St. Andrews Scots Sr. Sec. School

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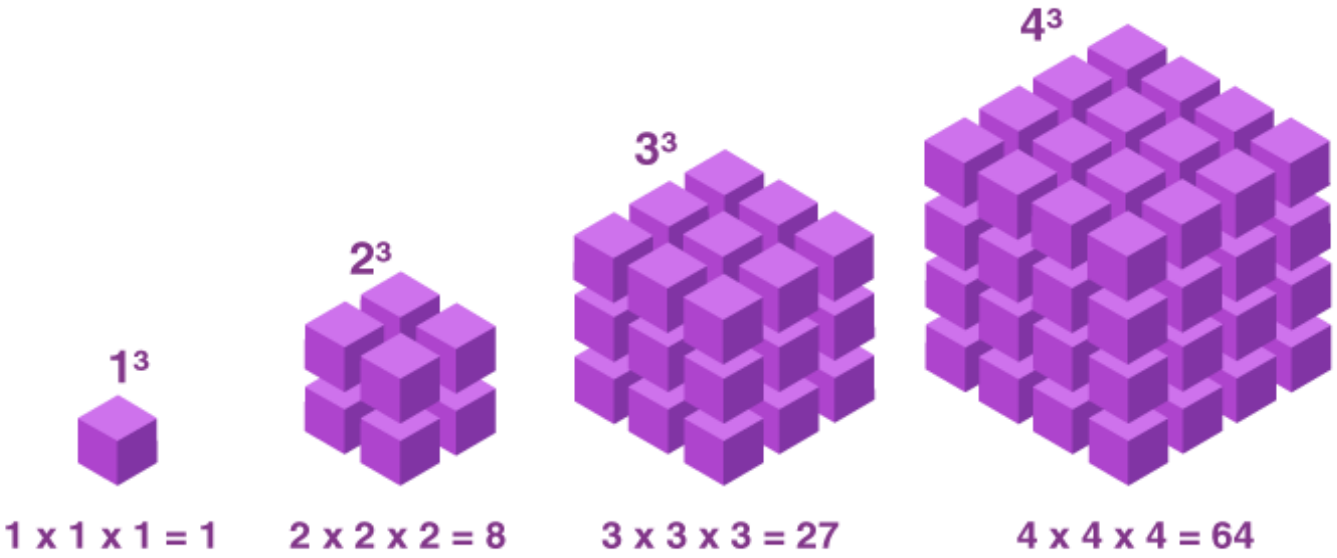
Class: VIII	Subject: Maths	Topic: Cubes and Cube Roots	NOTES-CH-4

Cube Numbers

If a natural number *m* can be expressed as n^3, where *n* is also a natural number, then *m* is called the cube number of *n*.
Numbers like 1, 8, 27 are cube number of the numbers 1, 2, and 3 respectively.
All perfect cube numbers are obtained by multiplying a number by itself three times.

Cubes Relation with Cube Numbers

In geometry, a cube is a solid figure where all edges are **equal** and are **perpendicular** to each other.



For example, take a cube of unit side. If we arrange these cubes to form a bigger cube of side 3 units, we find that there are a total of 27 such unit cubes that make up a cube of 3 units. Similarly, a cube of 4 units will have 64 such unit cubes.

Units Digits in Cube Numbers

Depending on whether a number is odd or even, its cube number is also odd or even respectively.
This is determined by the nature of the cube numbers' unit digit.

- If a number is odd, its cube numbers' unit digit is also odd.

- If a number is even, its cube numbers' unit digit is also even.

The table below shows the units digit of a number and the units digit of the cube of that number:

Units digit of number	Units digit of its cube
1	1
2	8
3	7
4	4
5	5
6	6
7	3
8	2
9	9

Inside Cube Numbers

Adding Consecutive Odd Numbers

$1 = 1 = 1^3$

$3 + 5 = 8 = 2^3$

$7 + 9 + 11 = 27 = 3^3$

$13 + 15 + 17 + 19 = 64 = 4^3$

$21 + 23 + 25 + 27 + 29 = 125 = 5^3$

We can see from the above pattern, if we need to find the n_3, n consective odd numbers will be needed, such that their sum is equal to n_3.

This pattern holds true for all natural numbers.

Also, if we need to find n_3 then we should add n consecutive natural numbers starting from

odd natural number.

Prime Factorisation Method to Find a Cube

In the **prime factorisation** of any number, if **each prime factor** appears **three times**, then the number is a **perfect cube**.

Consider, the number 216. By prime factorisation,
$216=2\times2\times2\times3\times3\times3=2^3\times3^3=6^3$
Hence, 216 is a perfect cube.

Consider, the number 500. By prime factorisation,
$500=2\times2\times5\times5\times5=2^2\times5^3$
In the above prime factorisation 2 appears twice.
Hence, 500 is not a perfect cube.

Cube Roots

Finding the **cube root** is the **inverse operation** of finding the **cube**.
We know that $3^3=27$. We can also write the same equation as $\sqrt[3]{27}=3$. The symbol '$\sqrt[3]{}$' denotes '**cube root**'.

Smallest Multiple that is a Perfect Cube

Consider an example: 53240.

Now, we have to check whether the given number 53240 is a perfect cube or not.

So, to find whether the given number is a perfect cube or not, first we have to find the prime factorisation of 53240.

Hence, the prime factorisation of 53240 is $2 \times 2 \times 2 \times 5 \times 11 \times 11 \times 11$.

Here, the number 11 is repeated thrice and "2" is also repeated thrice. But we don't have three 5's.

Hence, the given number is not a perfect cube.

Thus, to make 53240 a perfect cube, we should multiply 25 on both sides.

$53240 \times 25 = 2 \times 2 \times 2 \times 5 \times 11 \times 11 \times 11 \times 5 \times 5$ [Since $25 = 5 \times 5$]

So, we have three 2's, three 5's and three 11's.

$1331000 = 2^3 \times 5^3 \times 11^3$

$1331000 = (2 \times 5 \times 11)^3$

$1331000 = 110^3$

Hence, 1331000 is a perfect cube.

Therefore, the smallest natural number by which 53240 must be multiplied to make a perfect cube is 25.

Alternate Method:

As we know, the prime factorisation of 53240 = 2 × 2 × 2 × 5 × 11 × 11 × 11.

So, if we divide 53240 by 5 on both sides, we will get

(53240/ 5)= [(2 × 2 × 2 × 5 × 11 × 11 × 11) / 5]

On simplification, we get

10648 = 2 × 2 × 2 × 11 × 11 × 11

Hence, we have three 2's and three 11's, and we can say that 10648 is a perfect cube number.

I.e.,

$10648 = 2^3 \times 11^3$

$10648 = (2 \times 11)^3$

$10648 = 22^3$

Therefore, the smallest natural number by which 53240 must be divided to make a perfect cube is 5.

Cube root using prime factorisation

We can find the cube root of a number by prime factorisation method by the following steps:

- resolve the number into its prime factors. Consider the number 5832. 5832=(2×2×2)×(3×3×3)×(3×3×3).
- make groups of three same prime factors.
- take one **prime factor** from each group and multiply them. Their product is the required cube root.

Therefore, cube root of 5832=$\sqrt[3]{5832}$=2×3×3=18