times 5$

$3375 = 3 \times 3 \times 3 \times 5 \times 5 \times 5 = (3 \times 5) \times (3 \times 5) \times (3 \times 5) = 15^3$

Yes. $3375 = 15^3$ is a perfect cube and $\sqrt[3]{3375} = 15$.

IN-TEXT · PAGE 14 · T13

Is 500 a perfect cube?

ANSWER

$500 = 2 \times 2 \times 5 \times 5 \times 5$

The three 5's form a triplet, but 2 occurs only twice. Check: $7^3 = 343$ and $8^3 = 512$, and 500 lies between them.

No. The prime factors of 500 cannot be split into three identical groups, so 500 is not a perfect cube.

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IN-TEXT · PAGE 15 · T14

Find the cube roots of these numbers: (i) $\sqrt[3]{64}$ = (ii) $\sqrt[3]{512}$ = (iii) $\sqrt[3]{729}$ =

ANSWER

(i) $64 = 2 \times 2 \times 2 \times 2 \times 2 \times 2 = (2 \times 2)^3 = 4^3$
(ii) $512 = 2^9 = (2^3)^3 = 8^3$
(iii) $729 = 3^6 = (3^2)^3 = 9^3$

Check: 4 × 4 × 4 = 64, 8 × 8 × 8 = 512 and 9 × 9 × 9 = 729.

(i) $\sqrt[3]{64}$ = 4 (ii) $\sqrt[3]{512}$ = 8 (iii) $\sqrt[3]{729}$ = 9

IN-TEXT · PAGE 15 · T15

Compute successive differences over levels for perfect cubes until all the differences at a level are the same. What do you notice?
Perfect cubes: 1, 8, 27, 64, 125, 216 …

ANSWER

Take the cubes 1, 8, 27, 64, 125, 216, 343 and subtract each number from the next, level by level:

Perfect cubes	1	8	27	64	125	216	343
Level 1	7	19	37	61	91	127	
Level 2	12	18	24	30	36		
Level 3	6	6	6	6			

For squares, all differences became equal (2) at level 2. For cubes they become equal (6) at level 3.

The successive differences of the perfect cubes become constant, all equal to 6, at the third level (the second level increases by 6 each time).

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SECTION 1.3 · PAGE 16 · T16

Why is the word ‘root’ (the root of a plant) used for the mathematical operation √ (square root, cube root, etc.)?

ANSWER

In ancient India, the Sanskrit word mula, meaning root of a plant, basis, cause, origin, etc., was used for the mathematical operation of taking roots. In Sanskrit, varga-mula (the basis, cause, origin of the square) was used for square root and ghana-mula for cube root.

This use of mula was later emulated in Arabic and Latin through their words for the root of a plant, jidhr and radix respectively. Another Sanskrit term used was pada (foot, basis, cause, origin).

The word ‘root’ comes from the Sanskrit mula (root, basis, origin), used in India for taking roots at least from the first century BCE.

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