50 PRACTICE SETS

QUANTITATIVE APTITUDE

HIGHLY USEFUL FOR

SSC (CGL, CPO, 10+2 & Multitasking), IBPS (PO & Clerk), LIC (ADO & AAO), Railway and Other Competitive Exams

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2500
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Head Office Kalindi, TP Nagar, Meerut (UP) - 250002
Tel: 0121-2401479, 2512970, 4004199; Fax: 0121-2401648

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PREFACE

Quantitative Aptitude is one of the most important part of any competitive examination. It basically tests candidates's thinking power and calculation skills. The questions that are asked in different examination are not easy to solve without having a good practice. This section covers questions from various topics like as Percentage, Profit & Loss, SI & CI, Time & Work, Average, Speed, Time & Distance, Area & Perimeter, Geometry and Data Interpretation etc.

This book 50 Practice Sets on Quantitative Aptitude highly useful for all Competitive Exams *viz.* SSC (CGL, CPO, 10+2 and Multitasking), Bank (PO and Clerk), LIC (AAO and ADO), Railway and Other Competitive Exams.

This book 50 Practice Sets is a collection of 2500 Multiple Choice Questions covering all the concepts and all types of questions according to latest pattern of Examination.

Detailed explanations with answers has been given at the end of each practice set.

As we know '*Practice is the only key to Success*', after practicing this book you will get higher score and 100% success in the Examination.

Authors

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Quantitative Aptitude
At a Glance

In any competitive examination, the section 'Quantitative Aptitude' holds a great importance. Questions from this section are asked in almost all the competitive examinations. The purpose to ask the questions from this section is to test the mental ability and thinking power of the candidate. Quantitative aptitude contains various topics *viz*. Number System, HCF & LCM, Number Series, Profit & Loss, SI & CI, Work & Time; Speed, Time & Distance, Area & Perimeter, Geometry and Data Interpretation etc.

Number System

A system in which we study different types of numbers, their relationship and rules govern in them is called as number system.

Types of Numbers

1. **Natural numbers** Natural numbers are counting numbers. They are denoted by N.
   e.g. $N = \{1, 2, 3, \ldots\}$
   - All natural numbers are positive.
   - Zero is not natural number. Therefore, 1 is the smallest natural number.
2. **Whole numbers** All natural numbers and zero form the set of whole numbers. Whole numbers are denoted by W.
   e.g. $W = \{0, 1, 2, 3, \ldots\}$
   - Zero is the smallest whole number.
   - Whole numbers are also called as non-negative integers.
3. **Integers** Whole numbers and negative numbers form the set of integers. They are denoted by I.
   e.g. $I = \{\ldots, -4, -3, -2, -1, 0, 1, 2, 3, 4, \ldots\}$
   Integers are of two types.
   (i) **Positive integers** Natural numbers are called as positive integers. They are denoted by I^+. e.g. $I^+ = \{1, 2, 3, 4, \ldots)$
   (ii) **Negative integers** Negative of natural numbers are called as negative integers. They are denoted by I^-.
   e.g. $I^- = \{-1, -2, -3, -4, \ldots\}$
   '0' is neither + ve nor – ve integer.
4. **Even numbers** A counting number which is divisible by 2, is called an even number.
   e.g. 2, 4, 6, 8, 10, 12, ... etc.
5. **Odd numbers** A counting number which is not divisible by 2, is known as an odd number.
   e.g. 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, ... etc.
6. **Prime numbers** A counting number is called a prime number when it is exactly divisible by 1 and itself.
   e.g. 2, 3, 5, 7, 11, 13, ...etc.
   - 2 is the only even number which is prime.
   - Every prime number greater than 3 can be represented by $6n + 1$, where n is integer.
7. **Composite numbers** Composite numbers are non-prime natural numbers. They must have atleast one factor apart from 1 and itself. e.g. 4, 6, 8, 9, etc.
   - Composite numbers can be both odd and even.
   - 1 is neither a prime number nor composite number.
8. **Coprimes** Two natural numbers are said to be coprimes, if their HCF is 1.
   e.g. (7, 9), (15, 16)
   - Coprime numbers may or may not be prime.
9. **Rational Numbers** A number that can be expressed as p/q is called a rational number, where p and q are integers and $q \neq 0$.
   e.g. $\frac{3}{5}, \frac{7}{9}, \frac{8}{9}, \frac{13}{15}$ etc.
   - The sum and difference of rational and irrational number are irrational e.g. $3 + \sqrt{5}$.
   - The product of rational and irrational number are always irrational number e.g. $3\sqrt{5}$.

10. **Irrational numbers** The numbers that cannot be expressed in the form of p/q are called irrational numbers, where p and q are integers and $q \neq 0$. e.g. $\sqrt{2}, \sqrt{3}, \sqrt{7}, \sqrt{11}$ etc.
    - π is an irrational number as 22/7 is not the actual value of π but it is its nearest value.
11. **Real Numbers** Real numbers include rational and irrational numbers both.
    e.g. $\frac{7}{9}, \sqrt{2}, \sqrt{5}, \pi, \frac{8}{9}$ etc.

Divisibility Tests

Divisibility by 2 When the last digit of a number is either 0 or even, then the number is divisible by 2. e.g. 12, 86, 472, 520,1000 etc., are divisible of 2.

Divisibility by 3 When the sum of the digits of a number is divisible by 3, then the number is divisible by 3. e.g. 1233
$1 + 2 + 3 + 3 = 9$, which is divisible by 3, so 1233 must be divisible by 3.

Divisibility by 4 When the number formed by last two digits of a given number is divisible by 4, then that particular number is divisible by 4. A part from this, the number having two or more zeroes at the end is also divisible by 4.
e.g. The numbers 4300, 153000, 9530000 etc, are divisible by 4.

Divisibility by 6 When a number is divisible by both 3 and 2, then that particular number is divisible by 6 also. e.g. 18, 36, 720, 1440 etc., are divisible by 6 as they are divisible by both 3 and 2.

Divisibility by 7 A number is divisible by 7 when the difference between the number formed by the digits other than the units digit and twice the units digit is either 0 or a multiple of 7. e.g. 658 is divisible by 7 because $65 - 2 \times 8 = 65 - 16 = 49$. As, 49 is divisible by 7, the number 658 is also divisible by 7.

Divisibility by 8 When the number formed by last three digits of a number is divisible by 8, then the number is also divisible by 8. A part from this, if the last three or more digits of a number are zeroes, then the number is divisible by 8.

Divisibility by 9 When the sum of all the digits of a number is divisible by 9, then the number is also divisible by 9. e.g. 936819
$9 + 3 + 6 + 8 + 1 + 9 = 36$, which is divisible by 9. Therefore, 936819 is also divisible by 9.

Divisibility by 11 When the sum of digits at odd and even places are equal or differ by a number divisible by 11, then the number is also divisible by 11. e.g. 2865423
Sum of digits at odd place$(A) = 2 + 6 + 4 + 3 = 15$
Sum of digits at even places $(B) = 8 + 5 + 2 = 15$
$A = B$. Hence, 2865423 is divisible by 11.

Important Formulae

- Divident = Divisor × Quotient + Remainder
- Sum of first n natural numbers $= \frac{n(n+1)}{2}$
- Sum of first n odd numbers $= n^2$
- Sum of first n even numbers $= n(n+1)$
- Sum of square of first n natural numbers
  $$= \frac{n(n+1)(2n+1)}{6}$$
- Sum of cubes of first n natural numbers
  $$= \left[\frac{n(n+1)}{2}\right]^2$$
- There are 15 prime numbers between 1 and 50 and 10 prime numbers between 50 and 100.

Arithmetic Progression

$a, (a+d), (a+2d), (a+3d), \ldots$
a = Ist term, d = common difference. Then,
(a) nth term $= a + (n-1)d$
(b) Sum of n terms $= \frac{n}{2}[2a + (n-1)d]$
(c) Sum of n terms $= \frac{n}{2}(a + l)$, where l = last term

Geometric Progression

$a, ar, ar^2, ar^3, \ldots$
a = Ist term, r = common ratio. Then,
(a) nth term $= ar^{n-1}$
(b) Sum of n terms $= \frac{a(1-r^n)}{(1-r)}$, where $r < 1$
(c) Sum of terms $= \frac{a(r^n - 1)}{(r-1)}$, where $r > 1$

Example 1. $7^{6n} - 6^{6n}$, where n is a integer greater than 0, is divisible by
(a) 13 (b) 127 (c) 559 (d) 130

Sol. (b) $7^{6n} - 6^{6n}$ for $n = 1$, $7^6 - 6^6 = (7^3)^2 - (6^3)^2$
$= (7^3 - 6^3)(7^3 + 6^3)$ $[a^2 - b^2 = (a+b)(a-b)]$
$= (343 - 216)(343 + 216) = 127 \times 559$
$\therefore$ It is clearly divisible by 127.

Example 2. If the sum of first 11 terms of an arithmetic progression equal that of the first 19 terms. Then, what is the sum of first 30 terms?

(a) 0 (b) – 1 (c) 1 (d) 2

Sol. (*a*) Let the first term be a common difference of progression be d.

According to the question,

$$S_{11} = S_{19} \Rightarrow \frac{11}{2}[2a + 10d] = \frac{19}{2}[2a + 18d]$$

$$\Rightarrow \quad 16a + 232d = 0 \Rightarrow 2a + 29d = 0$$

$$\therefore \quad S_{30} = \frac{30}{2}[2a + 29d] = \frac{30}{2} \times 0 = 0$$

Square and Square Root

Square

If a number is multiplied with itself, then the result of this multiplication is called the square of that number. e.g. Square of $6 = 6 \times 6 = 36$

Square Root

The square root of a number is that number, the square of which is equal to the given number. It is denoted by the sign '$\sqrt{\ }$'. e.g. 49 has two square roots 7 and – 7, because $(7)^2 = 49$ and $(-7)^2 = 49$. Hence, we can write $\sqrt{49} = \pm 7$

Methods to Find Square Root

Different methods to calculate the square root of a number are as follows

Prime Factorisation Method

This method has the following steps

***Step* I** Express the given number as the product of prime factors.

***Step* II** Arrange the factors in pairs of same prime numbers.

***Step* III** Take the product of these prime factors taking one out of every pair of the same primes. This product gives us the square root of the given number. e.g. The square root of 1689 is $11 \times 11 \times 3 \times 3 = 11 \times 3 = 33$

Division Method

The steps of this method can be easily understood with the help of following examples.

For finding the square root of 18769, we follows following steps

***Step* I** In the given number, mark off the digits in pairs starting from the unit digit. Each pair and the remaining 1 digit (if any) is called a period.

***Step* II** Now, $1^2 = 1$; On subtracting, we get 0 (zero) as remainder.

***Step* III** Bring down the next period, i.e. 87. Now, the trial divisor is $1 \times 2 = 2$ and

	137
1	1 87 68
	1
23	87
	69
267	1869
	1869
	×

trial dividend is 87. So, we take 23 as divisor and put 3 as quotient. The remainder is 18 now.

***Step* IV** Bring down the next period, which is 69. Now, trial divisor is $13 \times 2 = 26$ and trial dividend is 1869. So, we take 267 as dividend and 7 as quotient. The remainder is 0.

***Step* V** The process (processes like III and IV) goes on till all the periods (pairs) come to an end and we get remainder as 0 (zero) now.

Hence, the required square root = 137

Example 3. Find the square root of 1089.

(a) 33 (b) 30

(c) 43 (d) 23

Sol. (*a*) Prime factors of $1089 = 11 \times 11 \times 3 \times 3$

$$\therefore \quad \sqrt{1089} = \sqrt{11 \times 11 \times 3 \times 3}$$

$$= 11 \times 3$$

$$= 33$$

Cube and Cube Root

Cube

If a number is multiplied two times with itself, then the result of this multiplication is called the cube of that number.

e.g. Cube of $6 = 6 \times 6 \times 6 = 216$

Cube Root

The cube root of a given number is the number whose cube is the given number. The cube root is denoted by the sign '$\sqrt[3]{\ }$'.

e.g.

(i) $\sqrt[3]{8} = \sqrt[3]{2 \times 2 \times 2} = 2$ (ii) $\sqrt[3]{512} = \sqrt[3]{8 \times 8 \times 8} = 8$

Methods to Find Cube Root

Method to calculate the cube root of a number is as follow

Prime Factorisation Method

This method has following steps

***Step* I** Express the given number as the product of prime factors.

***Step* II** Arrange the factors in a group of three of same prime numbers.

***Step* III** Take the product of these prime factors picking one out of every group (group of three) of the same primes. This product gives us the cube root of given number.

Example 4. The cube root of 9261 is

(a) 19 (b) 21 (c) 27 (d) 29

Sol. (*b*) Prime factors of

$9261 = (3 \times 3 \times 3) \times (7 \times 7 \times 7)$

$\Rightarrow \sqrt[3]{9261} = \sqrt[3]{3 \times 3 \times 3 \times 7 \times 7 \times 7}$

3	9261
3	3087
3	1029
7	343
7	49
7	7
	1

Now, taking one number from each group of three, we get $\sqrt[3]{9261} = 3 \times 7 = 21$

HCF and LCM

Highest Common Factor (HCF)

HCF of two or more numbers is the greatest number which divides each of them exactly.

e.g. 6 is the HCF of 12 and 18 as there is no number greater than 6 that divides both 12 and 18. HCF is also know as Highest Common Divisor (HCD) and Greatest Common Measure (GCM).

Least Common Multiple (LCM)

The LCM of two or more given numbers is the least number to be exactly divisible by each one of them.

e.g. We can obtain LCM of 4 and 12 as follows.

Common multiples of 4 and 12 = 12, 24, 36, …

But the least common multiple is 12

$\therefore$ LCM of 4 and 12 = 12

Important Points

- LCM of fraction $= \dfrac{\text{LCM of numerators}}{\text{HCF of denominators}}$
- HCF of fraction $= \dfrac{\text{HCF of numerators}}{\text{LCM of denominators}}$
- Product of two numbers = HCF of numbers × LCM of numbers

Example 5. What will be the LCM of 15, 24, 32 and 45?

(a) 1440 (b) 1224 (c) 1320 (d) 1540

Sol. (a) LCM of 15, 24 32 and 45 is calculated as

2	15, 24, 32, 45
2	15, 12, 16, 45
2	15, 6, 8, 45
3	15, 3, 4, 45
5	5, 1, 4, 15
	1, 1, 4, 3

$\therefore$ Required LCM

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

$= 1440$

Indices and Surds

Indices

When a number 'P' is multiplied by itself 'n' times, then the product is called nth power of 'P' and is written as P^n. Here, P is called the base and 'n' is known as the index of the power.

Therefore, P^n is the exponential expression. P^n is read as 'P raised to the power n' or 'P to the power n'.

Rules of Indices

1. $P^m \times P^n = P^{m+n}$
2. $\dfrac{P^m}{P^n} = P^{m-n}$
3. $(P^m)^n = P^{mn}$
4. $(PQ)^n = P^n \times Q^n$
5. $\left(\dfrac{P}{Q}\right)^n = \dfrac{P^n}{Q^n}$
6. $P^0 = 1$
7. $P^{-n} = \dfrac{1}{P^n}$

Surds

When root of a non-negative rational number (i.e.quantities of type $\sqrt[n]{a}$, a being a rational number) does not provide an exact solution, then this root is called a surd.

e.g. $\sqrt{2}, \sqrt{5}, \sqrt[3]{8}, a + \sqrt{b}$ etc.

Note: All surds are irrational numbers.
All irrational numbers are not surds.

Rules of Surds

1. $\sqrt[m]{P} = P^{1/m}$
2. $\sqrt[m]{PQ} = \sqrt[m]{P} \times \sqrt[m]{Q}$
3. $\sqrt[m]{\dfrac{P}{Q}} = \dfrac{\sqrt[m]{P}}{\sqrt[m]{Q}}$
4. $(\sqrt[m]{P})^m = P$
5. $(\sqrt[m]{P})^n = (P^{1/m})^n = P^{n/m} = \sqrt[m]{P^n}$

Example 6. The 75% of
$2 + \sqrt{0.09} - \sqrt[3]{0.008} - 2.80$ is

(a) 0
(b) $\dfrac{1}{2}$
(c) $-\dfrac{21}{40}$
(d) 8

Sol. (c) $\dfrac{75}{100} \times (2 + \sqrt{0.09} - \sqrt[3]{0.008} - 2.80)$

$$= \frac{3}{4} \times \left(2 + \sqrt{\frac{9}{100}} - \sqrt[3]{8/1000} - \frac{280}{100}\right)$$

$$= \frac{3}{4} \times \left(2 + \frac{3}{10} - \frac{2}{10} - \frac{280}{100}\right)$$

$$= \frac{3}{4} \times \left(2 + \frac{1}{10} - \frac{14}{5}\right)$$

$$= \frac{3}{4} \times \left(\frac{20 + 1 - 28}{10}\right) = \frac{3}{4} \times \frac{-7}{10} = \frac{-21}{40}$$

Fraction

A digit which can be represented in p/q form, where $q \neq 0$, is called a fraction. Here, p is called the numerator and q is called the denominator.

e.g. 3/5 is a fraction, where 3 is called numerator and 5 is called denominator.

Operations on Simple Fractions

1. Addition of Simple Fractions

- **When Denominators are Same** If denominators of fractions are same, then numerators of fractions are added and their addition is divided by denominator.

  e.g. $\dfrac{1}{4} + \dfrac{2}{4} = (1 + 2)\dfrac{1}{4} = \dfrac{3}{4}$

- **When Denominators are Different** If denominators of fractions are not same, then make their denominators equal (by taking their LCM) and then add their numerators.

  e.g. $\dfrac{1}{2} + \dfrac{1}{3} + \dfrac{1}{4}$

  $$= \frac{(1 \times 6) + (1 \times 4) + (1 \times 3)}{12} = \frac{6 + 4 + 3}{12} = \frac{13}{12}$$

2. Subtraction of Simple Fractions

- **When Denominators are Same** If denominators of fractions are same, then numerators of fractions are subtracted and their subtraction is divided by the denominator.

  e.g. $\dfrac{3}{4} - \dfrac{1}{4} = (3 - 1)\dfrac{1}{4} = \dfrac{2}{4} = \dfrac{1}{2}$

- **When Denominators are Different** If denominators of fractions are not same, then make their denominators equal and then subtract their numerators.

  e.g. $\frac{2}{3}-\frac{1}{2}=\frac{(2\times2)-(3\times1)}{6}=\frac{4-3}{6}=\frac{1}{6}$

3. Multiplication of Simple Fractions

To multiply two or more simple fractions, multiply their numerators and denominators.

e.g. $\frac{1}{2}\times\frac{3}{4}=\frac{(1\times3)}{(2\times4)}=\frac{3}{8}$

If fractions are given in mixed form, first convert them into improper fraction and then multiply.

e.g. $2\frac{4}{5}\times1\frac{8}{3}=\frac{14}{5}\times\frac{11}{3}=\frac{154}{15}$

4. Division of Simple Fractions

To divide two fractions, first fraction is multiplied by the inverse of second fraction.

e.g. $\frac{2}{3}\div\frac{3}{5}=\frac{2}{3}\times\frac{5}{3}=\frac{10}{9}$

Example 7. The value of $\frac{1}{20}+\frac{1}{30}+\frac{1}{42}+\frac{1}{56}+\frac{1}{72}+\frac{1}{90}$ is

(a) $\frac{1}{10}$ (b) $\frac{3}{5}$ (c) $\frac{3}{20}$ (d) $\frac{7}{20}$

Sol. (c) $\frac{1}{20}+\frac{1}{30}+\frac{1}{42}+\frac{1}{56}+\frac{1}{72}+\frac{1}{90}$

$=\left(\frac{1}{4}-\frac{1}{5}\right)+\left(\frac{1}{5}-\frac{1}{6}\right)+\ldots+\left(\frac{1}{9}-\frac{1}{10}\right)$

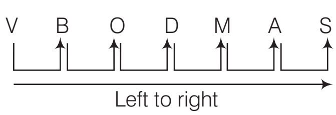
$=\frac{1}{4}-\frac{1}{10}=\frac{5-2}{20}=\frac{3}{20}$

Simplification

Simplification is a process of reducing a complex expression into a simpler form.

'VBODMAS' Rule

This rule gives the correct order in which various operations regarding simplification are to be performed, so as to find out the values of given expressions in simple ways. Let us see what these letters mean. Order of operations is as same as the order of letters in the 'VBODMAS' from the left to right as



Clearly, the order will be as follows

First Vinculum bracket is solved,
[Remember $-5-10=-15$, but
$-\overline{5-10}=-(-5)=5$]

Second Brackets are to be solved in order given below

- First, small brackets (circular brackets)'( )'
- Second, middle brackets (curly brackets) '{ }'
- Third, square brackets (big brackets) '[ ]'

Third Operation of 'Of' is performed.

Fourth Operation of division is performed.

Fifth Operation of multiplication is performed.

Sixth Operation of addition is performed.

Seventh Operation of subtraction is performed.

Important Formulae

1. $(a+b)^2=a^2+2ab+b^2$
2. $(a-b)^2=a^2-2ab+b^2$
3. $(a+b)^2+(a-b)^2=2(a^2+b^2)$
4. $(a+b)^2-(a-b)^2=4ab$
5. $a^2-b^2=(a+b)(a-b)$
6. $(a+b)^3=a^3+b^3+3ab(a+b)$
7. $(a-b)^3=a^3-b^3-3ab(a-b)$
8. $a^3+b^3=(a+b)(a^2-ab+b^2)$
9. $a^3-b^3=(a-b)(a^2+ab+b^2)$
10. $\frac{a^3+b^3+c^3-3abc}{a^2+b^2+c^2-ab-bc-ca}=(a+b+c)$

    (i) If $a+b+c=0$, then $a^3+b^3+c^3=3abc$
11. $(a+b+c)^2=a^2+b^2+c^2+2(ab+bc+ca)$
12. $(a+b+c)^2=a^2+b^2+c^2+2ab+2bc+2ca$
13. $a^3+b^3+c^3-3abc$

    $=\frac{1}{2}(a+b+c)[(a-b)^2+(b-c)^2+(c-a)^2]$

Example 8. The simplified value of $4-[6-\{12-(10-\overline{8-6})\}]$ is

(a) 3 (b) 4 (c) 2 (d) 1

Sol. (*c*) Given expression,

$4 - [6 - \{12 - (10 - 8 + 6)\}]$ [remove vinculum]

$= 4 - [6 - \{12 - (10 - 2)\}]$

$= 4 - [6 - \{12 - 8\}]$ [remove ( )]

$= 4 - [6 - 4]$ [remove { }] $= 4 - 2 = 2$ [remove [ ]]

Example 9. The simplified value of

$$\frac{(9.8)^3 - (6.8)^3}{9.8^2 + 9.8 \times 6.8 + 6.8^2} \text{ is}$$

(a) 3 (b) 2 (c) 0 (d) 1

Sol. (*a*) We know that,

$$a^3 - b^3 = (a - b)(a^2 + ab + b^2)$$

$$\therefore \quad \frac{a^3 - b^3}{a^2 + ab + b^2} = (a - b)$$

[here, $a = 9.8$, $b = 6.8$]

$$\Rightarrow \quad \frac{(9.8)^3 - (6.8)^3}{(9.8)^2 + 9.8 \times 6.8 + (6.8)^2} = (9.8 - 6.8)$$

$$= 3$$

Number Series

A number series is a sequence of numbers written from left to right in a certain pattern. To solve the questions on series, we have to detect/find the pattern that is followed in the series between the consecutive terms, so that the wrong/missing term can be find out.

Types of Series

There can be following types of series

1. **Prime Number Series** The number which is divisible by 1 and itself, is called a prime number. The series formed by using prime number is called prime number series.
   e.g. 7, 11, 13, 17, 19, …
2. **Addition Series** The series in which next term is obtained by adding a specific number to the previous term, is known as addition series. Addition series are increasing order series and difference between consecutive term is equal e.g. 2, 6, 10, 14 …
3. **Difference Series** Difference series are decreasing order series in which next term is obtained by subtracting a fixed/specific number from the previous term.
   e.g. 108, 99, 90, 81, …
4. **Multiple Series** When each term of a series is obtained by multiplying a number with the previous term, then the series is called a multiplication series. e.g. 4, 8, 12, 16 …
5. **Division Series** Division Series are those in which the next term is obtained by dividing the previous term by a number.
   e.g. 10080, 1440, 240, …
6. n^2 **Series** When a number is multiplied with itself, then it is called as square of a number and the series formed by square of numbers is called n^2 series. e.g. 1, 4, 9, 16, …
7. $(n^2 \pm 1)$ **Series** If in a series each term is a sum or difference of a square term and 1, then this series is called $(n^2 \pm 1)$ series.
   e.g. 10, 17, 26, 37, …
8. $(n^3 \pm 1)$ **Series** Those series in which each term is a sum or difference of a cube of a number and 1, are known as $(n^3 \pm 1)$ series.
   e.g. 126, 217, 344, …

Example 10. What should be the next term in the series 12, 24, 72, 144, … ?

(a) 432 b) 560 (c) 460 (d) 632

Sol. (*a*) Series pattern, $12 \times 2 = 24$; $24 \times 3 = 72$

$72 \times 2 = 144$; $144 \times 3 = 432$

Clearly, next term is 432.

Example 11. There are two number series given below. First number series is arranged in a particular way and second series is based on first series. On the basis of this, which number will come at the place of D.

49	100	153	208	265	324
16	(A)	(B)	(C)	(D)	(E)

(a) 230 (b) 232 (c) 303 (d) 409

Sol. (*b*)

49 → 100 → 153 → 208 → 265 → 324
(+51, +53, +55, +57, +59)

Similarly,

	A	B	C	D	E
16	67	120	175	232	291

(+51, +53, +55, +57, +59)

Percentage

"A per cent is a fraction whose denominator is 100 and the numerator of the fraction is called the rate per cent." Per cent is denoted by the sign '%'.

e.g. 45% means $\frac{45}{100}$ or 45 part in 100.

- For converting percentage into fraction, we divide the percentage by 100 i.e. $25\% = \frac{25}{100} = \frac{1}{4}$.
- For converting fraction into percentage, we multiply 100 and place percentage sign '%' i.e. $\frac{3}{4} \times 100 = 75\%$.
- To express a quantity as a per cent with respect to other quantity following formula is used

$$\frac{\text{The quantity to be expressed in per cent}}{\text{2nd quantity (in respect of which the per cent has to be obtained)}} \times 100\%$$

Note To apply this formula, both the quantities must be in same metric unit. i.e. 200 g sugar is what per cent of 400 g rice

$$\frac{200\text{ g}}{400\text{ g}} \times 100\% = \frac{100}{2}\% = 50\%$$

Important Formulae

- When a value/number/quantity 'A' is increased or decreased by b %, then new value/number/quantity will be $\frac{100 \pm b}{100} \times A$
- If a is x% more than b, then b is less than a by $\left[\frac{x}{100 + x} \times 100\right]\%$.
- If a is x% less than b, then b is more than a by $\left[\frac{x}{100 - x} \times 100\right]\%$.
- When the value of an object is first changed (increased or decreased) by x% and then changed by y%, then net effect is given as $\left[\pm x \pm y + \frac{(\pm x)(\pm y)}{100}\right]\%$.
- If the price of a commodity increases or decreases by a %, then the decrease or increase in consumption, so as not to increase or decrease the expenditure is equal to $\left(\frac{a}{100 \pm a}\right) \times 100\%$.
- If value of a object is P and it increases (or decreases) at the rate of r % per annum, then
  - (a) Value of the object, after t yr $= P\left(1 \pm \frac{r}{100}\right)^t$
  - (b) Value of the object, before t yr $= \frac{P}{\left(1 \pm \frac{r}{100}\right)^t}$
- If value of an object/number P is successively changed by x %, y % and z %, then final value $= P\left(1 \pm \frac{x}{100}\right)\left(1 \pm \frac{y}{100}\right)\left(1 \pm \frac{z}{100}\right)$
- In an examination a % of total number of candidates failed in a subject X and b% of total number of candidates failed in subject Y and c% failed in both subjects, then percentage of candidates, who passed in both the subjects, is $[100 - (a + b - c)]\%$.
- If an amount of sum is increased by x% and then decreased by x%. At last the sum decreased by $\frac{x^2}{100}\%$.

Note [+ ve sign is used for increase and – ve sign used for decrease]

Example 12. If income of Ravi is 20% more than that of Ram, then income of Ram is how much per cent less than that of Ravi?

(a) $14\frac{2}{3}\%$ (b) $16\frac{2}{3}\%$ (c) $18\frac{1}{3}\%$ (d) 18%

Sol. (*b*) Let Ram's income be 100.

Then, Ravi's income = 120

$\therefore$ Required percentage $= \frac{120 - 100}{100} \times 100\%$

$= \frac{20}{120} \times 100\% = 16\frac{2}{3}\%$

Alternate Method

Here, $a = 20\%$

According to the formula,

Required percentage $= \left(\frac{a}{100 + a} \times 100\right)\%$

$= \left(\frac{20}{100 + 20} \times 100\right)\%$

$= \frac{50}{3}\% = 16\frac{2}{3}\%$

Profit and Loss

Profit and loss are the terms related to monetary transactions in trade and business. Whenever a purchased article is sold, then either profit is earned or loss is incurred.

Cost Price (CP) This is the price at which an article is purchased or manufactured.

Selling Price (SP) This is the price at which an article is sold.

Overhead Charges Such charges are the extra expenditures on purchased goods apart from actual cost price. Such charges include freight charges, rent, salary of employees, repairing cost on purchased articles etc.

Note If overhead charges are not specified in the question, then they are not considered.

Marked Price (MP) or MRP The list price of an item is known as its marked price.

Profit (SP>CP) When an article is sold at a price more than its cost price, then profit is earned.

Loss (CP>SP) When an article is sold at a price lower than its cost price, then loss is incurred.

Important Formulae

1. Profit = SP − CP
2. Loss = CP − SP
3. $\text{Profit\%} = \dfrac{\text{Profit}}{\text{Cost Price}} \times 100\%$
4. $\text{Loss\%} = \dfrac{\text{Loss}}{\text{Cost price}} \times 100\%$
5. $\text{SP} = \left(\dfrac{100 + \text{Gain\%}}{100}\right) \times \text{CP}$
6. $\text{SP} = \left(\dfrac{100 - \text{Loss \%}}{100}\right) \times \text{CP}$
7. $\text{CP} = \left(\dfrac{100}{100 + \text{Gain \%}}\right) \times \text{SP}$
8. $\text{CP} = \left(\dfrac{100}{100 - \text{Loss \%}}\right) \times \text{SP}$

Some Important Short Tricks

- If an item is sold for ₹ A on a profit (or loss) of r%, then the selling price of the item will be $\dfrac{₹A(100 \pm R)}{(100 \pm r)}$ for a profit (loss) of R%.
- If an article is sold for ₹ A more, instead of a profit or loss of R%, it has a profit of r%, then the cost price of the article is ₹$\left(\dfrac{A \times 100}{R \mp r}\right)$.
- If selling price of two articles are same and one of them is sold at a profit of r% and another is sold at loss of r%, then there is always a loss of $\left(\dfrac{r^2}{100}\right)$%.
- If cost price of x articles is equal to selling price of y articles and $x > y$, then there is always a profit.

  $$\text{Profit percentage} = \frac{x - y}{y} \times 100\%$$

  But if $x < y$, then there is always a loss.

  $$\text{Loss percentage} = \frac{y - x}{y} \times 100\%$$

Note [+ ve sign is used for a profit and –ve sign is used for a loss]

- If there are two successive profits and a loss of x% and y%, then resultant gain or loss per cent is $\left[\pm x \pm y + \dfrac{(\pm x)(\pm y)}{100}\right]\%$

  [+ ve for profit and – ve for loss]
- If selling price of x articles is equal to the profit of selling price of y, then

  $$\text{Profit \%} = \frac{y}{x - y} \times 100$$

  $$\text{Loss \%} = \frac{y}{x + y} \times 100$$

Example 13. Ravish lost 20% by selling a radio set for ₹ 3072. Then, per cent will he gain by selling it for ₹ 4080 is equal to

(a) 6.25% (b) 7.50% (c) 8.50% (d) 11%

Sol. (*a*) Given, SP = ₹ 3072 and loss = 20%

$\therefore$ $\text{CP} = \dfrac{100}{80} \times 3072 = ₹\,3840$

Now, CP = ₹ 3840 and SP = ₹ 4080

Gain = 4080 − 3840 = ₹ 240 [$\because$ gain = SP − CP]

$\therefore$ $\text{Gain\%} = \dfrac{240}{3840} \times 100\% = 6.25\%$

$\left[\because \text{gain \%} = \dfrac{\text{gain}}{\text{CP}} \times 100\%\right]$

Discount

The reduction in the marked price of item is known as discount. There is a fixed rate of discount on any item.

Discount = Market price − Selling price

$$\text{Discount} = \frac{\text{Marked Price} \times \text{Rate of discount}}{100}$$

Important Formulae

1. Discount %
$$= \frac{\text{Marked price} - \text{Selling price}}{\text{Marked price}} \times 100$$
2. $$\text{Discount \%} = \frac{\text{Discount}}{\text{Marked price}} \times 100$$

Where, r% is the rate of discount allowed.

Note Discount is always calculated with respect to marked price of an article.

Some Important Short Tricks

- If marked price of an item is ₹ x and the successive discounts rates are r_1%, r_2%, r_3% and so on, then selling price of the item
$$= x \times \left(1 - \frac{r_1}{100}\right)\left(1 - \frac{r_2}{100}\right)\left(1 - \frac{r_3}{100}\right)\ldots$$
- If a shopkeeper wants a profit of R% after allowing a discount of r%, then Marked Price (MP) of the item
$$= \text{CP} \times \left(\frac{100 + R}{100 - r}\right)$$
- Single discount equivalent to two successive discounts x_1% and x_2% $= \left(x_1 + x_2 - \frac{x_1 \times x_2}{100}\right)$%
- A merchant fixes the marked price of an article in such a way that after allowing a discount of r%, he earns a profit of R%, then marked price of the article is $\left(\frac{r + R}{100 - r} \times 100\right)$% more than its cost price.

Example 14. A shopkeeper on the eve of Diwali allowed a series of discount on television sets. Then, the selling price of a television set, if the marked price of television is ₹ 1000 and successive discounts are 10% and 5%, is

(a) ₹ 895 (b) ₹ 845 (c) ₹ 805 (d) ₹ 855

Sol. (*d*) Selling price of a television

$$= \text{Marked price} \times \left(1 - \frac{r_1}{100}\right)\left(1 - \frac{r_2}{100}\right)$$

Here, marked price = ₹ 1000, r_1 = 10% and r_2 = 5%

$$\therefore \text{ Selling price } = 1000\left(1 - \frac{10}{100}\right) \times \left(1 - \frac{5}{100}\right)$$
$$= 1000 \times \left(\frac{100 - 10}{100}\right) \times \left(\frac{100 - 5}{100}\right)$$
$$= 1000 \times \frac{90}{100} \times \frac{95}{100} = ₹\ 855$$

Simple Interest

When a person borrows some amount of money from another person or organisation (bank), then the person borrowing money (borrower) pays some extra money during repayment, that extra money during repayment is called interest.

Principal (P) Principal is the money borrowed or deposited for a certain time.

Amount (A) The sum of principal and interest is called amount.

Rate of Interest (R) It is the rate at which the interest is charged on principal. It is always specified in percentage terms.

Time (T) The period, for which the money is borrowed deposited, is called time.

Simple Interest (SI) If the interest is calculated on the original principal for any length of time, then it is called simple interest. Simple Interest

$$= \frac{\text{Principal} \times \text{Rate} \times \text{Time}}{100} \text{ or SI} = \frac{P \times R \times T}{100}$$

Important Formulae

1. $A = P + \text{SI}$, where A = Amount, P = Principal and SI = Simple interest
2. $A = P\left(1 + \frac{RT}{100}\right)$, where A = Amount, P = Principal and SI = Simple interest.