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Powers and Roots

Power

A number multiplied by itself repeatedly is called a power or exponential of the number. The number is called the base of the power and the number of times it is multiplied is called the exponent or index.

The product $a \times a$, written as a^2, is a power of a. The base is a and the index is 2 because a is multiplied twice. Similarly, $x \times x \times x$, written as x^3, is a power of x, the base being x and the index 3 because x is multiplied thrice.

Examples (i) In $2^5 = 2 \times 2 \times 2 \times 2 \times 2$, base = 2, index = 5.

(ii) In $8^3 = 8 \times 8 \times 8$, base = 8, index = 3.

Squares and square roots

If a number is multiplied by itself, we get a squared number, also called a perfect square. For example, $4 \times 4 = 4^2 = 16$. So, 16 is a perfect square and 4 is said to be the square root of 16. Thus, the square root of a is b if $b^2 = a$. The symbol for square root is $\sqrt{\ }$ or $(\ )^{1/2}$. Therefore, we write $\sqrt{16} = 4$ or $(16)^{1/2} = 4$.

Examples (i) $7 \times 7 = 7^2 = 49$. So, the square root of 49 is 7. $\therefore \sqrt{49} = 7$.

(ii) $15 \times 15 = 15^2 = 225$. So, the square root of 225 is 15.

$\therefore \sqrt{225} = 15$.

Note $4^2 = 16$ and $(-4)^2 = 16$. So, $\sqrt{16} = 4$ and -4. Similarly, $\sqrt{49} = 7$ and -7, $\sqrt{225} = 15$ and -15, and so on. Here, we will consider only the positive value of a square root.

To find the square root of a number

There are two ways of finding the square roots of large numbers.

(a) By prime factorization (b) By division

By prime factorization

Steps 1. Write the number as a product of prime factors.

2. Make pairs of equal prime factors.

3. Take one factor from each pair and multiply them.

You can also express the number as a product of powers of prime factors. Taking half of each index and then finding the product of the factors will give the square root.

EXAMPLE **Find the square root of 2025.**

Solution On prime factorization,

3	2025
3	675
3	225
3	75
5	25
	5

$\therefore\ 2025 = 3 \times 3 \times 3 \times 3 \times 5 \times 5 = (3 \times 3) \times (3 \times 3) \times (5 \times 5).$

$\therefore\ \sqrt{2025} = 3 \times 3 \times 5 = 45.$

Alternatively

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

$\therefore\ \sqrt{2025} = 3^{4/2} \times 5^{2/2} = 3^2 \times 5 = 9 \times 5 = 45.$

By division

Steps

1. Make pairs of the digits of the given number from right to left. If the number of digits is odd, one digit will be left unpaired at the extreme left of the number. Put a small line segment over each pair of digits.
2. Consider the first pair of digits (or the single unpaired digit) from left. This is the dividend. Find the greatest number the square of which is not more than the dividend. Write this number in the place of the quotient.
3. Write the square of the number obtained in Step 2 below the dividend and subtract. Find the remainder (if any).
4. Write the remainder obtained in Step 3 along with the next pair of digits of the given number. This new number is the new dividend. (If there is no remainder in Step 3, write only the next pair of digits of the given number.)
5. Write the first quotient just below the divisor and add them.
6. Write the largest possible digit on the right of the sum (obtained in Step 5) so that the product of the new number and the largest possible digit does not exceed the new dividend. Subtract it from the new dividend. This largest possible digit will be the second digit of the square root of the given number.
7. Write the remainder (if any) obtained in Step 6 along with the next pair of digits of the given number. This number is the new dividend.

   Repeat the process till all the pairs of the given number are exhausted.

EXAMPLE **Find the square roots of (i) 3721 and (ii) 15376.**

Solution (i)

6	$\overline{37}\,\overline{21}$	(61
+ 6	− 36	
121	121	
	− 121	
	×	

$\therefore\ \sqrt{3721} = 61.$

Steps 1. Make the pairs of digits, that is, 21 and 37. (Here, no digit is left out of pairing.)

2. The greatest number the square of which does not exceed 37 is 6. Write 6 in the quotient's places.
3. Write $6^2 = 36$ below 37 and subtract. The remainder is 1.
4. The new dividend is 121—the remainder (1) along with the second pair (21).
5. Write the quotient (6) below the divisor (6) and add. The sum is 12.
6. The largest possible digit that can be written next to 12 such that the product of the new number and that digit does not exceed 121 is 1. Write 1 next to 6 in the quotient's place.
7. Write 1×121 below the dividend and subtract. As we have no remainder after this, our work ends.

$\therefore \quad \sqrt{3721} = 61.$

(ii)

1	$\overline{1}\,\overline{53}\,\overline{76}$	(124
+ 1	− 1	
22	× 53	
+ 2	− 44	
244	976	
	− 976	
	×	

$\therefore \quad \sqrt{15376} = 124.$

Note Here, the number of digits is odd. So, a digit (1) is left out as the single unpaired digit.

To find the square root of a decimal number

Steps
1. Make pairs of the digits in the decimal part of the given number from left to right. Also, make pairs of the digits in the integral part of the given number from right to left. As usual, put a small line segment over each pair of digits.
2. Now proceed to find the square root of the number, ignoring the decimal point.
3. Place the decimal point in the quotient when you write the first pair of digits after the decimal point in the dividend.

EXAMPLE **Find the square root of 15.21.**

Solution

3	$\overline{15}.\overline{21}$	(3.9
+ 3	− 9	
69	621	
	− 621	
	×	

$\therefore \quad \sqrt{15.21} = 3.9.$

Note that the decimal point is placed in the quotient when the first pair of digits of the decimal part is written in the dividend.

Square root of a fraction

To find the square root of a mixed fraction, convert it into an improper fraction. The square root of a proper or improper fraction is given by the following formula.

The square root of a fraction = $\dfrac{\text{the square root of the numerator}}{\text{the square root of the denominator}}$

Thus, $\sqrt{\dfrac{a}{b}} = \dfrac{\sqrt{a}}{\sqrt{b}}$.

EXAMPLE **Find the square roots of (i) $\dfrac{16}{25}$, (ii) $1\dfrac{13}{36}$ and (iii) 12.25.**

Solution (i) $\sqrt{\dfrac{16}{25}} = \dfrac{\sqrt{16}}{\sqrt{25}} = \dfrac{4}{5}$.

(ii) $\sqrt{1\dfrac{13}{36}} = \sqrt{\dfrac{49}{36}} = \dfrac{\sqrt{49}}{\sqrt{36}} = \dfrac{7}{6} = 1\dfrac{1}{6}$.

(iii) $\sqrt{12.25} = \sqrt{\dfrac{1225}{100}} = \dfrac{\sqrt{1225}}{\sqrt{100}} = \dfrac{35}{10} = 3.5$.

To find the square root of a nonperfect square natural number

Steps
1. Put a suitable number of pairs of zeros after the decimal point. For example, $17 = 17.\overline{00}\overline{00}\ldots$.
2. Now find the square root of the number up to one more decimal place than the desired one.
3. Now round off the quotient.

EXAMPLE **Find the square root of 17, correct to 2 decimal places.**

Solution First, we shall find $\sqrt{17}$ to 3 decimal places.

4	$\overline{17}.\overline{00}\,\overline{00}\,\overline{00}$	(4.123
+ 4	− 16	
81	100	
+ 1	− 81	
822	1900	
+ 2	− 1644	
8243	25600	
	− 24729	
	871	

Now 4.123 = 4.12, correct to 2 decimal places.

$\therefore$ $\sqrt{17} = 4.12$, correct to 2 decimal places.

To find the squares and square roots of numbers using the tables

Approximate values of the squares and the square roots of numbers may be found by using printed tables, the degree of accuracy depending on the number of significant figures given by the tables.

Here is a table of the squares of the first 20 natural numbers.

Number (a)	Square of the number (a^2)
1	1
2	4
3	9
4	16
5	25
6	36
7	49
8	64
9	81
10	100

Number (a)	Square of the number (a^2)
11	121
12	144
13	169
14	196
15	225
16	256
17	289
18	324
19	361
20	400

Note
- The numbers 1, 4, 9, 16, 25, 36, 49, 64, 81, 100, etc., are perfect squares and their square roots are 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, etc., respectively.
- Some properties of the squares of natural numbers are as follows.
  (i) The squares of even numbers are even, while the squares of odd numbers are odd.
  (ii) Perfect squares can never end with the digits 2, 3, 7 and 8. Also, they cannot have an odd number of zeros at the end. For example, 342, 5013, 117, 3568, 25000 are not perfect squares.
  (iii) The square of a natural number (other than 1) is
    (a) divisible by 3 or leaves the remainder 1 when divided by 3;
    (b) divisible by 4 or leaves the remainder 1 when divided by 4.

  Examples $15^2 = 225 = 3 \times 75 = 4 \times 56 + 1$, $16^2 = 256 = 3 \times 85 + 1 = 4 \times 64$.

  (iv) The difference of the squares of two consecutive natural numbers is always odd and is equal to the sum of those consecutive natural numbers.

  Examples $7^2 - 6^2 = 49 - 36 = 13 = 7 + 6$, $14^2 - 13^2 = 196 - 169 = 27 = 14 + 13$

EXAMPLE **Use the tables to find the following.**

(i) 38^2 (ii) 69^2 (iii) $\sqrt{8}$ correct to 2 decimal places

(iv) $\sqrt{59}$ correct to 2 decimal places (v) $\sqrt{26.35}$ correct to 3 decimal places

[Tables are given at the end of the book.]

Solution

(i) Look at the row in which 38 lies. Now, see the column of squares in that row.
$38^2 = 1444$.

(ii) Look at the row in which 69 lies and look for the column of squares in that row.
$69^2 = 4761$.

(iii) Look at the row in which 8 lies. Now, see the column of square roots in that row.
$\sqrt{8} = 2.8284 = 2.83$, correct to 2 decimal places.

(iv) Look at the row in which 59 lies. Now, see the column of square roots in that row.
$\sqrt{59} = 7.6811 = 7.68$, correct to 2 decimal places.

(v) 26.35 lies between 26 and 27.
From the table of square roots,
$\sqrt{26} = 5.0990$ and $\sqrt{27} = 5.1962$. $\therefore \quad \sqrt{27} - \sqrt{26} = 0.0972$
Also, 27 – 26 = 1.
If the difference of the numbers = 1, the difference of their square roots = 0.0972.

$\therefore$ if the difference of the numbers = 0.35,

the difference of their square roots $= 0.35 \times 0.0972 = 0.03402$

$= 0.034$ (correct to 3 decimal places).

$\therefore$ $\sqrt{26.35} = \sqrt{26}$ + difference corresponding to $0.35 = 5.0990 + 0.034$

$= 5.133$, correct to 3 decimal places.

Cubes and cube roots

If a natural number is multiplied by itself three times, the result is a cubed number, also called a perfect cube. For example, $6 \times 6 \times 6 = 6^3 = 216$. So, 216 is a perfect cube and 6 is called the cube root of 216. The symbol for cube root is $\sqrt[3]{}$ or $(\ )^{1/3}$. Thus, we write $\sqrt[3]{216} = 6$ or $(216)^{1/3} = 6$.

Examples (i) $5 \times 5 \times 5 = 5^3 = 125$. So, the cube root of 125 = 5.

$\therefore$ $\sqrt[3]{125} = 5$.

(ii) $12 \times 12 \times 12 = 12^3 = 1728$. So, the cube root of 1728 = 12.

$\therefore$ $(1728)^{1/3} = 12$.

(iii) $(0.2)^3 = 0.2 \times 0.2 \times 0.2 = 0.008$. $\therefore$ $\sqrt[3]{0.008} = 0.2$.

(iv) $(-8)^3 = (-8) \times (-8) \times (-8) = -512$. $\therefore$ $\sqrt[3]{-512} = -8$.

(v) $\left(\frac{-2}{3}\right)^3 = \left(\frac{-2}{3}\right) \times \left(\frac{-2}{3}\right) \times \left(\frac{-2}{3}\right) = \frac{-8}{27}$. $\therefore$ $\sqrt[3]{-\frac{8}{27}} = -\frac{2}{3}$.

To find the cube root by prime factorization

Steps 1. Express the number as a product of prime factors.

2. Make triplets of equal prime factors.

3. Take one factor from each triplet and multiply them.

You can also express the number as a product of powers of prime factors. Then dividing each index by 3 and multiplying the factors will give you the cube root.

EXAMPLE **Find the cube root of 3375.**

Solution

3	3375
3	1125
3	375
5	125
5	25
	5

$\therefore$ $3375 = (3 \times 3 \times 3) \times (5 \times 5 \times 5) = 3^3 \times 5^3$.

$\therefore$ $\sqrt[3]{3375} = 3 \times 5 = 15$.

Cube root of a fraction

To find the cube root of a mixed fraction, first convert it into an improper fraction. The cube root of a proper or improper fraction is given by the following formula.

$$\text{Cube root of a fraction} = \frac{\text{cube root of the numerator}}{\text{cube root of the denominator}}$$

Thus, $\sqrt[3]{\frac{a}{b}} = \frac{\sqrt[3]{a}}{\sqrt[3]{b}}$.

EXAMPLE **Find the cube root of (i) $\frac{27}{343}$, (ii) $18\frac{26}{27}$.**

Solution (i) $\sqrt[3]{\frac{27}{343}} = \frac{\sqrt[3]{27}}{\sqrt[3]{343}} = \frac{\sqrt[3]{3^3}}{\sqrt[3]{7^3}} = \frac{3}{7}$.

(ii) $18\frac{26}{27} = \frac{18 \times 27 + 26}{27} = \frac{512}{27}$.

$\therefore \sqrt[3]{18\frac{26}{27}} = \sqrt[3]{\frac{512}{27}} = \frac{\sqrt[3]{512}}{\sqrt[3]{27}} = \frac{\sqrt[3]{8^3}}{\sqrt[3]{3^3}} = \frac{8}{3} = 2\frac{2}{3}$.

To find the cubes and cube roots of numbers using the tables

Approximate values of the cubes and the cube roots of numbers may be found by using printed tables, the degree of accuracy depending on the number of significant figures given by the tables.

EXAMPLE **Use the tables to find the following.**

(i) 34^3 (ii) 77^3 (iii) $\sqrt[3]{16}$ (iv) $\sqrt[3]{89}$

[Tables are given at the end of the book.]

Solution (i) Look at the row in which 34 lies. Now, see the column of cubes in that row.

$34^3 = 39304$.

(ii) Look at the row in which 77 lies. Now, see the column of cubes in that row.

$77^3 = 456533$.

(iii) Look at the row in which 16 lies. Now, see the column of cube roots in that row.

$\sqrt[3]{16} = 2.5198 = 2.52$, correct to 2 decimal places.

(iv) Look at the row in which 89 lies, then look at the column of cube roots in that row.

$\sqrt[3]{89} = 4.4647 = 4.465$, correct to 3 decimal places.

Solved Examples

EXAMPLE 1 **Find the value of each of the following.**

(i) $\left(1\frac{16}{17}\right)^2$ (ii) $\left(-4\frac{3}{4}\right)^3$ (iii) $(4.8)^2$ (iv) $(0.06)^3$

Solution (i) $\left(1\frac{16}{17}\right)^2 = \left(\frac{33}{17}\right)^2 = \frac{33^2}{17^2} = \frac{1089}{289} = 3\frac{222}{289}$.

(ii) $\left(-4\frac{3}{4}\right)^3 = \left(-\frac{19}{4}\right)^3 = -\frac{19^3}{4^3} = -\frac{6859}{64} = -107\frac{11}{64}$.

(iii) $(4.8)^2 = 4.8 \times 4.8 = 23.04$.

(iv) $(0.06)^3 = 0.06 \times 0.06 \times 0.06 = 0.000216$.

EXAMPLE 2 **Find the square roots of (i) 11.7649 and (ii) 0.076176.**

Solution (i)

3	$\overline{11}.\overline{76}\,\overline{49}$ (3.43
+ 3	− 9
64	276
+ 4	− 256
683	2049
	− 2049
	×

$\therefore \sqrt{11.7649} = 3.43.$

Note that the decimal point is placed in the quotient when the first pair of digits of the decimal part (76) is written in the dividend.

(ii)

2	$.\overline{07}\,\overline{61}\,\overline{76}$ (.276
+ 2	− 4
47	361
+ 7	− 329
546	3276
	− 3276
	×

$\therefore \sqrt{0.076176} = 0.276.$

Note that the given number has no integral part. So, the quotient starts with the decimal point.

EXAMPLE 3 **(i) Find the square root of 7 correct to 2 decimal places.**

(ii) Find the value of $\sqrt{\dfrac{4+\sqrt{7}}{4-\sqrt{7}}}$ correct to (a) 2 decimal places (b) 3 significant figures.

Solution (i) First, we find the value of $\sqrt{7}$ to 3 decimal places and then round it off to 2 decimal places.

2	$\overline{7}.\overline{00}\,\overline{00}\,\overline{00}$ (2.645
+ 2	− 4
46	300
+ 6	− 276
524	2400
+ 4	− 2096
5285	30400
	− 26425
	3975

2.645 = 2.65, correct to 2 decimal places.

$\therefore \sqrt{7} = 2.65$, correct to 2 decimal places.

(ii) The given expression

$$= \sqrt{\frac{4+\sqrt{7}}{4-\sqrt{7}}} = \sqrt{\left(\frac{4+\sqrt{7}}{4-\sqrt{7}}\right) \times \left(\frac{4+\sqrt{7}}{4+\sqrt{7}}\right)} = \sqrt{\frac{(4+\sqrt{7})^2}{(4)^2 - (\sqrt{7})^2}}$$

$$= \frac{\sqrt{(4+\sqrt{7})^2}}{\sqrt{16-7}} = \frac{4+\sqrt{7}}{\sqrt{9}} = \frac{4+2.645}{\sqrt{9}} = \frac{6.645}{3} = 2.215.$$

(a) The required value = 2.215 = 2.22, correct to 2 decimal places.

(b) The required value = 2.22, correct to 3 significant figures.

EXAMPLE 4 **Find the square root of 9.8 correct to 3 decimal places.**

Solution We shall find $\sqrt{9.8}$ to 4 decimal places and then round it off to 3 decimal places.

3	$\overline{9}.\overline{80}\,\overline{00}\,\overline{00}\,\overline{00}$	(3.1304
+3	−9	
61	×80	
+1	−61	
623	1900	
+3	−1869	
62604	310000	
	−250416	
	59584	

3.1304 rounded off to 3 decimal places is 3.130.

$\therefore \quad \sqrt{9.8} = 3.130$ correct to 3 decimal places.

EXAMPLE 5 **Find the least number which should be added to 1018 to make it a perfect square.**

Solution First, we find the square root of 1018.

3	$\overline{10}\,\overline{18}$	(31
+3	−9	
61	118	
	−61	
	57	

$\therefore \quad \sqrt{1018}$ lies between 31 and 32. Also, $32^2 = 1024$.

$\therefore \quad$ the required least number $= 32^2 - 1018 = 1024 - 1018 = 6$.

EXAMPLE 6 **Find the least number by which 23328 should be (i) multiplied, (ii) divided and (iii) decreased to make it a perfect square.**

Solution By prime factorization, we have

2	23328
2	11664
2	5832
2	2916
2	1458
3	729
3	243
3	81
3	27
3	9
	3

$\therefore \quad 23328 = 2^5 \times 3^6$. The index of 2 = 5, which is odd.

(i) Multiplying the given number by 2 makes it a perfect square.

$2 \times 23328 = 2^6 \times 3^6 = (2^3 \times 3^3)^2 = (216)^2$.

So, the required least number = 2.

(ii) Dividing the given number by 2 makes it a perfect square.

$$\frac{23328}{2} = \frac{2^5 \times 3^6}{2} = 2^4 \times 3^6 = (2^2 \times 3^3)^2 = (108)^2.$$

Hence, the required least number = 2.

(iii) We find $\sqrt{23328}$ by division.

1	$\overline{2}\,\overline{33}\,\overline{28}$	(152
+1	−1	
25	133	
+5	−125	
302	828	
	−604	
	224	

$\therefore$ $23328 = (152)^2 + 224$

$\Rightarrow$ $23328 - 224 = (152)^2$.

$\therefore$ if 224 is subtracted from 23328, it becomes a perfect square.

Hence, the required number = 224.

EXAMPLE 7 **Find the cube root of 16.9 correct to 3 decimal places.**

Solution We have $16 < 16.9 < 17 \Rightarrow \sqrt[3]{16} < \sqrt[3]{16.9} < \sqrt[3]{17}$.

From the table of cube roots, we have

$$\sqrt[3]{17} = 2.5713$$
$$\sqrt[3]{16} = 2.5198$$

The difference of the cube roots $= 0.0515$. Also, 17 – 16 = 1.

When the difference of the numbers = 1, the difference of the cube roots = 0.0515.

$\therefore$ when the difference of the numbers $= 0.9$,

the difference of the cube roots $= 0.9 \times 0.0515 = 0.04635$

$= 0.0464$, correct to 4 decimal places.

$\sqrt[3]{16.9} = \sqrt[3]{16} +$ difference corresponding to 0.9

$= 2.5198 + 0.0464 = 2.5662$

$= 2.566$, correct to 3 decimal places.

Remember These

1. $\sqrt{a^2} = a$ or $-a$; $(-a)^2 = a^2$.
2. $\sqrt[3]{a^3} = a$; $\sqrt[3]{-a^3} = -a$.

EXERCISE 7

1. Find the value of each of the following.

(i) $\left(\frac{11}{13}\right)^2$ (ii) $\left(-1\frac{7}{11}\right)^3$ (iii) $(3.5)^2$ (iv) $(0.08)^3$

2. Find the square root of each of the following by prime factorization.

(i) 256 (ii) 324 (iii) 784 (iv) 7056

(v) 28224 (vi) 60025

3. Find the square root of each of the following by division.
(i) 841 (ii) 2304 (iii) 39204 (iv) 55225
(v) 177241 (vi) 425104

4. Find the square root of each of the following.
(i) 13.69 (ii) 0.002025 (iii) 1.5129 (iv) 20.7936
(v) 6146.56 (vi) 1.024144

5. Find the square root of each of the following.
(i) $\frac{169}{484}$ (ii) $5\frac{580}{729}$ (iii) $12\frac{52}{81}$ (iv) 0.0009
(v) 4.41

6. Find the square root of each of the following correct to 2 decimal places.
(i) 2 (ii) 3 (iii) 8 (iv) 11
(v) 35 (vi) 99

7. Find the value of $\sqrt{5}$ correct to 2 decimal places. Then, find the value of the square root of $\frac{3-\sqrt{5}}{3+\sqrt{5}}$ correct to 2 decimal places.

8. Find the square root of each of the following, correct to 3 decimal places.
(i) 2.5 (ii) 0.036 (iii) 6.4 (iv) 0.100

9. Find the least number by which 10368 should be (i) increased, (ii) decreased, (iii) multiplied, (iv) divided to make it a perfect square.

10. Use the tables to find the following.
(i) 55^2 (ii) 98^2 (iii) $\sqrt{38}$ (iv) $\sqrt{89}$
(v) $\sqrt{38.83}$ (vi) $\sqrt{64.25}$

11. Find each of the following.
(i) 8^3 (ii) 15^3 (iii) $\left(\frac{-6}{7}\right)^3$ (iv) $(0.5)^3$
(v) $\sqrt[3]{0.000216}$ (vi) $\sqrt[3]{\frac{729}{1331}}$

12. By prime factorization, find the cube root of each of the following.
(i) 1728 (ii) 4096 (iii) 13824 (iv) 216000

13. Find each of the following by using the tables [correct to three decimal places in (iii) to (viii)].
(i) 25^3 (ii) 83^3 (iii) $\sqrt[3]{18}$ (iv) $\sqrt[3]{97}$
(v) $\sqrt[3]{36}$ (vi) $\sqrt[3]{19.46}$ (vii) $\sqrt[3]{38.75}$ (viii) $\sqrt[3]{65.2}$

ANSWERS

1. (i) $\frac{121}{169}$ (ii) $-\frac{5832}{1331}$ (iii) 12.25 (iv) 0.000512 **2.** (i) 16 (ii) 18 (iii) 28 (iv) 84 (v) 168 (vi) 245

3. (i) 29 (ii) 48 (iii) 198 (iv) 235 (v) 421 (vi) 652

4. (i) 3.7 (ii) 0.045 (iii) 1.23 (iv) 4.56 (v) 78.4 (vi) 1.012

5. (i) $\frac{13}{22}$ (ii) $\frac{65}{27}$ (iii) $\frac{32}{9}$ (iv) 0.03 (v) 2.1

6. (i) 1.41 (ii) 1.73 (iii) 2.83 (iv) 3.32 (v) 5.92 (vi) 9.95

7. 2.24, 0.38

8. (i) 1.581 (ii) 0.190 (iii) 2.530 (iv) 0.316

9. (i) 36 (ii) 167 (iii) 2 (iv) 2

10. (i) 3025 (ii) 9604 (iii) 6.164 (correct to 3 decimal places) (iv) 9.43 (correct to 2 decimal places) (v) 6.23 (correct to 2 decimal places) (vi) 8.016 (correct to 3 decimal places)

11. (i) 512 (ii) 3375 (iii) $\frac{-216}{343}$ (iv) 0.125 (v) 0.06 (vi) $\frac{9}{11}$

12. (i) 12 (ii) 16 (iii) 24 (iv) 60

13. (i) 15625 (ii) 571787 (iii) 2.621 (iv) 4.595 (v) 3.302 (vi) 2.689 (vii) 3.384 (viii) 4.025

❖

Revision Exercise 3

1. Insert three rational numbers between

(i) $\frac{17}{25}$ and $\frac{14}{19}$ (ii) $\frac{24}{121}$ and $\frac{9}{11}$

2. Evaluate the following.

(i) $9\sqrt{8}-12\sqrt{18}+46\sqrt{32}+156\sqrt{128}-25\sqrt{2}$

(ii) $3\sqrt{3}(27\sqrt{27}+125\sqrt{243})-7\sqrt{3}(3\sqrt{75}+7\sqrt{300})$

3. Rationalise the denominator of each of the following.

(i) $\frac{6}{7\sqrt{3}}$ (ii) $\frac{2\sqrt{7}}{5\sqrt{11}}$ (iii) $\frac{7+\sqrt{5}}{4\sqrt{3}-5}$ (iv) $\frac{2\sqrt{19}-\sqrt{17}}{2\sqrt{19}+\sqrt{17}}$

4. Arrange the following in descending order

(i) $12\sqrt{2}, 17, 5\sqrt{7}, 11\sqrt{3}$ (ii) $2\sqrt{11}, 5\sqrt{7}, 7\sqrt{5}, 9\sqrt{2}, 10\sqrt{3}$

5. Find the square root of each of the following.

(i) 36864 (ii) 50176 (iii) 968256 (iv) 4096576

6. Find the square root of each of the following.

(i) $20\frac{605}{1681}$ (ii) 97.0225 (iii) 0.006084 (iv) 0.0625

7. Find the square root of each of the following correct to 2 decimal places

(i) 122 (ii) 22.5

8. Use the tables to find the following.

(i) 79^2 (ii) 45^2 (iii) 98^3 (iv) 61^3

9. Use the tables to find the following correct to 3 decimal places

(i) $\sqrt{70.21}$ (ii) $\sqrt{9.29}$ (iii) $\sqrt[3]{19.75}$ (iv) $\sqrt[3]{49.4}$

10. Find the least number which should be added to make 151316 a perfect square.

ANSWERS

1. (i) $\frac{1319}{1900}, \frac{673}{950}, \frac{1373}{1900}$ (ii) $\frac{171}{484}, \frac{123}{242}, \frac{321}{484}$ **2.** (i) $1389\sqrt{2}$ (ii) 9069

3. (i) $\frac{2\sqrt{3}}{7}$ (ii) $\frac{2\sqrt{77}}{55}$ (iii) $\frac{35}{23}+\frac{28\sqrt{3}}{23}+\frac{5\sqrt{5}}{23}+\frac{4\sqrt{15}}{23}$ (iv) $\frac{93}{59}-\frac{4\sqrt{323}}{59}$

4. (i) $11\sqrt{3}, 17, 12\sqrt{2}, 5\sqrt{7}$ (ii) $10\sqrt{3}, 7\sqrt{5}, 5\sqrt{7}, 9\sqrt{2}, 2\sqrt{11}$

5. (i) 192 (ii) 224 (iii) 984 (iv) 2024 **6.** (i) $4\frac{21}{41}$ (ii) 9.85 (iii) 0.078 (iv) 0.25

7. (i) 11.05 (ii) 4.74 **8.** (i) 6241 (ii) 2025 (iii) 941192 (iv) 226981

9. (i) 8.379 (ii) 3.048 (iii) 2.703 (iv) 3.669 **10.** 5

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