

# **SOSWAAL BOOKS®** LEARNING MADE SIMPLE



# **QUANTITATIVE APTITUDE**

# **All Competitive Examinations**

For

SSC/Defence/Banking/LIC/RRB/CAT & other Important Examinations

# Get the #OswaalEdge

100% Updated

with latest questions of different examinations Chapter-wise Segregation

with concise revision notes & learning objectives Crisp Revision

with smart mind maps and important formulae & tricks Extensive Practice

with fully solved 1500+ practice questions with 3 levels of difficulty Valuable Exam Insights

with chapter-wise & Exam-wise trend analysis





• OSWAAL BOOKS® LEABNING MADE SIMPLE

# OBJECTIVE QUANTITATIVE APTITUDE

# For All Competitive Examinations

SSC/Defence/Banking/LIC/RRB/CAT & other Important Examinations

#### Get the #OswaalEdge

#### 100% Updated

with latest questions of different examinations Chapter-wise Segregation

with concise revision notes & learning objectives

#### Crisp Revision

with smart mind maps and important formulae & tricks Extensive Practice

with fully solved 1500+ practice questions with 3 levels of difficulty

#### Valuable Exam Insights

with chapter-wise & Exam-wise trend analysis





**ISBN** 

"9789359589923"





# Objective Quantitative Aptitude



All rights reserved. No part of this book may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, without written permission from the publishers. The author and publisher will gladly receive information enabling them to rectify any error or omission in subsequent editions.





contact@oswaalbooks.com

www.OswaalBooks.com

# DISCLAIMER

This book is published by Oswaal Books and Learning Pvt Ltd ("Publisher") and is intended solely for educational use, to enable students to practice for examinations/tests and reference. The contents of this book primarily comprise a collection of questions that have been sourced from previous examination papers. Any practice questions and/or notes included by the Publisher are formulated by placing reliance on previous question papers and are in keeping with the format/pattern/ guidelines applicable to such papers.

The Publisher expressly disclaims any liability for the use of, or references to, any terms or terminology in the book, which may not be considered appropriate or may be considered offensive, in light of societal changes. Further, the contents of this book, including references to any persons, corporations, brands, political parties, incidents, historical events and/or terminology within the book, if any, are not intended to be offensive, and/or to hurt, insult or defame any person (whether living or dead), entity, gender, caste, religion, race, etc. and any interpretation to this effect is unintended and purely incidental. While we try to keep our publications as updated and accurate as possible, human error may creep in. We expressly disclaim liability for errors and/or omissions in the content, if any, and further disclaim any liability for any loss or damages in connection with the use of the book and reference to its contents".

**Kindle Edition** 

# Contents

Deciphering Quantitative Aptitude & Its Importance		4 - 4	
• Preface	• Preface		
• Tips to Cracl	6 - 6		
• Syllabus for	7 – 11		
Chapter-wise	12 - 12		
Important For	Important Formulae & Tricks		
Section - 1 :	Arithmetic		
1.	Percentage	1 - 12	
2.	Profit, Loss & Discount	13 - 24	
3. 3	Simple Interest	25 - 37	
4. (	Compound Interest	38 - 55	
5. I	Ratio and Proportion	56 - 65	
6. I	Partnership	66 - 72	
7. /	Average	73 - 86	
8. I	Mixture & Allegation	87 - 96	
9. 3	Speed, Time & Distance	97 - 114	
10.	Time and Work	115 - 129	
11.	Pipes and Cisterns	130 - 144	
Section - 2: /	Advance Maths		
12. (	Geometry	145 - 178	
13. I	Mensuration	179 – 201	
14. /	Algebra	202 - 222	
15.	Trigonometry	223 - 248	
16. I	Height & Distance	249 - 262	
17. (	Co-ordinate Geometry	263 - 278	
Section - 3: N	Number System		
18. I	Number System	279 – 293	
19. I	Power Indices & Surds	294 - 309	
20. 3	Simplification	310 - 327	
Section - 4: [	Data Interpretation		
21.	Bar & Line Graph	328 - 343	
22.	Pie-Chart	344 - 354	
23.	Data Tabulation	355 - 368	
24. (	Caselets	369 - 378	
Section - 5: N	Modern Mathematics		
25.	Permutation & Combination	379 - 384	
26. I	Probability	385 - 390	
27. 3	Set Theory	391 – 399	

# Deciphering Quantitative Aptitude & Its Importance

Quantitative aptitude refers to the ability to understand and solve mathematical problems quickly and accurately. It involves the application of basic arithmetic, algebra, geometry, and other mathematical concepts to solve problems related to quantitative analysis, data interpretation, and logical reasoning.

Some common topics included in quantitative aptitude assessments are:

- **1.** *Arithmetic:* This involves solving problems related to addition, subtraction, multiplication, division, percentages, ratio, and proportion.
- **2.** *Algebra:* This includes solving problems related to linear and quadratic equations, inequalities, and simultaneous equations.
- 3. *Geometry:* This includes problems related to lines, angles, triangles, circles, and polygons.
- 4. *Trigonometry:* This involves solving problems related to trigonometric functions such as sine, cosine, and tangent.
- **5.** *Data Interpretation:* This involves analysing and interpreting data presented in graphs, charts, and tables.

To improve your quantitative aptitude skills, you can practice solving mathematical problems regularly, familiarize yourself with different formulas and concepts, and improve your mental calculation speed.

Quantitative Aptitude, also known as mathematical aptitude, is a vital component of most competitive exams in India. It tests a candidate's ability to solve numerical problems accurately and quickly. Here are some of the competitive exams where Quantitative Aptitude plays a significant role:

- 6. *Bank Exams:* Quantitative Aptitude is an essential component of bank exams like IBPS PO, IBPS Clerk, SBI PO, SBI Clerk, etc. The section includes questions on topics like arithmetic, algebra, geometry, trigonometry, and data interpretation.
- 7. *SSC Exams:* Quantitative Aptitude is also an important section of various Staff Selection Commission (SSC) exams, including SSC CGL, SSC CHSL, etc. The section includes questions on topics like time and distance, profit and loss, percentage, ratio and proportion, etc.
- 8. *Railway Exams:* Quantitative Aptitude is a crucial section in railway exams like RRB NTPC, RRB JE, etc. The section includes questions on topics like number system, simplification, geometry, data interpretation, etc.
- **9.** *MBA Entrance Exams:* Quantitative Aptitude is a crucial section in MBA entrance exams like CAT, XAT, MAT, etc. The section includes questions on topics like arithmetic, algebra, geometry, trigonometry, and data interpretation.
- **10.** *UPSC Civil Services Exam:* Quantitative Aptitude is a part of the CSAT (Civil Services Aptitude Test) paper in the UPSC Civil Services Exam. The section includes questions on topics like data interpretation, simplification, and arithmetic.

In conclusion, Quantitative Aptitude is a critical component of various competitive exams in India, and it is essential to have a good understanding of mathematical concepts to perform well in these exams.

# Preface

Welcome to the revised edition of "Objective Quantitative Aptitude"! This book aims to equip readers with a comprehensive understanding of quantitative aptitude concepts essential for various competitive exams and entrance tests such as Banking, SSC, Railways, UPSC, and various other State Level Exams.

The objective of this book is to provide a comprehensive understanding of the concepts of Quantitative Aptitude and their applications to the readers. The book covers all essential topics of Quantitative Aptitude such as Simplification, Number System, Ratio & Proportion, Percentage, Profit & Loss, Time & Distance, Time & Work, Data Interpretation, etc.

This book is meticulously crafted to cater to the diverse needs of aspirants preparing for competitive exams. Whether you are a beginner looking to build a strong foundation or an experienced candidate aiming to refine your skills, "Objective Quantitative Aptitude" provides a structured approach to mastering quantitative aptitude concepts.

Some unique features of this book are:

- 100% Updated: with latest questions asked in different examinations.
- *Crisp Revision:* Concepts Review, Important Formulae & Tricks and Mind Maps offer bite-sized and just-in-time revision tools.
- *Extensive Practice:* with More than 1500 Previous year questions from various competitive exams segregated based on difficulty level.
- *Concept Clarity:* Easy to Grasp concepts through Solved examples.
- *Expert Tips:* Helps you get expert knowledge to master the Quantitative Aptitude Concepts on your first attempt.
- *Learning Objectives:* Outlines what aspirant should understand or be able to achieve after the course
- *To-the-point theory:* The book provides concise and clear explanations of quantitative aptitude concepts without overwhelming readers with too much information.
- *Quick and easy techniques:* The book offers shortcuts and easy-to-follow techniques to help readers solve typical exam questions quickly and efficiently.

In conclusion, this book aims to provide a one-stop solution for all the aspirants who are preparing for competitive exams.

It is hoped that the book will be immensely useful to the readers and will help them to achieve their desired goals.

Our books have always been well received by our readers and this is a testament to our research-oriented approach. Our learning pedagogy supplements our editorial research and makes our book current and relevant. We hope our resources will help students to supplement their examination preparation strategy and help them secure high scores.

We wish our readers great success ahead!

Happy learning!

# Tips to Crack Quantitative Aptitude in the First Attempt

The Quantitative Aptitude is a crucial section in many competitive exams in India, such as bank exams, UPSC, SSC, CAT, and other MBA entrance exams. Quantitative Aptitude has a major role in competitive exams in India as it tests essential knowledge and skills required for various fields & evaluates analytical and problem-solving skills. Cracking the quantitative aptitude section of a competitive exam in the first attempt requires hard work, dedication, and a strategic approach. Here are some tips that can help you achieve success in your first attempt:

#### Think Right

Calming yourself and thinking positive is the first and the best course of action that one is required to take. Think and believe that the exam goal is achievable if worked upon smartly.

#### Start studying from the beginning

All the aspirants are aware of how vast, comprehensive and detailed the syllabus of the Quantitative section is. To crack the exam in the first attempt you have to start preparing for the exam from the beginning of your 12th class. It is only then that you will be able to complete the entire syllabus. Following this approach will also allow you plenty of time to revise.



# Respect the syllabus and arrange the materials accordingly

While preparing for the Quantitative Aptitude nothing can be labelled as less important. Questions can come from the most unexpected topics too. Laying down your whole syllabus in front of you will help you to decide on the study material you require.



#### Get the right tools and study material

Gathering and preparing from the appropriate study material is something you cannot be ignorant towards. You can refer to Oswaal 'Objective Quantitative Aptitude' to enhance your preparation. the is on the lines of the current syllabus and can be entrusted upon before the examination.



#### Understand the concepts

No one can crack the Quantitative Aptitude exam just by mugging up all the concepts and topics. The syllabus of the exam is in-depth such that you need to understand every concept.

7

#### Practice a lot of Sample Papers

Oswaal 'Objective Quantitative Aptitude' will not only help you in understanding the examination pattern, but they will also help you in figuring out the questons that come up every year and this might give you an edge over other students. The includes all the typologies of Questons asked in the Examination, Previous Years Papers with solutions, Mind Maps, etc. Referring to various sample papers might also help you in comprehending the areas which require more work.



#### Schedule total me for each subject

Creating a schedule which gives due time to all the subjects is a must. Giving proper time to all the subjects daily will help you cover the syllabus on time, giving you enough time for revision.



#### Revise whenever you get me

Make sure you revise as much as possible. The revision will help you in keeping the concepts fresh in your mind.



#### Analysing your performance

While you are solving papers, make sure you keep a track of time i.e. how much time does it take to solve one section or one question? Make a report of the sections and type of questions which take minimum and maximum me.

# **Syllabus for major Competitive Examinations**

#### CHSL (Combined Higher Secondary Level)

- Number Systems: Computation of Whole Number, Decimal and Fractions, Relationship between numbers.
- Fundamental arithmetical operations: Percentages, Ratio and Proportion, Square roots, Averages, Interest (Simple and Compound), Profit and Loss, Discount, Partnership Business, Mixture and Allegation, Time and distance, Time and work.
- Mensuration: Triangle, Quadrilaterals, Regular Polygons, Circle, Right Prism, Right Circular Cone, Right Circular Cylinder, Sphere, Hemispheres, Rectangular Parallelepiped, Regular Right Pyramid with triangular or square Base.
- Algebra: Basic algebraic identities of School Algebra and Elementary surds (simple problems) and Graphs of Linear Equations.
- Geometry: Familiarity with elementary geometric figures and facts: Triangle and its various kinds of centres, Congruence and similarity of triangles, Circle and its chords, tangents, angles subtended by chords of a circle, common tangents to two or more circles.
- > Trigonometry: Trigonometry, Trigonometric ratios, Complementary angles, Height and distances (simple problems only) Standard Identities like  $\sin 2\theta + \cos 2\theta = 1$  etc.
- Statistical Charts: Use of Tables and Graphs: Histogram, Frequency polygon, Bar-diagram, Pie-chart.

	SSC - CGL (Combined Graduate Level)					
AAAAAAAAAAAAA AAA	Computation of whole numbers Decimals Fractions Fractions Relationships between numbers <u>Profit and Loss</u> Discount Partnership Business Mixture and Alligation Time and distance Time & Work Percentage Ratio & Proportion Square roots Averages Interest Basic algebraic identities of School Algebra & Elementary surds Graphs of Linear Equations Tiangle and its various kinds of centres Congruence and similarity of triangles	A AAAAAAAAAAA AAAA	Circle and its chords, tangents, angles subtended by chords of a circle, common tangents to two or more circles Triangle Quadrilaterals Regular Polygons Right Prism Right Circular Cone Right Circular Cylinder Sphere Heights and Distances Histogram Frequency polygon Bar diagram & Pie chart Hemispheres Rectangular Parallelepiped Regular Right Pyramid with triangular or square base Trigonometric ratio Degree and Radian Measures Standard Identities Complementary angles			

	LIC - AAO (Assistant Administrative Officer)					
≻	Simplification	$\blacktriangleright$	Quadratic Equations			
≻	Simple and Compound Interest	≻	Ratio and Proportion			
≻	Problem on Ages	≻	Surds and Indices			
$\triangleright$	Probability	$\triangleright$	Data Interpretation (Bar Graph, Line Chart,			
≻	Cistern and Pipe		Tabular, Radar/Web, Pie Chart)			
≻	Mensuration	$\succ$	HCF and LCM			
≻	Percentage	$\succ$	Permutation and Combination			
≻	Data Sufficiency	$\succ$	Speed, Distance and Time			
$\triangleright$	Number Series	$\triangleright$	Boats and Streams			
≻	Profit and Loss	$\triangleright$	Approximation			
≻	Work and Time	$\triangleright$	Partnership			
≻	Average		Mixtures & Alligations			

	IBPS PO – Probationary Officer		IBPS – Clerk
A A	Data Interpretation Mensuration		Number Series Simplification/ Approximation
AAA	Profit Discount Probability	AAA	Data Sufficiency Average Ratio and Proportion
AA	Simple and Compound Interest Logarithms,		Time and Distance Relations
AAD	Volume and Surface Area Partnership, Stocks and Shares Distance and Time	AAD	Permutation and Combination Data Interpretation Quadratic Equation
	Time and Work Ratio and Proportion		Mensuration Profit and Loss
A A	Elements of Algebra Discount	A A A	Work, Time, and Energy Probability
AAL	Trigonometry Equations Permutation and Combinations		Simple and Compound Interest
	Height and Distances Clocks		
AA	Percentages Mixture and Allegation		
≻	Speed.		

NDA/NA - National Defence Academy/Naval Academy				
Торіс	Topic-wise			
Algebra	Sets, Venn diagrams, De Morgan laws, Cartesian product, relation, equivalence relation. Real numbers, Complex numbers, Modulus, Cube roots, Conversion of a number in Binary system to Decimals, and vice-versa. Arithmetic, Geometric and Harmonic progressions. Quadratic equations, Linear inequations, Permutation and Combination, Binomial theorem, and Logarithms.			
Calculus	Concept of a real-valued function, domain, range, and graph of a function. Composite functions, one-to-one, onto, and inverse functions. The notion of limit, Standard limits, Continuity of functions, algebraic operations on continuous functions. Derivative of function at a point, geometrical and physical interpretation of a derivative-application. Derivatives of sum, product, and quotient of functions, a derivative of a function concerning another function, the derivative of a composite function. Second-order derivatives. Increasing and decreasing functions. Application of derivatives in problems of maxima and minima			
Matrices and Determinants	Types of matrices, operations on matrices. Determinant of a matrix, basic properties of determinants. Adjoint and inverse of a square matrix, Applications-Solution of a system of linear equations in two or three unknowns by Cramer's rule and by Matrix Method.			
Integral Calculus and Differential Equations	Integration as inverse of differentiation, integration by substitution and by parts, standard integrals involving algebraic expressions, trigonometric, exponential, and hyperbolic functions. Evaluation of definite integrals—determination of areas of plane regions bounded by curves—applications.Definition of order and degree of a differential equation, formation of a differential equation by examples. General and particular solution of differential equations of various types—examples. Application in problems of growth and decay.			
Trigonometry	Angles and their measures in degrees and radians. Trigonometric ratios. Trigonometric identities Sum and difference formulae. Multiple and Sub-multiple angles. Inverse trigonometric functions. Applications-Height and distance, properties of triangles.			
Vector Algebra	Vectors in two and three dimensions, magnitude, and direction of a vector. Unit and null vectors, the addition of vectors, scalar multiplication of a vector, scalar product, or dot product of two vectors. Vector product or cross product of two vectors. Applications—work done by a force and moment of a force and in geometrical problems.			
Analytical Geometry Of Two and Three Dimension	Rectangular Cartesian Coordinate system. Distance formula. Equation of a line in various forms. The angle between two lines. Distance of a point from a line. Equation of a circle in standard and a general form. Standard forms of parabola, ellipse, and hyperbola. Eccentricity and axis of a conic. Point in a three-dimensional space, the distance between two points. Direction Cosines and direction ratios. Equation two points. Direction Cosines and direction of a plane and a line in various forms. The angle between two lines and the angle between two planes. Equation of a sphere.			
Statistics and Probability	Probability: Random experiment, outcomes, and associated sample space, events, mutually exclusive and exhaustive events, impossible and certain events. Union and Intersection of events. Complementary, elementary, and composite events. Definition of probability—classical and statistical—examples. Elementary theorems on probability—simple problems. Conditional probability, Bayes' theorem—simple problems. Random variable as function on a sample space. Binomial distribution, examples of random experiments giving rise to Binomial distribution.			

	CDS-Cobined Defence Services
Algebra	<ul> <li>Basic Operations</li> <li>simple factors</li> <li>Remainder Theorem</li> <li>H.C.F.</li> <li>L.C.M.</li> <li>Theory of polynomials</li> <li>solutions of quadratic equations</li> <li>relation between its roots and coefficients (Only real roots to be considered)</li> <li>Simultaneous linear equations in two unknowns—analytical and graphical solutions</li> <li>Simultaneous linear inequations in two variables and their solutions</li> <li>Practical problems leading to two simultaneous linear equations or inequations in two variables or quadratic equations in one variable &amp; their solutions</li> <li>Set language and set notation</li> <li>Rational expressions and conditional identities</li> <li>Laws of indices</li> </ul>
Arithematic	<ul> <li>Number System: Natural numbers, Integers, Rational and Real numbers.</li> <li>Fundamental operations: addition, substraction, multiplication, division, Square roots, Decimal fractions</li> <li>Unitary method</li> <li>time and distance</li> <li>time and work</li> <li>percentages</li> <li>applications to simple and compound interest</li> <li>profit and loss</li> <li>ratio and proportion</li> <li>variation</li> <li>Elementary Number Theory: Division algorithm</li> <li>Prime and composite numbers</li> <li>Tests of divisibility by 2, 3, 4, 5, 9 and 11</li> <li>Multiples and factors. Factorisation Theorem</li> <li>H.C.F. and L.C.M.</li> <li>Euclidean algorithm</li> <li>Logarithms to base 10</li> <li>laws of logarithms</li> </ul>
Trigonometry	<ul> <li>sine ×, cosine ×, tangent × when 0° &lt; × &lt; 90°</li> <li>Values of sin ×, cos × and tan ×, for × = 0°, 30°, 45°, 60° and 90°</li> <li>Simple trigonometric identities</li> <li>Use of trigonometric tables</li> <li>Simple cases of heights and distances</li> </ul>
Geometry	<ul> <li>Lines and angles</li> <li>Plane and plane figures</li> <li>Theorems on Properties of angles at a point</li> <li>Parallel lines</li> <li>Sides and angles of a triangle</li> <li>Congruency of triangles</li> <li>Similar triangles</li> </ul>

	★ Concurrence of medians and altitudes
	★ Properties of angles
	★ sides and diagonals of a Parallelogram
	★ rectangle and square
	<ul> <li>Circles and its properties including tangents and normals</li> </ul>
	* Loci
	★ Areas of squares
	★ rectangles
	★ parallelograms
Monguration	★ triangle and circle
Wiensulation	* Areas of figures which can be split up into these figures (Field Book)
	★ Surface area and volume of cuboids
	★ lateral surface and volume of right circular cones and cylinders
	★ surface area and volume of spheres
	★ Collection and tabulation of statistical data
	★ Graphical representation frequency polygons
Statistics	★ histograms
Stausues	★ bar charts
	★ pie charts etc
	★ Measures of central tendency

Common Admission Test (CAT)					
Arithmetic	Algebra	Modern Maths	Geometry		
Mixtures & Alligations	Higher Order Equation	LCM & HCF	Permutations	Circles	
Averages	Graphs	Base System	Combinations	Quadrilaterals	
Percentages	Linear Equations	Factors	Probability	Mensuration	
Races	Inequalities	Divisibility	Functions	Trigonometry	
Profits and Loss	Logarithms	Digits	Sequences & Series	Triangles	
Pipers and Cisterns	Maxima and MInima	Complex Numbers	Progressions	Polygons	
Ratio & Proportion	Quadratic Equations	Higher Powers	Set Theory	Coordinate Geometry	
Time & Work		Remainder Theorem	Venn Diagram		
Speed, Time & Distance		Trailing Zeroes			
Trains and Boats		Surds and Indicies			
Simple & Compound Interest					

# **Chapter-wise & Exam-wise Trend Analysis**

Chantons 9 Tonics	Exam - wise Weightage Analysis							
Chapters & lopics	SSC - CHSL	SSC - CGL	IBPS PO	IBPS Clerk	NDA	CDS	САТ	LIC AAO
Percentage	1	1	-	1-2	-		-	-
Profit, Loss, and Discount	1	2	1-2	1-3	-			-
Simple Interest and Compound Interest	2	1	1-2	1-3	-		4	-
Ratio and Proportion	-	1	3-4	1-3	-		3	-
Partnership	-	-	-	-	-		-	-
Average	1	1	-	1-3	-		2	-
Mixture and Alligation	-	-	-	0-2	-	14	-	-
Time , Speed & Distance	1	1	1-2	1-4	-		1	-
Boat and Stream	-	-	-	-	-		-	-
Time and Work	1	1	-	1-2	-		-	-
Pipes and Cisterns	-	-	-	-	-		-	-
Quadratic Equations	-	-	-	-	-		-	-
Derivatives	-	-	-	-	18		-	-
Age Problems	-	-	2-3	-	-		-	-
Geometry	1	5	-	-	-	13	3	-
Mensuration	1	2	-	2-4	-	23	-	-
Algebra	-	4	5-6	3-5	31	11	4	-
Trigonometry	2-3	3	-	-	21	11	-	-
Height and distance	-	-	-	-	-	-	-	-
Co–Ordinate Geometry	-	-	-	-	20	-	-	-
Matrices and Determi- nants	-	-	-	-	9	-	-	-
Number system	-	-	-	0-1	-	18	1	-
Number Series	-	-	-	3-5	-	-	-	5
Divisibility Rules		-	2-5	-	-	-	-	-
Unit digit		-	-	-	-	-	-	-
Number of zeroes		-	-	-	-	-	-	-
Factors	1	-	1-2	-	-	-	-	-
Remainder theorem		-	-	-	-	-	-	-
A.P and G.P		-	-	-	-	-	-	-
Power Indices and Surds		-	-	-	-	-	-	-
Simplification		1	5-6	10-15	-	-	-	5
Data Interpretation	3	4	3-4	5-10	-	-	3	11
Modern Mathematics	-	-	-	0-1	-	-	1	-
Miscellaneous	10-12	-	10-15	-	13	10	4	14
Total	25	25	35	50	150	100	26	35

# **Exclusive School Books Suppliers**

	ANDHRA PRADESH		MAHARASHTRA
VIJAYAWADA	Sri Vikas Book Centre, 9848571114, 9440715700,	JALNA	Anil Paper Mart, 9422722522, (02482) 230733
	ASSAM	PUNE	Madhusheela Books & Stationery, 7875899892
WEST KAMENG	Dutta Book Stall, 8729948473	CHENNAL	TAMIL NADU Bookmark-IT_7305151653
RAJKOT	Royal Stationers, 9824207514	CHERRY	TELANGANA
	KARNATAKA	HYDERABAD	Sri Balaji Book Depot , 9676996199, (040) 27613300
BANGLORE	Satish Agencies, 8861630123		WEST BENGAL
			United book House, 5651544622
	Our Dist	ributors	5
	ANDHRA PRADESH	INDORE	Bhaiya Industries, 9893326853, Sushil Prakashan,(0731) 2503333, 2535892,
TIRUPATI	Shree Aditya Book Centre, 7013300914, 8332972720		9425322330, Bhaiya Store, 9425318103, Arun Prakashan, 9424890785,
VISAKHAPATHAM	JBD Educational, 9246632691, 9246633693, Sri Rajeshwari Book Link, 9848036014		Bhaiya Book Centre, 9424081874, Seva Suppliers, 9826451052
VIJAYAWADA	Akshaya Books Corner, 9666155555	JABALPUR	Vinay Pustak Sadan, 8962362667, Anand Books and Stationers, 9425323508
PORTBLAIR	Krishna Book Centre, 9474205570, Kumar Book Depot, 9932082455	KATNI	Shri Mahavir Agency, 9425363412
	ARUNACHAL PRADESH	UJJAIN	Shreenath Book Depot, 9827544045
NAHARLAGUN	New Pothi Ghar, 8731832947	BHOPAL	Gupta Brother, 9644482444
	ASSAM		MAHARASHTRA
GUWAHATI	Book Emporium, 9675972993, 6000763186, Asbok Publication, 78961/1127	PUNE	Natraj Book Depot, (020) 24485054, 9890054092, Vikas Book House, 9921331187, Pravin Sales, 9890683475, New Saraswati Granth Rhandar, 9422323859, Akshar
	Kayaan Enterprises, (0361) 2630443, Orchid Book house, 9864624209,		Books & Stationary, 7385089789, Vardhaman Educational, 9860574354, Yash Book
	Newco, 9864178188		Centre, 9890156763, Pragati Book Centre, (ISC), 9850039311, Praveen Sales, Pragati Book Centre, Pune ( E & C ), 9850039311
	BIHAR	AURANGABAD	Shree Sainath Agencies, 7350294089, Maya Book Centre, (ISC), 9372360150
PATNA	Nova Publisher & Distributors, (0612) 2666404, Shri Durga Pustak Mandir, 9334477386, Sharda Pustak Bhandar, 9334259293, Vikas Book Depot, 9504780402, Alka Book Agency,	BECD	Adarsh Book Depot, 9860374645
	9835655005, Metro Book(E&C), Ishu Pustak Bhandar, 8294576789, Gyan Ganga Limited, 930/826651	MUMBAI	Vidyarthi Sales Agencies, 9819776110, New Student Agencies, 7045065799, Shivam
MUZAFFARPUR	Pustak Bhandar, 7870834225	JALGAON	Sharma Book Depot & Stat. (ISC), 9421393040
	CHATTISGARH	LATUR	Yash Book House, 9637936999, Shri Ganesh Pustakalay, 9730172188
AMBIKAPUR	Saini Brothers, 9425582561, M.P Department Stores, 9425254264	KOLHAPUR	Granth the Book World, 9922295522
BOKARO	Bokaro Student Friends Pvt. Ltd, Bokaro, 7277931285	NAGPUR	Laxmi Pustakalay and Stationers, (0712) 2727354, Vijay Book Depot, 9860122094
BHILAI	Ann Book Depol, 9423234200		Book Depot, 9923966466, Arun Book & Stationers, 9423110953,
DURG	Bhagwati Bhawani Book Depot, 0788-2327620, 9827473100		Shree Mahalaxmi Pustakalaya, 7507099360
RAIPUR	Shri Ramdev Traders, 9981761797, Gupta Pustak Mandir, 7974220323,	NASHIK	Rahul Book Centre, 9970849681, New India Book House, 9623123458
	Anil Publication, 9691618258/7999078802	DHULE	Navjeevan Book Stall, 7020525561
RAIGARH	Sindhu Book Deopt, 9981935763	YAVATMAL	Shri Ganesh Pustkalaya, 9423131275
	DELHI	VASAI	Prime Book Centre, Vasai, 9890293662
DELHI	Mittal Books, (011) 23288887, 9899037390, Singhania Book & Stationer, 9212028238, Aone Books, New Delhi, 8800497047, Radhey Book Depot, 9818314141, Batheja		ODISHA
	Super Store, 9871833924, Lov Dev & Sons, Delhi ( E & C ), 9811182352, Zombozone,	CUTTACK	A. K. Mishra Agencies, 9437025991, 9437081319
	GILIADAT	BHUBANESHWAR	M/s Pragnya, 8847888616, 9437943777, Padmalaya, 9437026922, Bidyashree,
AHMEDABAD	Patel Book Agencies 9898184248 9824386112 9825900335 Zaveri Agency	BARIPADA	9937017070, Books Godown, 7894281110 Trimurti Book World 9437034735
	9979897312, 9979890330, Hardik Book Agency, (ISC) 9898618613		
BHAVNAGAR	Samir Book Stall, Bhavnagar (ISC) 9586305305, 7825658466	KEONJHAR	Students corner, 7008435418
VAPI	Goutam Book Sellers, 9081790813	AMBALA	Bharat Book Depot, 7988455354
VALSAD	Mahavir Stationers, 9429474177	PATIALA	Goel Sons, 9463619978, Adarsh Enterprises, 9814347613
NAVSARI	College Store, (ISC) NO CALL 02637-258642, 9825099121,8141913750	JALANDHAR	Cheap Book Store, 9872223458, 9878258592, City Book Shop, 9417440753,
SURAT	Shopping Point, 9824108663		Subhash Book Depot, 9876453625, Paramvir Enterprises, 9878626248,
VADODARA	Umakant Book Sellers & Stationer, 6359396370	FEROZPUR	Sita Ram book Depot, 9463039199, 7696141911
	HARYANA	LUDHIANA	Amit Book, 9815807871, Gupta Brothers, 9888200206, Bhatia Book Centre,
ROHTAK	Manish Traders, 9812556687, Swami Kitab Ghar, 9355611088,	CHANDIGARH	9815277131 Mohindra Book Depot. 9814920226
	Babu Ram Pradeep Kumar, 9813214692		· · · · · · · · · · · · · · · · · · ·
REWARI	Sanjay Dook depot, 9255447231 Kashi Ram Kichan lal 9289504004, 8920567245		RAJASTHAN
HISAR	Natraj Book Distributors, 7988917452	KOTA	Vardhman Book Depot, 9571365020, 8003221190 Raj Traders, 9309232829
BHUNA	Khurana Book Store, 9896572520	BHILWARA	Nakoda Book Depot, (01482) 243653, 9214983594,
	JAMMU	BHIWADI	Alankar Book Depot, 9414707462
	Sahitya Sangam, 9419190177	JAIPUR	Ravi Enterprises, 9829060694, Saraswati Book House, (0141) 2610823, 9829811155, Goval Book Distt., 9460983939, 9414782130
	JHARKHAND	UDAIPUR	Sunil Book Store, 9828682260
BOKARO	Bokaro Student Friends Pvt. Ltd. (0654) 2233094, 7360021503, Bharati Bhawan	JODHPUR	Second Hand Book Stall, 9460004745
RANCHI	Agencies, 06542-265302, 9431740797 Crown Book Distributor & Publishers, (0651) 2213735, 9431173904,		TRIPURA
DUMKA	Pustak Mandir, 9431115138, Vidvarthi Pustak Bhandar, 9431310228	AGARTALA	Books Corner 8794894165 8984657146 Book Emporium 9089220412
DOWINA	KARNATAKA	AGARIALA	
HUBLI	Renuka Book Distributor, (0836) 2244124, Vidyamandir Book Distributors, 9980773976	COIMBATORE	Majestic Book House, (0422) 2384333, CBSC Book Shop, 9585979752
BANGLORE	Krishna book house, 9739847334, Hema Book Stores, 9986767000,	CHENNAI	Arraba Book Traders, (044) 25387868, 9841459105, M.R. Book Store (044) 25364596,
BELLERI	Hema Book World, (Chamrajpet) (ISC) 080-40905110, 9945731121		It-Books & Stat. Store, 7305151653, M.K. Stores, 9840030099, Tiger Books Pvt. Ltd.,
	KERALA		9710447000, New Mylai Stationers, 9841313062, Prince Book House, Chennai, 0444-2053926, 9952068491, S.K. Publishers & Distributors, 9789865544, Dharma
			Book Shop, 8667227171
EKNAKULAM	Асааетис воок House, (U484) 2376613, H & C Store, 9864196344, Surya Book House, 9847124217, 9847238314, Asad Book Centere	PUDUCHERRY	Sri Lakshmi Book Seller, 78/1555145
КОТТАУАМ	Book Centre, (0481) 2566992	SALEM	Pattu book centre, 9894816280, Selem Book House, 9487724584
CALICUT	Асадетніс воок House, (047 г) 2333349, 9447063349, Ponni Book Stall, 9037591721 Aman Book Stall, (0495) 2721282	THENI	r.к.sons воок seller, 9443370597, Rasi Publication, 9894816280 Mava Book Centre, 9443929274
	MADHYA PRADESH	MADURAI	Selvi Book Shoppe, 9843057435, Jayam Book Centre, 9894658036
CHHINDWARA	Pustak Bhawan, ( E & C ), 8982150100	VELLORE	G.K book centre and collections, 9894517994
GWALIOR	Agarwal Book Depot, 9425116210		ň

	TELANGANA	NAJIBABAD	Gupta News Agency, 8868932500, Gupta News Agency, ( E & C ), 8868932500
HYDERABAD	Sri Balaji Book Depot, (040) 27613300, 9866355473, Shah Book House, 9849564564	DHAMPUR	Ramkumar Mahaveer Prasad, 9411942550
	Vishal Book Distributors, 9246333166, Himalaya Book World, 7032578527	GORAKHPUR	Central Book House, 9935454590, Friends & Co., 9450277154, Dinesh book depot, 9125818274, Friends & Co., 9450277154, Dwivedi Brothers, 8299684731
	UTTARAKHAND	JHANSI	Bhanu Book Depot, 9415031340
DEHRADUN	Inder Book Agencies, 9634045280, Amar Book Depot , 8130491477, Goyal Book Store, 9897318047, New National Book House, 9897830283/9720590054	KANPUR	Radha News Agency, 8957247427, Raj Book Dist., 9235616506, H K Book Distributors, 9506033137/9935146730
MUSSORIE	Ram Saran Dass Chanda kiran, 0135-2632785, 9761344588	LUCKNOW	Vyapar Sadan, 7607102462, Om Book Depot, 7705871398, Azad Book Depot Pvt. Ltd., 7317000250, Book Sadan, 9839487327, Rama Book Depot(Retail), 7355078254,
	UTTAR PRADESH		Ashirwad Book Depot, 9235501197, Book.com, 7458922755, Universal Books, 9450302161, Sheetla Book Agency, 9235832418, Vidyarthi Kendra Publisher &
AGRA	Sparsh Book Agency, 9412257817, Om Pustak Mandir, (0562) 2464014, 9319117771,		Distributor Pvt Ltd, (Gold), 9554967415, Tripathi Book House, 9415425943, Navyoug Book Agencies 807356/410
	Sanjay Publication, 8126699922 Arti book centre, 8630128856, Panchsheel Books, 9412257962, Bhagwati Book Store, (E & C), 9149081912	MEERUT	Ideal Book Depot, (0121) 4059252, 9837066307
ALLAHABAD	Mehrotra Book Agency, (0532) 2266865, 9415636890	NOIDA	Prozo (Global Edu4 Share Pvt. Ltd), 9318395520, Goyal Books Overseas Pvt.Ltd., 1204655555 9873387003
AZAMGARH	Sasta Sahitya Bhandar, 9450029674	PRAYAGRAJ	Kanhaiya Pustak Bhawan, 9415317109
ALIGARH	K.B.C.L. Agarwal, 9897124960, Shaligram Agencies, 9412317800,	MAWANA	Subhash Book Depot, 9760262264
	New Vimal Books, 9997398868, T.I.C Book centre, 9808039570	RENUKOOT	Om Stationers, 7007326732
BULANDSHAHAR	Rastogi Book Depot, 9837053462/9368978202	SHAHJAHANPUR	New Rastogi Book Seller, 9935395062
BALRAMPUR	Universal Book Center, 8933826726		WEST BENGAL
BAREILLY	Siksha Prakashan, 9837829284, Deepak Book Depot 9837027416	KOLKATA	Oriental Publishers & Distributor (033) 40628367, Katha 'O' Kahini, (033) 22196313, 22419071, Saha Book House, (033), 22193671, 9333416484,
HARDOI	Mittal Pustak Kendra, 9838201466		United Book House, 9831344622, Bijay Pustak Bhandar, 8961260603, Shawan Books Distributors, 8336820363, Krishna Book House, 9123083874
DEORIA	Kanodia Book Depot, 9415277835	COOCH BEHAR	S.B. Book Distributor, Cooch behar, 9002670771
VARANASI	Gupta Books, 8707225564, Bookman & Company, 9935194495/7668899901	KHARAGPUR	Subhani Book Store, 9046891334
MATHURA	Sapra Traders, 9410076716, Vijay Book House , 9897254292	SILIGURI	Agarwal Book House, 9832038727, Modern Book Agency, 8145578772
FARRUKHABAD	Anurag Book Agencies, 8844007575	DINAJPUR	Krishna Book House, 9434394212
		MURCHIDARAD	New Book House 89//876176 9/2/012126

#### MURSHIDABAD New Book House, 8944876176, 9434013126 Entrance & Competition Distributors

	BIHAR	CUTTAK	A.K.Mishra Agencies, 9437025991
PATNA	Metro Books Corner, 9431647013, Alka Book Agency, 9835655005, Vikas Book Depot, 9504780402, Ishu Pustak Bhandar, 9334186300, 8294576789	BHUBANESH- WAR	M/s Pragnya, 9437943777
	CHATTISGARH		PUNJAB
KORBA	Kitab Ghar, 9425226528,	JALANDHAR	Cheap Book Store, 9872223458, 9878258592
RAIPUR	Shri Ramdev Traders, 9981761797		RAJASTHAN
	DELHI	КОТА	Vardhman Book Depot, 9571365020, Raj Traders, 9309232829
DELHI	Singhania Book & Stationer, 9212028238, Radhey Book depot, 9818314141, The Book Shop, 9310262701, Mittal Books, 9899037390, Lov Dev & Sons, 9999353491	JAIPUR	Goyal Book Distributors, 9414782130
NEW DELHI	Anupam Sales, 9560504617, A ONE BOOKS, 8800497047		UTTAR PRADESH
	HARYANA	AGRA	BHAGWATI BOOK STORE, 9149081912, Sparsh Book Agency, 9412257817, Sanjay Publication, 8126699922
AMBALA	Bharat Book Depot, 7988455354	ALIGARH	New Vimal Books, 9997398868
	JHARKHAND	ALLAHABAD	Mehrotra Book Agency, (532) 2266865, 9415636890
BOKARO	Bokaro Student Friends Pvt. Ltd, 7360021503	GORAKHPUR	Central Book House, 9935454590
	MADHYA PRADESH	KANPUR	Raj Book Dist, 9235616506
INDORE	Bhaiya Industries, 9109120101	LUCKNOW	Azad Book Depot PVT LTD, 7317000250, Rama Book Depot(Retail), 7355078254 Ashirwad Book Depot , 9235501197, Book Sadan, 8318643277,
CHHINDWARA	Pustak Bhawan, 9827255997		Book.com , 7458922755, Sheetla Book Agency, 9235832418
	MAHARASHTRA	NAJIBABAD	Gupta News Agency, ( E & C ), 8868932500
NAGPUR	Laxmi Pustakalay and Stationers, (0712) 2727354	PRAYAGRAJ	Format Center, 9335115561, Garg Brothers Trading & Services Pvt. Ltd., 7388100499
PUNE	Pragati Book Centre, 9850039311		UTTARAKHAND
MUMBAI	New Student Agencies LLP, 7045065799	DEHRADUN	Inder Book Agancies, 9634045280
	ODISHA		WEST BENGAL
BARIPADA	Trimurti Book World, 9437034735	KOLKATA	Bijay Pustak Bhandar Pvt. Ltd., 8961260603, Saha Book House, 9674827254 United Book House, 9831344622, Techno World, 9830168159

# **Important Formulae and Tricks**

#### Percentage

**Concept of Percentage:** A percentage is a relative value which denotes the hundredth part of any term.

- > If x is R% more than y, then y is less than x by  $\left(\frac{R}{100+R} \times 100\right)\%$
- ► If x is R% less than y, then y is more than x by  $\left(\frac{R}{100-R} \times 100\right)\%$

**Percentage increase/decrease:** If the price of an item increases by x%, then the reduction in the consumptions expenditure is:

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

If the price of an item decreases by x%, then the increase in the consumption decrease the expenditure is:

$$\left(\frac{x}{100-x} \times 100\right)\%$$

**Percentage change result on population:** Assuming the population of a city is *x* now and it increases at the rate of y% per annum,

- > Population after *n* years =  $x \left(1 + \frac{y}{100}\right)^n$
- ► Population *n* years ago =  $\frac{x}{\left(1 + \frac{y}{100}\right)^n}$

**Depreciation:** Assuming the current value of an article is x and it depreciates at the rate of y% per year;

> Value of the article after *n* years = 
$$x \left(1 - \frac{y}{100}\right)^n$$
 Value

of the article *n* years ago = 
$$\frac{x}{\left(1 - \frac{y}{100}\right)^n}$$

PERCENTAGE FRACTION TABLE		
Fractions	% Values	
1	100%	
1/2	50%	
1/3	33.33%	
1/4	25%	
1/5	20%	
1/6	16.66%	
1/7	14.28%	
1/8	12.5%	

1/9	11.11%
1/10	10%
1/11	9.09%
1/12	8.33%
1/13	7.69%
1/14	7.14%
1/15	6.66%
1/16	6.25%
1/17	5.88%
1/18	5.55%
1/19	5.26%
1/20	5%

#### **Profit and Loss**

- Profit = Selling Price Cost Price.
- > Profit percentage (P%) = (Profit /Cost Price)  $\times$  100
- ➢ Loss = Cost Price − Selling Price
- > Loss percentage (L%) = (Loss /Cost Price)  $\times$  100
- Marked price = Discount + Selling price
- Discount = Marked Price Selling Price
- Discount Percentage = (Discount/Marked price) × 100

Successive discount percentage = 
$$\frac{x + y - (xy)}{100}$$

#### Simple Interest

➢ If a certain sum P in T years at R% per annum amounts to A , then the simple interest will be:

A-P = 
$$\left(\frac{P \times R \times T}{100}\right)$$
.....[where A-P =

simple interest(SI)]

OR

$$\mathrm{SI} = \frac{(\mathrm{P} \times \mathrm{R} \times \mathrm{T})}{100}$$

The annual payment that will discharge a debt of Rs. A due in T years at R% per annum is.

Annual payment = 
$$\frac{100A}{100T + \frac{RT(T-1)}{2}}$$

If a certain sum is invested in n types of investments in such a manner that an equal amount is obtained on each investment where interest rates are R<sub>1</sub>, R<sub>2</sub>, R<sub>3</sub>...., R<sub>n</sub>, respectively and time periods are T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub>, ...., T<sub>n</sub>, respectively, then the ratio in which the amounts are invested is

$$\frac{1}{100 + R_1 T_1} : \frac{1}{100 + R_2 T_2} : \frac{1}{100 + R_3 T_3} : \frac{1}{100 + R_n T_n}$$

If a certain sum of money becomes n times itself in T years at simple interest, then the rate of interest per annum is

$$R = \frac{100(n-1)}{T}$$

If a certain sum of money becomes n times itself at R% per annum simple interest in T years, then

$$T = \left(\frac{n-1}{R}\right) \times 100 \text{ years}$$

If a certain sum of money becomes n times itself in T years at simple interest, then the time T in which it will become m times itself is given by

$$\mathbf{T'} = \left(\frac{m-1}{n-1}\right) \times \mathbf{T} \text{ years}$$

Effect of change of P, R, and T on simple interest is given by the following formula:

 $= \frac{\text{Product of fixed parameter}}{100} \times$ 

[difference of product of variable parameters] For example, if rate (R) changes from  $R_1$  to  $R_2$  and P, T are fixed, then

Change in SI= 
$$\frac{\text{PT}}{100} \times (\text{R}_1 - \text{R}_2)$$

Similarly, if principal (P) changes from P<sub>1</sub> to P<sub>2</sub> and R, T are fixed, then change in SI =  $\frac{\text{RT}}{100} \times (\text{P}_1 - \text{P}_2)$ 

 $\Gamma$  are fixed, then change in SI =  $\frac{1}{100} \times (\Gamma_1 - \Gamma_2)$ 

Also, if rate (R) changes from  $R_1$  to  $R_2$  and time (T) changes from  $T_1$  to  $T_2$  but principal (P) is fixed, then change in

$$SI = \frac{P}{100} \times (R_1 T_1 - R_2 T_2)$$

If a certain sum of money P lent out at SI amounts to A<sub>1</sub> in T<sub>1</sub> years and to A<sub>2</sub> in T<sub>2</sub> years, then

$$P = \frac{A_1 T_2 - A_2 T_1}{T_2 - T_1} \text{ and } R = \frac{A_1 - A_2}{A_1 T_2 - A_2 T_1} \times 100\%$$

If a certain sum of money P lent out for a certain time T amounts to A<sub>1</sub> at R<sub>1</sub> % per annum and to A<sub>2</sub> at R<sub>2</sub> % per annum, then

$$P = \frac{A_2R_1 - A_1R_2}{R_1 - R_2}$$
 and  $T = \frac{A_1 - A_2}{A_2R_1 - A_1R_2} \times 100$  years

If an amount P<sub>1</sub> is lent at the simple interest rate of R<sub>1</sub> % per annum and another amount P<sub>2</sub> at the simple interest rate of R<sub>2</sub> % per annum, then the rate of interest for the whole sum is

$$R = \left(\frac{P_1 R_1 - P_2 R_2}{P_1 + P_2}\right)$$

#### **Compound Interest**

The amount A due after t years, when a principal P is given on compound interest at the rate R% per annum is given by

$$A = P \left( 1 + \frac{R}{100} \right)^t$$

Compound interest (CI) = A – P

$$= P\left[\left(1 + \frac{R}{100}\right)^t - 1\right]$$

• Rate of interest (R)

$$= \left[ \left( \frac{A}{P} \right)^{\frac{1}{t}} - 1 \right] \% \text{ p.a}$$

**NOTE:** Simple interest and compound interest for 1 year at a given rate of interest per annum are always equal.

When interest is compounded half-yearly, then

Amount (A) = 
$$P\left(1 + \frac{R}{100 \times 2}\right)^{2t}$$

> If the interest is compounded quarterly, then

Amount (A) = 
$$P\left(1 + \frac{R}{100 \times 4}\right)^4$$

When the rates of interest are different for different years, say R<sub>1</sub>, R<sub>2</sub>, R<sub>3</sub> percent for the first, second and third year, respectively, then

Amount= 
$$P\left(1 + \frac{R_1}{100}\right)\left(1 + \frac{R_2}{100}\right)\left(1 + \frac{R_3}{100}\right)$$

When the time is given in the form of a fraction, say 2 3/4 years, then,

Amount = 
$$P\left(1 + \frac{R_1}{100}\right)^2 \times \left(1 + \frac{\frac{3}{4}R}{100}\right)^2$$

 (a) The difference between the compound interest and the simple interest on a certain sum of money for 3 years at R% per annum is given by

$$CI - SI = P\left(\frac{R}{100}\right)^2$$
 [in terms of P and R]

- and,  $CI SI = \frac{2 \times 102}{2 \times 100}$  [in terms of SI and R] (b) The difference between the compound interest
- (b) The difference between the compound interest and the simple interest on a certain sum of money for 2 years at R% per annum is given by

$$CI - SI = P\left[\left(\frac{R}{100}\right)^3 + \left(\frac{R}{100}\right)^2\right]$$

[in terms of P and R]

And 
$$CI - SI = \frac{SI}{3} \left[ \left( \frac{R}{100} \right)^3 + 3 \left( \frac{R}{100} \right) \right]$$

- If a certain sum becomes n times in t years at compound interest, then the same sum becomes nm times in *mt* years.
- If a certain sum becomes n times in t years, then the ≻ rate of compound interest is given by

 $\mathbf{R} = 100 \left| \left( n \right)^{\frac{1}{t}} - 1 \right|$ 

If a certain sum of money at compound interest ≻ amounts to Rs. x in A years and to Rs. y in B years, then the rate of interest per annum is

$$\mathbf{R} = \left[ \left( \frac{y}{x} \right)^{1\mathrm{B}-\mathrm{A}} - 1 \right] \times 100$$

If a loan of Rs. P at R% compound interest per annum  $\geq$ is to be repaid in n equal yearly installments, then the value of each installment is given by

Rs. 
$$\frac{P}{\left(\frac{100}{100 + R}\right) + \left(\frac{100}{100 + R}\right)^2 + \dots \left(\frac{100}{100 + R}\right)^n}$$

#### **Time and Work**

- Total Work Done = Time Taken × Rate of Work ۶
- Rate of Work = 1 / Time Taken $\triangleright$
- Time Taken = 1 / Rate of Work $\triangleright$
- ≻ If a piece of work is done in *x* number of days, then the work done in one day =
- $\geq$ Total work done = Number of Days  $\times$  Efficiency

#### IMPORTANT POINTS

- Efficiency and Time are inversely proportional to 1. each other.
- x : y is the ratio of the number of men which are 2. required to complete a piece of work, then the ratio of the time taken by them to complete the work will be *y* : *x*.
- If x number of people can do W1 work in D1 days, 3. working T1 hours each day and the number of people can do W2 work in D2 days, working T2 hours each day, then the relation between them will be

 $M1 \times D1 \times T1$   $M2 \times D2 \times T2$ W1 W2

#### **Pipe and Cistern**

If a pipe can fill a tank in *x* hours, then the part filled in 1 hour =  $\frac{1}{r}$ 

If a pipe can fill a tank in x hours and another pipe ≻ can empty the full tank in *y* hours, then the net part filled in 1 hour, when both the pipes are opened:

$$\left(\frac{1}{x} - \frac{1}{y}\right)$$

 $\geq$ Time taken to fill the tank, when both the pipes are opened:

$$\left(\frac{x \times y}{y - x}\right)$$

If a pipe can fill a tank in *x* hours and another pipe can fill the same tank in *y* hours, then the net part filled in 1 hr, when both pipes are opened:

$$\left(\frac{1}{x} + \frac{1}{y}\right)$$

So, time to fill the tank will be:  $\mathbf{b}$ 

 $\frac{x \times y}{(x+y)}$ 

If a pipe fills a tank in *x* hrs and another fills the same  $\mathbf{b}$ tank in y hrs, but a third empties the full tank in z hrs and all of them are opened together, the net part filled in 1 hr:

$$\left(\frac{1}{x} + \frac{1}{y} - \frac{1}{z}\right)$$

So, time taken to fill the tank:  $\geq$ 

$$\frac{xyz}{(yz+xz-xy)}$$

#### Speed, Time and Distance

- ≻ Speed = Distance/Time
- ≻ Time = Distance/Speed
- ≻  $Distance = (Speed \times Time)$
- $\geq$ Average Speed = Total Distance / Total Time

> 1 km/hr = 
$$\frac{5}{18}$$
 m/sec

> 1 m/sec = 
$$\frac{16}{5}$$
 km/hr

- If the ratio of the speeds of A and B is *a* : *b*, then the ≻ ratio of the time taken by them to cover the same distance is  $\frac{1}{a}: \frac{1}{b} = b: a$ .
- Suppose a man covers a certain distance at *x* km/hr and an equal distance at y km/hr. Then, the average speed during the whole journey is  $\left(\frac{2xy}{x+y}\right)$  km/hr.

A's speed) / (B's speed) equals 
$$\sqrt{\left(\frac{T2}{T1}\right)}$$

#### TRAINS

(

1. If the speed of the two trains is S<sub>1</sub> and S<sub>2</sub>, respectively and lengths are L<sub>1</sub> and L<sub>2</sub> While moving in the opposite direction Relative speed =  $S_1 + S_2$ Time taken =  $[(L_1 + L_2)/(S_1 + S_2)]$ While moving in the same direction Relative speed =  $S_1 - S_2$ Time taken =  $[(L_1 + L_2)/(S_1 - S_2)]$ 

- 2. When two trains of lengths  $l_1$  and  $l_2$  cross each other at speeds of  $S_1$  and  $S_{2'}$  respectively, in time *t*, the equation is given as  $S_1 + S_2 = \frac{(l_1 + l_2)}{t}$ .
- 3. When a train of length  $l_1$  passes another train of length  $l_2$  at a speed, the formula is expressed as  $S_1 S_2 = \frac{(l_1 + l_2)}{t}.$
- 4. When a train of length  $l_1$  travelling at a speed of  $S_1$  traverses a platform, bridge, or tunnel of length  $l_2$  in

time *t*, the equation is stated as  $S_1 = \frac{(l_1 + l_2)}{t}$ .

 If the train passes an electric pole then Length of the Train= Train's speed × Time Time = Length of the Train/speed Speed = Length of the Train / Time

#### **Boats and Streams**

#### BASIC CONCEPT OF BOATS AND STREAM

**Still water:** If the water is not moving, then it is called still water.

Speed of boat in still water is

=  $\frac{1}{2}$  (Downstream Speed + Upstream Speed)

Stream: Moving water of the river is called a stream.

**Upstream:** If a boat moves in the opposite direction as of the stream.

**Downstream:** When the boat moves in the direction of the stream.

**Cyclist and wind:** Cyclist analogous to boat and wind analogous to stream.

Swimmer and stream: Swimmer analogous to boat

If the speed of boat in still water is 'b' km/hr and speed of the stream is 's' km/hr,

Speed of boat downstream = (b + s) km/hr, since the boat goes with the stream of water and hence its speed increase.

Speed of boat upstream = (b - s) km/hr, since the boat goes against the stream of water and hence, its speed gets reduced.

 $\begin{aligned} \text{Distance} &= \text{Speed} \times \text{Time} \\ \text{D} &= \text{ST} \end{aligned}$ 

#### **Ratio and Proportion**

**Ratio:** Ratio is the comparison between two quantities in terms of their magnitudes. The ratio of two quantities a and *b* in some units is the fraction a/b and we write it as a : b. In the ratio a : b, we call 'a' as the first term or antecedent and 'b', the second term or consequent.

#### RULE

- The multiplication or division of each term of a ratio by the same non-zero number does not affect the ratio.
- The comparison should always be done of the same quantity (of length, of weight, etc.)

**Proportion:** When two ratios are equal, then the four quantities involved in the two ratios are said to be proportional.

When *a*, *b*, *c*, *d* are in proportion, then a and d are called EXTREMES and b and c are called MEANS.

If a : b = c : d, we write, a : b :: c : d and say that a, b, c, d are in proportion. Here a and b are called extremes, and b and c are called means terms.

Thus,  $a : b :: c : d \Rightarrow (a \times d) = (b \times c)$ 

**Fourth proportional:** If 2 : 3 :: 5 : 7, then 7 is called the fourth proportional to 2, 3, 5.

$$a:b:c:d:e=4:10:6:9:15$$

**Third proportional:** If 2 : 3 :: 5 : 7, then 5 is called the third proportional to 2 and 3.

**Mean proportional:** Mean proportional between *a* and *b* is  $\sqrt{ab}$ .

**Compounded ratio:** The compound ratio of the ratios (a:b), (c:d), (e:f) is (*ace* : *bdf*)

Duplicate ratio of (a:b) is  $(a^2:b^2)$ 

Sub-duplicate ratio of (a : b) is  $(\sqrt{a} : \sqrt{b})$ 

Triplicate Ratio of (a:b) is  $(a^3:b^3)$ 

Sub-triplicate ratio of 
$$(a:b)$$
 is  $\begin{pmatrix} \frac{1}{3} & \frac{1}{5} \\ a^3 & b^3 \end{pmatrix}$ 

#### Average

- Sum of quantities = Average × Number of quantities
- > The average of the first *n* natural numbers is  $\frac{(n+1)}{n}$ .
- The average of the squares of the first *n* natural numbers is  $\frac{(n+1)(2n+1)}{6}$ .
- > The average of cubes of the first *n* natural numbers is  $n(n+1)^2$
- The average of the first n odd numbers is given by (last odd number +1)/2
- The average of the first *n* even numbers is given by (last even number + 2) / 2
- The average of squares of first n consecutive even numbers is  $\frac{2(n+1)(2n+1)}{2}$ .
- The average of squares of consecutive even numbers till *n* is  $\frac{(n+1)(n+2)}{3}$ .
- The average of squares of squares of consecutive odd numbers till *n* is  $\frac{n(n+2)}{3}$ .
- > If the average of *n* consecutive numbers is *m*, then the difference between the smallest and the largest number is 2(m 1).
- > If the number of quantities in two groups is  $n_1$  and  $n_2$  and their average is x and y, respectively, the combined average is  $\frac{(n_1x + n_2y)}{(n_1 + n_2)}$ .

- > The average of *n* quantities is equal to *x*. When a quantity is removed, the average becomes *y*. The value of the removed quantity is n(x y) + y.
- > The average of *n* quantities is equal to *x*. When a quantity is added, the average becomes *y*. The value of the new quantity is n(y x) + y.

#### Partnership

If P and Q contributed Rs. *a* and *b*, respectively for one year in business, then their profit or loss at that time will be:

P's benefit (or misfortune) : Q's profit (or misfortune) = a : b.

**Compound Partnership:** In a compound partnership, the money is invested during different periods of time by multiple investors. The benefit-sharing proportion is ascertained by duplicating the capital contributed with the unit of time (generally months).

- P1: P2 = C1  $\times$  T1: C2  $\times$  T2
- P1 = Partner 1's Profit.
- C1 = Partner 1's Capital.
- T1 = Time period for which Partner 1 contributed his capital.
- P2 = Partner 2's Profit.
- C2 = Partner 2's Capital.
- T2 = Time period for which Partner 2 contributed his capital.

#### **Mensuration**

#### Mensuration Formula of 2D Shapes

Check out the formula for area and perimeter of some of the 2D shapes:

Shape	Area (Square units)	Perimeter (units)
Square	a <sup>2</sup>	4a
Rectangle	$l \times b$	2(l+b)
Circle	$\pi r^2$	$2\pi r$
Scalene Triangle	$\sqrt{[s(s-a)(s-b)(s-c)]}$	a + b + c
	where, $s = \frac{(a+b+c)}{2}$	
Isosceles Triangle	$\frac{1}{2} \times b \times h$	2a + b
Equilateral Triangle	$\left(\frac{\sqrt{3}}{4}\right) \times a^2$	За
Right Angle Triangle	$\frac{1}{2} \times b \times h$	b + hypotenuse + h
Rhombus	$\frac{1}{2} \times d_1 \times d_2$	$4 \times side$
Parallelogram	$b \times h$	2(1+b)
Trapezium	$\frac{1}{2}h(a+b)$	a+b+c+d

Mensuration Formula of 3D Shapes

Shape	Volume (Cubic units)	Curved Surface Area (CSA) or Lateral Surface Area (LSA) (Square units)	Total Surface Area (TSA) (Square units)
Cube	a <sup>3</sup>	$4a^{2}$	6a <sup>2</sup>
Cuboid	$l \times b \times h$	2h(l+b)	2(lb+bh+hl)
Sphere	$\left(\frac{4}{3}\right)\pi r^3$	$4\pi r^2$	$4\pi r^2$
Hemisphere	$\left(\frac{2}{3}\right)\pi r^3$	$2\pi r^2$	$3\pi r^2$
Cylinder	$\pi r^2 h$	2πrh	$\frac{2\pi rh}{2\pi r^2}$
Cone	$\left(\frac{1}{3}\right)\pi r^2h$	πrl	$\pi r (r + l)$

#### **Mensuration Formulas in Detail**

Scalene Triangle:



Area 
$$=\frac{1}{2}$$
 base  $\times$  height

Area = 
$$\sqrt{s(s-a)(s-b)(s-c)}$$

where 
$$s = \frac{a+b+a}{2}$$

Area = 
$$\frac{1}{2} \times a \times c \sin B$$

$$=\frac{1}{2} \times a \times b \times \sin C = \frac{1}{2} \times a \times b \times \sin C$$

Isosceles Triangle:



Height (h) = 
$$\frac{1}{2}\sqrt{4a^2 - b^2}$$
  
Area =  $\frac{1}{2} \times$  base  $\times$  height  
Area =  $\frac{1}{2}b\sqrt{4a^2 - b^2}$ 

Equilateral Triangle:





1. Cuboid



- $\blacktriangleright \quad \text{Volume of cuboid} = 1 \times b \times h$
- Lateral surface Area = Perimeter of Base × Height Base = 2(l + b) × h
- Total surface area = Lateral surface Area + 2 × Area of base = 2 (lh + bh + lb)

$$\blacktriangleright \quad \text{Diagonal} = \sqrt{l^2 + b^2 + h^2}$$

- $\blacktriangleright \quad V = \sqrt{A_1 \times A_2 \times A_2}$ 
  - $A_1 \Rightarrow$  Area of base or top = lb
  - $A_2 \Rightarrow$  Area of one side face = bh
  - $A_3 \Rightarrow$  Area of another side face = hl
- To find the total surface area of a cuboid if the sum of all three sides and diagonals are given. Total surface area = (sum of all three side)<sup>2</sup> – (Diagonal)<sup>2</sup>
- For painting the surface area of a box or to know how much tin sheet is required, we will use total surface area.
- > To find the length of the longest pole to be placed is a room, we will calculate diagonal, i.e.,  $\sqrt{l^2 + b^2 + h^2}$ .

2. Cube



- ▶ Volume =  $(side)^3 = a^3$
- $\blacktriangleright$  Lateral surface area =  $4a^2$
- $\succ$  Total surface area =  $6a^2$
- > Diagonal of the cube =  $\sqrt{3}a$
- Face diagonal of the cube =  $\sqrt{2a}$

> Volume of cube = 
$$\left(\sqrt{\frac{\text{total surface area}}{6}}\right)^3$$

- > In Radius of cube =  $\frac{u}{2}$
- $\mathbf{\succ} \quad \text{Circumradius of cube} = \frac{\sqrt{3}}{2}a$
- 3. Right circular cone



- > Slant height,  $l = \sqrt{r^2 + h^2}$
- ► Volume =  $\frac{1}{3}$  × area of base × height =  $\frac{1}{3}\pi r^2 h$
- > Curved surface area =  $\frac{1}{2}$  (Perimeter of base) × slant height =  $\frac{1}{2} \times 2\pi r \times l = \pi r \sqrt{r^2 + h^2}$
- Total surface area = C.S.A + Area of base =  $\pi r l + \pi r^2 = \pi r (l + r)$
- If cone is formed by sector of a circle, then.
  - (a) Slant height = radius of circle

(b) circumference of base of cone = length of arc of sector

Radius of maximum size sphere in a cone =(h×r)/(l+r)

$$= \frac{h \times r}{l+r} \begin{bmatrix} r \to \text{ radius of cone} \\ l \to \text{ slant height of cone} \\ h \to \text{ height of cone} \end{bmatrix}$$

➤ If cone is cut parallel to its base and ratio of heights, radius or slant height of both parts is given as  $\rightarrow x : y$ . Then, Ratio of their volume =  $x^3 : y^3$  4. Frustum of a right circular cone



Slant height



AC = l, AB = h, BC = R - r

Applying Pythagorean theorem in **ABC** 

$$L = \sqrt{h^2 + (\mathbf{R} - r)}$$

- Volume of frustrum =  $\frac{1}{3}\pi(R^2 + r^2Rr)h$
- Curved surface area =  $\pi(R+r)l$
- > Total surface area T.S.A =  $\pi(R+r)l + \pi(R^2 + r^2)$
- 5. Prism



- > A prism a solid object with:
  - (a) Identical Ends
  - (b) Flat faces
- Volume of Prism = Area of base × height
- Lateral surface area of prism
   perimeter of base × height
- Total surface area of prism
- = Perimeter of base  $\times$  height +2  $\times$  area of base
- 6. Pyramids



- > Volume =  $\frac{1}{3}$  (area of base) × height
- Curve surface area =  $\frac{1}{2} \times (\text{perimeter of base}) \times \text{slant}$ height.
- Total surface area = curved surface area + area of the base.
- Whenever in a question, if we want to find the slant height or height, then we will used inradius of the base not the radius of side of the base.
- 7. Hollow Cylinder



- $\succ$  Volume = π(R<sup>2</sup> − r<sup>2</sup>)h
- Curved Surface Area = $2\pi (R + r)h$
- > Total surface area = $2\pi$  (R+*r*)  $h + 2\pi$  (R<sup>2</sup>-*r*<sup>2</sup>)

#### Probability

**Probability:** It is the numerical measurement of the degree of certainty. There are two types of approaches to study probability:

**Experimental or Empirical Probability:** The result of probability based on the actual experiment is called experimental probability. In this case, the results could be different if we do the same experiment again.

#### Probability of Occurrence of an Event:

$$P((E) = \frac{(Number of Outcomes of Favourable to E)}{(Total number of possible outcomes)}$$

**Theoretical probability:** Associated with an event E, it is defined as "If there are 'n' elementary events associated with a random experiment and m of these are favourable to the event E, then the probability of occurrence of an event is defined by P(E) as the ratio mn."

If P(E) = 1, then it is called a 'Certain Event'.

If P(E) = 0, then it is called an 'Impossible Event'.

The probability of an event E is a number P(E) such that:  $0 \le P(E) \le 1$ .

An event having only one outcome is called an elementary event. The sum of the probabilities of all the elementary events of an experiment is 1.

For any event E,  $P(E) + P(E^-) = 1$ , where  $E^-$  stands for 'not E'. E and  $E^-$  are called complementary events.

Favourable outcomes are those outcomes in the sample space that are favourable to the occurrence of an event.

**Sample Space:** A collection of all possible outcomes of an experiment is known as a sample space. It is denoted by 'S' and represented in curly brackets.

#### Trigonometry

**Trigonometric Ratios:** To study different trigonometric ratio functions, we will use a right-angled triangle. Suppose ABC is a right-angled triangle with angle  $A = 90^{\circ}$ .



#### **Relations between Trigonometric Ratios**

(i) 
$$\csc \theta = \frac{1}{\sin \theta} \text{ or } \csc \theta \times \sin \theta = 1$$
  
(ii)  $\sec \theta = \frac{1}{\cos \theta \otimes \theta} \text{ or } \sec \theta \times \cos \theta = 1$ 

(iii) 
$$\cot \theta = \frac{1}{\tan \theta}$$
 or  $\cot \theta \times \tan \theta = 1$ 

(iv) 
$$\tan \theta = \frac{\sin \theta}{\cos \theta}$$

(v) 
$$\cot \theta = \frac{\cos \theta}{\sin \theta}$$

Value of Trigonometric Ratios in Different Quadrants



## Different Values of Specific Angles of Trigonometric Ratio

You must learn the following table to solve the questions based on the trigonometrical ratios of angle 0°, 30°, 45°, 60°.

<b>0</b> °	<b>0</b> °	30°	45°	60°	90°
sin	0	$\frac{1}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{\sqrt{3}}{2}$	1
COS	1	$\frac{\sqrt{3}}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{1}{2}$	0
tan	0	$\frac{1}{\sqrt{3}}$	1	$\sqrt{3}$	œ
cot	×	$\sqrt{3}$	1	$\frac{1}{\sqrt{3}}$	0
sec	1	$\frac{2}{\sqrt{3}}$	$\sqrt{2}$	2	∞
cosec	×	2	$\sqrt{2}$	$\frac{2}{\sqrt{3}}$	1

## Relation between squares of different types of trigonometric ratios

- (i)  $\sin^2\theta + \cos^2\theta = 1$  or  $\sin^2\theta = 1 \cos^2\theta$  or  $\cos^2\theta = 1 \sin^2\theta$
- (ii)  $1 + \tan^2 \theta = \sec^2 \theta$  or  $\tan^2 \theta = \sec^2 \theta 1$  or  $\sec^2 \theta \tan^2 \theta = 1$
- (iii)  $1 + \cot^2\theta = \csc^2\theta$  or  $\csc^2\theta 1 = \cot^2\theta$  or  $\csc^2\theta \cot^2\theta = 1$

#### **Important concept to solve a specific type of question** If $A + B = 90^{\circ}$

Results that are true always:

- (i)  $\sin A \cdot \sec B = 1 \text{ or } \sin A = \cos B$
- (ii)  $\cos A. \csc B = 1 \text{ or } \sec A = \csc B$
- (iii)  $\tan A \cdot \tan B = 1$  or  $\tan A = \cot B$
- (iv)  $\cot A \cdot \cot B = 1$
- (v)  $\sin^2 A + \sin^2 B = 1$
- (vi)  $\cos^2 A + \cos^2 B = 1$

## Important Trigonometry Formula for Sum and Difference of Two Angles

- (1)  $\sin(A+B) = \sin A \cdot \cos B + \cos A \sin B$
- (2) sin(A B) = sinA. cosB cosA sinB
- (3)  $\cos(A+B) = \cos A \cdot \cos B \sin A \sin B$
- (4)  $\cos(A-B) = \cos A \cdot \cos B + \sin A \sin B$
- (5)  $2\sin A \cdot \cos B = \sin(A+B) + \sin(A-B)$
- (6)  $2\cos A \cdot \sin B = \sin(A+B) \sin(A-B)$
- (7)  $2 \sin A \cdot \sin B = \cos(A-B) \cos(A+B)$
- (8)  $2\cos A.\cos B = \cos(A+B) + \cos(A-B)$
- (9)  $\sin^2 A \sin^2 B = \sin(A+B) \cdot \sin(A-B)$
- (10)  $\cos^2 A \cos^2 B = \cos(A + B) \cdot \cos(A B)$

Trigonometry Formulas For Tangent

(i)  $\tan(A+B) = \frac{\tan A + \tan B}{1 - \tan A \cdot \tan B}$ 

(ii) 
$$\tan(A-B) = \frac{\tan A - \tan B}{1 + \tan A \cdot \tan B}$$

(iii) 
$$\cot(A + B) = \frac{\cot A \cdot \cot B - 1}{\cot A + \cot B}$$
  
(iv)  $\cot(A - B) = \frac{\cot A \cdot \cot B + 1}{\cot A - \cot B}$   
(v)  $\tan(45 + \theta) = \frac{1 + \tan \theta}{1 - \tan \theta} = \frac{\cos \theta + \sin \theta}{\cos \theta - \sin \theta}$   
(vi)  $\tan(45 - \theta) = \frac{1 - \tan \theta}{1 + \tan \theta} = \frac{\cos \theta - \sin \theta}{\cos \theta + \sin \theta}$   
FORMULAS LIST  
> If  $A + B + C = 180^{\circ}$   
Then,  $\tan A + \tan B + \tan C = \tan A \cdot \tan B \cdot \tan C$   
> If  $A + B + C = 90^{\circ}$   
Then,  $\cot A + \cot B + \cot C = \cot A \cot B \cot C$   
> (a) If  $\sin \theta + \csc \theta = 2$   
 $\sin^{m}\theta + \csc^{m}\theta = 2$   
(b)  $\cos \theta + \sec \theta = 2$   
Then,  $\cos^{m}\theta + \sec^{m}\theta = 2$   
(c)  $\tan \theta + \cot \theta = 2$   
Then,  $\tan^{m}\theta + \cot^{m}\theta = 2$   
(d)  $\sin 15^{\circ} = \frac{\sqrt{3} - 1}{2\sqrt{2}}$   
 $\cos 15^{\circ} = \frac{\sqrt{3} + 1}{2\sqrt{2}}$   
 $\tan 15^{\circ} = 2 - \sqrt{3}$   
 $\tan 75^{\circ} = 2 + \sqrt{3}$ 

 $\tan 22\frac{1}{2} = \sqrt{2} - 1$ 

 $\cos 22\frac{1}{2} = \sqrt{2} + 1$ 

 $\sin 18^\circ = \cos 72^\circ = \frac{\sqrt{5} - 1}{4}$ 

 $\sin 54^\circ = \cos 36^\circ = \frac{\sqrt{5}+1}{4}$ 

 $\sin 22\frac{1}{2}^{\circ} = \frac{\sqrt{2-\sqrt{2}}}{2}$ 

 $\cos 22\frac{1}{2}^{\circ} = \frac{\sqrt{2-\sqrt{2}}}{2}$ 

cot B cot C

$$a \sin^2 \theta + \cos^2 \theta$$
  
if  $a > b$  if  $b > a$   
Max  $\rightarrow a$  Max  $\rightarrow b$   
Min  $\rightarrow b$  Min  $\rightarrow b$   
 $\theta.\theta$   
Max  $\Rightarrow \frac{1}{2^n} \left| \begin{array}{l} \text{Min} \rightarrow n \rightarrow \text{odd} \rightarrow -\frac{1}{2^n} \\ \text{Min} \rightarrow n \rightarrow \text{even} \rightarrow 0 \end{array} \right|^{\theta}$   
Max  $\Rightarrow \frac{1}{2^n} \left| \begin{array}{l} \text{Min} \rightarrow n \rightarrow \text{odd} \rightarrow -\frac{1}{2^n} \\ \text{Min} \rightarrow n \rightarrow \text{even} \rightarrow 0 \end{array} \right|^{\theta}$   
Max  $\Rightarrow \frac{1}{2^n} \left| \begin{array}{l} \text{Min} \rightarrow n \rightarrow \text{even} \rightarrow 0 \end{array} \right|^{\theta}$   
Maximum  $\rightarrow 1$   
Min  $\Rightarrow P\theta = 45^{\circ}$   
 $a \sin\theta + b \cos\theta$   
Max  $\Rightarrow +\sqrt{a^2 + b^2}$   
Min  $\Rightarrow -\sqrt{a^2 + b^2}$   
 $a \sin^2\theta + b \csc^2\theta$   $a \cos^2\theta + b \sec^2\theta$   
if  $a < b$  Min  $= a + b$  if  $b > a$   
Min  $= 2\sqrt{ab}$  Min  $= \sqrt{ab}$   
 $a \csc^2\theta + b \sec^2\theta$   
Min  $= (\sqrt{a} + \sqrt{b})^2$   
 $a \tan^2\theta + b \cot^2\theta$ 

 $Min = 2\sqrt{ab}$ 

#### **Height and Distance**

Line of Sight: The imaginary horizontal straight ۶ line drawn from the observer's eye to the objects to be viewed. It gives an accurate idea of where the observers view.



- Horizontal line: The line passing parallel to the ≻ ground or surface is called a horizontal line. The horizontal line is shown in the above figure.
- ≻ The angle of elevation: The angle formed by the light of sight with the horizontal line when observers view the object situated upward over the horizontal line. It is formed only when the observer views the upwardplaced object. (Refer the above figure.)
- ≻ The angle of depression: The angle of depression is the inclination of the light of sight and horizontal line when observers view the downward object. It is formed only when the observer views the object at the ground from any height.

#### **Trigonometry Maximum & Minimum Value** Maximum & Minimum Value

		Minimum	Maximum
۶	$\sin\theta$ , $\cos\theta$ [odd power]	-1	+1
۶	$\sin\theta$ , $\cos\theta$ [even power]	0	+1
۶	$tan\theta$ , $cot \theta$ [odd power]	$-\infty$	$+\infty$
≻	$tan\theta$ , $cot \theta$ [even power]	0	$+\infty$
≻	sec $\theta$ , cosec $\theta$ [odd power]		$+\infty$
≻	$\sec\theta$ , $\csc\theta$ [even power	r] +1	$+\infty$



#### FORMULA

The height and distance can be simply calculated using trigonometric ratios. Generally, the Tan trigonometric function is used to get the height and distance accurately. We know that the ratio of the Tan function is tan = Height/ Distance = Perpendicular/Base

You know the values of the tan function at different angles for this. The trigonometric values are mentioned in the table given below. You can refer to the table for this.



**Trigonometric Ratios** 

The trigonometric ratios and formulas are mentioned below:

- >  $\sin\theta = \text{perpendicular/hypotenuse} = AB/OB$
- $\triangleright$  cos $\theta$  = base/hypotenuse = OA/OB
- >  $\tan\theta = \text{perpendicular/base} = AB/OA$
- $\succ$  cosec $\theta$  = 1/sin $\theta$  = OB/AB
- $\blacktriangleright$  sec $\theta = 1/\cos\theta = OB/OA$
- $\succ$  cot $\theta = 1/\tan\theta = OA/AB$

#### Trigonometric Identities

- 1.  $\sin^2\theta + \cos^2\theta = 1$
- 2.  $1 + \tan^2\theta = \sec^2\theta$
- 3.  $1 + \cot^2\theta = \csc^2\theta$

#### Algebra

- $(a + b)^2 = a^2 + 2ab + b^2$
- $a^2 + b^2 = (a + b)^2 2ab$
- $(a-b)^2 = a^2 2ab + b^2$
- $(a + b + c)^2 = a^2 + b^2 + c^2 + 2ab + 2bc + 2ca$
- $(a-b-c)^2 = a^2 + b^2 + c^2 2ab + 2bc 2ca$
- $(a + b)^3 = a^3 + 3a^2b + 3ab^2 + b^3$
- $(a + b)^3 = a^3 + b^3 + 3ab(a + b)$
- $▷ (a-b)^3 = a^3 3a^2b + 3ab^2 b^3$

- >  $(a + b)^4 = a^4 + 4a^3b + 6a^2b^2 + 4ab^3 + b^2$
- $(a-b)^4 = a^4 4a^3b + 6a^2b^2 4ab^3 + b^4$
- >  $a^5 b^5 = (a b)(a^4 + a^3b + a^2b^2 + ab^3 + b^4)$

Algebraic Formulas-Laws of Exponents

Multiplication Rule	$a^x \times a^y = a^{x+y}$
Division Rule	$a^x \div a^y = a^{x-y}$
Power of a Power Rule	$(a^x)^y = a^{xy}$
Power of a Product Rule	$(ab)^x = a^x b^x$
Power of a Fraction Rule	$\left(\frac{a}{b}\right)^x = \frac{a^x}{b^x}$
Zero Exponent	$a^0 = 1$
Negative Exponent	$a^{-x} = \frac{1}{a^x}$
Fractional Exponent	$a^{\frac{x}{y}} = \sqrt[y]{a^x}$

**Algebra Formulas for Irrational Numbers:** The Algebra formulas used to solve equations based on irrational numbers are as follows:

$$1. \quad \sqrt{ab} = \sqrt{a}\sqrt{b}$$

$$2. \qquad \sqrt{\frac{a}{b}} = \frac{\sqrt{a}}{\sqrt{b}}$$

3.  $(\sqrt{a} + \sqrt{b})(\sqrt{a} - \sqrt{b}) = a - b$ 

$$4. \quad (\sqrt{a} + \sqrt{b})^2 = a + 2\sqrt{ab} + b$$

5. 
$$(a+\sqrt{b})(a-\sqrt{b}) = a^2 - b$$



## Section-1 : Arithmetic

#### Chapter

# Percentage

#### LEARNING OBJECTIVES:

- Percentage and fractional value of different numbers.
- \*\* Concepts related to election based questions, expenditure based question.
- Different types of questions that are covered in different competitive exams such as SSC, bank, railway, CAT, \*

•

\* Method of solving questions related to percentage.

#### SOME IMPORTANT CONCEPTS RELATED TO PERCENTAGE

- Percentage: A percentage is a fraction of 100. It is  $\geq$ denoted by the symbol %.
- $\triangleright$ Percentage change: Percentage change is the difference between the new value and the old value, expressed as a percentage of the old value.
  - i.e., percentage change, if value changes from 25 to 30  $=\frac{30-25}{25}\times 100=20\%$
- $\geq$ Fraction to percentage conversion: To convert a fraction to a percentage, multiply the fraction by 100.

i.e., percentage value of 
$$\frac{1}{5} = \frac{1}{5} \times 100 = 20\%$$

Percentage to fraction conversion: To convert a per- $\geq$ centage to a fraction, divide the percentage by 100 and simplify the fraction.

i.e., fraction value of 
$$30\% = \frac{30}{100} = \frac{3}{10}$$

- Percentage to decimal conversion: To convert a  $\triangleright$ percentage to a decimal, divide the percentage by 100. i.e., decimal value of  $30\% = \frac{30}{100} = 0.3$
- $\geq$ Decimal to percentage conversion: To convert a decimal to a percentage, multiply the decimal by 100. i.e., percentage value of  $0.3 = 0.3 \times 100 = 30\%$
- $\geq$ Percentage of a number: To calculate the percentage of a number, multiply the number by the percentage and divide by 100.

i.e., 20% of 50 = 
$$50 \times \frac{20}{100} = 10$$

Successive percentage change: When a value changes by successive percentage changes, the net percentage change is calculated by multiplying the individual percentage changes.

i.e., two successive changes of 20% and 25% in 100 
$$-100 \times \frac{120}{125} - 150$$

$$= 100 \times \frac{120}{100} \times \frac{125}{100} = 150$$

So, net percentage change =  $(150-100)/100 \times 100 = 50\%$ 

- Percentage increase = [(new value old value)/old • value]  $\times$  100%
- Percentage decrease = [(old value new value)/old value] × 100%
- Percentage change = [(new value old value)/old value]  $\times$  100%

• Percentage to fraction = 
$$\left(\frac{\text{percentage}}{100}\right)$$

- Fraction to percentage = (fraction  $\times$  100)
- percentage Percentage to decimal = 100
- Decimal to percentage =  $(\text{decimal} \times 100)$
- Percentage of a number = (percentage/100)  $\times$  number

• Net percentage change = 
$$a + b + \left(\frac{ab}{100}\right)$$

where 
$$a$$
 and  $b$  are the successive percentage changes.

Actual Price = Rate 
$$\times \frac{A}{100}$$
 - Rate  $\times$  X Per kg

• If the population of a city is P and it increases at the rate of R% perannum, then population after 'n' vears:

Population = 
$$P \times \left(1 + \frac{R}{100}\right)^n$$

If the population of a city is P and it decreases at the rate of R% perannum, then population after 'n' years: . 11

Population = 
$$P \times \left(1 - \frac{R}{100}\right)^n$$

If the population of a city is P and it increases at the rate of R% per annum, then population of the city '*n*' years ago :

Population *n* years ago =  $\frac{P}{\left(1 + \frac{R}{100}\right)^n}$ 

If the city's population is P and it decreases at the . rate of R% per annum, then city's population 'n' years ago:

Population *n* years ago = 
$$\frac{r}{\left(1 - \frac{R}{100}\right)}$$

Percentage – Fraction Table

1% = 1/100	25% = 1/4	80% = 4/5
2% = 1/50	33.33% = 1/3	83.33% = 5/6
4% = 1/25	37.50% = 3/8	87.50% = 7/8
5% = 1/20	40% = 2/5	100% = 1
8.33% = 1/12	50% = 1/2	120% = 6/5
10% = 1/10	60% = 3/5	125% = 5/4
12.50% = 1/8	62.50% = 5/8	133.33% = 4/3
16.67% = 1/6	66.67% = 2/3	150% = 3/2
20% = 1/5	75% = 3/4	175% = 7/4

S **Example 1:** Radha saves x% of her income. If her expenditure increases by 20% and her income increases by 28%, then her savings increase by 40%. Find *x*.

(a)	56	(b)	40
<i>(u)</i>	00	(D)	-10

- (c) 60 (d) 70
- Sol. (b) Expenditure



S **Example 2:** The population of a town increased by 15% in 2018 and 10% in 2019. Due to pandemic, it decreased by 10% in 2020. What was the percentage increase in population of town in 3 years?

- (a) 12.5% (b) 17.5%
- (c) 13.85% (d) 15%

**Sol. (c)** Let population = 100

= 13.85%

 $\Rightarrow$  Population after 3 years

$$= 100 \times \frac{115}{100} \times \frac{110}{100} \times \frac{90}{100} = 113.85$$
  
Percentage increase =  $\frac{113.85 - 100}{100} \times 100$ 

100

- **Example 3:** A number P is 20% more than a number Q but 10% less than a number R. What percentage is number Q of number R?
- (a) 80% (b) 85% 75% (d) 90% (c) Sol. (c) Р : Q : R 6 5 9 : 10 18 : 15 : 20  $\Rightarrow$  Required percentage =  $\frac{15}{20} \times 100 = 75\%$
- **Example 4:** If each side of a triangle is increased by 13%, then its area will increase by:
- (a) 21.69% (b) 13% (c) 27.69% (d) 26% Sol. (c) 100 113  $\rightarrow$  $\downarrow$  $\downarrow$ 10000 ----- 12769 Percentage increase =  $\frac{12769 - 10000}{10000} \times 100$
- **Example 5:** Rita's income is 15% less than Richa's income. By what per cent Richa's income is more than Rita's income?

(a) 
$$15\frac{11}{17}\%$$
 (b)  $17\frac{11}{17}\%$   
(c)  $16\frac{11}{17}\%$  (d)  $14\frac{11}{17}\%$ 

- Rita : Richa = 17 : 20Sol. (b) So,
  - required% =  $\frac{3}{17} \times 100 = 17 \frac{11}{17} \%$ **Example 6:** A person's salary has increased from ₹7,000

to ₹ 12,000. What is the percentage increase in his salary?

(a) 
$$71\frac{3}{7}\%$$
 (b)  $61\frac{1}{7}\%$   
(c)  $69\frac{1}{7}\%$  (d)  $76\frac{4}{7}\%$ 

Sol. (a) Increase in salary is ₹ 5,000 i.e., 7,000 → 12,000

So, percentage increase = 
$$\frac{5,000}{7,000} \times 100 = 71\frac{3}{7}\%$$

S **Example 7:** If 49% of x = y, they y% of 50 is:

(a) 40% of *y* (b) 50% of x (c) 50% of y (d) 24.5% of x

Sol. (d) 
$$\frac{x}{y} = \frac{100}{49}$$
  
 $y\% \text{ of } 50 = \frac{50 \times 49}{100} = 24.5$   
i.e., 24.5% of x.

13. What percentage of  $\overline{\mathbf{\xi}}$  124 is  $\overline{\mathbf{\xi}}$  49.60? [SSC CPO 2018]

# **1** Beginner

- A team played 40 games in a season and won 24 of them. What per cent of games played did the team win? [SSC 10+2 2012]
   (A) 70%
   (B) 40%
   (C) 60%
   (D) 35%
- 2. 1% of 1% of 25% of 1,000 is: [SSC 10+2 2014]
  (A) .025
  (B) .0025
  (C) .25
  (D) .00025
- Ram's income is greater than Shyam's income by 20%. Then, the per cent by which Shyam's income is less than Ram's income is: [SSC 10+2 2013]

(A) 
$$16\frac{2}{3}\%$$
 (B)  $18\frac{2}{5}\%$   
(C)  $10\frac{1}{5}\%$  (D)  $12\frac{1}{3}\%$ 

(A) 20

- 4. If 125% of x is 100, then x is:
   [SSC 2012]

   (A) 80
   (B) 150
   (C) 400
   (D) 125
- 5. If 40% of  $\frac{4}{5}$  of  $\frac{3}{4}$  of a number is 48, then what is 1% of the same number? [SSC Sub Inspector 2014]

(B) 2 (C) 10 (D) 1

- 6. In an examination, 75% candidates passed in English and 60% passed in Mathematics. 25% failed in both and 240 passed in the examination. Find the total number of candidates. [SSC Sub Inspector 2014]
  (A) 492 (B) 300 (C) 500 (D) 400
- 7. A shopkeeper purchased 200 bulbs for ₹ 10 each. However, 5 bulbs were fused and had to be thrown away. The remaining were sold at ₹ 12 each. What will be the percentage profit? [SSC Clerk 2014]
  (A) 25% (B) 15% (C) 13% (D) 17%
- A person's salary increased from ₹ 8,100 to ₹ 9,000. What is the percentage increase in his salary?

[SSC CGL 2019]

(A) 
$$6\frac{1}{9}\%$$
 (B)  $13\frac{7}{9}\%$  (C)  $11\frac{1}{9}\%$  (D)  $9\frac{1}{9}\%$ 

- 9. In an examination, 92% of the students passed and 480 students failed. If so, how many students appeared in the examination? [SSC CGL 2019]
  (A) 6,200 (B) 5,000 (C) 6,000 (D) 5,800
- **10.** The value of 18% of 15% of  $\frac{25}{9}$  of 3,800 is:

[SSC CGL 2019] (A) 285 (B) 582 (C) 583 (D) 385

**11.** Convert  $\frac{9}{40}$  into percentage: [SSC CPO 2018]

(A) 
$$2\frac{1}{2}\%$$
 (B) 2%  
(C) 22% (D)  $22\frac{1}{2}\%$ 

 12.
 8% of 5 litres is:
 [SSC CPO 2018]

 (A)
 0.4 ml
 (B)
 400 ml
 (C)
 40 ml
 (D)
 4 ml

	1	0	L .	
	<b>(A)</b> 250	<b>(B)</b> 16	(C) 123	<b>(D)</b> 40
14.	A saves 12% o	f her income.	If she spend	ls ₹ 2,16,128,
	then her total i	ncome is:	[SS	C CPO 2018]
	<b>(A)</b> ₹ 2,42,063		<b>(B)</b> ₹ 2,45,6	00
	(C) ₹ 2,48,000		<b>(D)</b> ₹ 2,43,5	60
15.	If A's salary is 6	50% more that	n B's salary, t	hen by what
	percentage is E	's salary is les	s than that o	f A?
			[SS	C CGL 2019]
	(A) 47.7%	<b>(B)</b> 33.3%	(C) 37.5%	<b>(D)</b> 45%
16.	Radha saves 2	5% of her inc	come. If her	expenditure
	increases by 20	J% and her in	ncome increa	ases by $29\%$
	$(\mathbf{A}) = 60^{\circ}$	(P) 520	. [557	(D) 70%
17	(A) 50%	( <b>B</b> ) 52%	(C) 05%	(D) 70%
1/.	4% What will	he its value a	fter 2 vears	if its present
	value is ₹ 75.00	0?	Iter 2 years,	C CGL 2019
	(A) ₹ 72,000		(B) ₹ 70,120	)
	(C) ₹ 69,120		(D)₹69,000	)
18.	Ajay spends	25% of his	salary on	house rent
	5% on food, 1	5% on travel,	10% on clot	thes and the
	remaining amo	ount of ₹ 27,00	0 is saved. W	/hat is Ajay's
	income?			[SBI 2014]
	(A) ₹ 60,000		( <b>B</b> ) ₹ 80,500	)
	(C) ₹ 60,700		( <b>D</b> ) ₹ 70,500	)
19.	In 2021, Sam	received an a	annual incre	ment in his
	salary by 40%	cost cutting	ression in 20.	22, company
	was reduced b	v 15%. What y	was the net o	hange in his
	salary?	, .,	[SSC	CHSL 2023
	(A) 17% increa	se	<b>(B)</b> 19% inc	crease

(C) 9% decrease
(D) 11% increase
20. 72% of the students of a certain class took biology and 44% took mathematics. If each student took biology or mathematics and 40 took both, then the total number of students in the class was:

[SSC Sub Inspector 2012]

**21.** Roma spends 25% of her income on food, 15% on children's books and 75% of the remaining income on uniforms. What is the percentage of income she is left with?

[SSC CHSL 2023]

(A) 35% (B) 20% (C) 15% (D) 19%
22. Two persons contested on election of parliament. The winning candidate secured 57% of the total votes polled and won by a majority of 42,000 votes. The number of total votes polled is: [SSC MT 2013]
(A) 4,00,000 (B) 5,00,000
(C) 6,00,000 (D) 3,00,000

**23.** If each side of a cube is decreased by 12%, then the percentage decrease in its surface area is:

	[55C CH5L 2025]
(A) 25.66%	<b>(B)</b> 28.23%
<b>(C)</b> 22.56%	<b>(D)</b> 26.54%

24. In a class, if 60% of the students are boys & the number of girls is 36, then the number of boys is: [SSC CGL 2019]

**(B)** 54 **(C)** 60 **(D)** 58



(A) 65

# Intermediate

 One litre of water is evaporated from 6 litres of a solution containing 5% salt. The percentage of salt in the remaining solution is: [SSC CGL 2014]

(A) 
$$4\frac{4}{9}\%$$
 (B)  $5\frac{5}{7}\%$ 

(D) 6%

- Raghav spends 80% of his income. If his income increases by 12% and his expenditure increases by 17.5%, then what is the percentage decrease in his savings? [SSC CHSL 2021]
   (A) 15%
   (B) 10%
   (C) 12%
   (D) 8%
- 3. A number is mistakely multiplied by  $\frac{7}{5}$  instead of 3

being multiplied by  $\frac{3}{2}$ . What is the percentage change

- in the result due to this mistake? [SSC CHSL 2021] (A)  $6\frac{2}{3}\%$  (B)  $7\frac{2}{3}\%$  (C)  $3\frac{2}{3}\%$  (D)  $5\frac{2}{3}\%$
- 4. The price of sugar is increased by 24%. A person wants to increase his expenditure by 18% only. By approximately what per cent should he decrease his consumption? [SSC CGL 2018]
  (A) 5.3% (B) 5.1% (C) 4.6% (D) 4.8%
- 5. A reduction of 20% in the price of sugar enables a purchases to obtain 4 kg more for ₹ 160. The original price of sugar per kg is: [SSC CGL 2019]
  (A) ₹ 12
  (B) ₹ 10
  (C) ₹ 14
  (D) ₹ 15
- 6. The monthly salaries of A and B together amount to ₹ 40,000. A spends 85% of his salary and B spends 95% of his salary. If now their savings are the same, then the salary of A is: [SSC CGL 2014]
  (A) ₹ 10,000 (B) ₹ 12,000
  - (C) ₹ 16,000 (D) ₹ 18,000
- 7. Rakesh got 273 marks in an examination and scored 5% more than the pass %. If Lokesh got 312 marks, then by what % above the pass mark did he pass the examination? [SSC CGL 2013]
  (A) 20% (B) 27% (C) 25% (D) 15%

(A) 20% (B) 27% (C) 25% (D) 15% The price of sugar is increased by 17%. A person

 The price of sugar is increased by 17%. A person wants to increase his expenditure by 5% only. By Shyam's income is what per cent less than Mohan's income? [SSC CHSL 2021] (A)  $28\frac{2}{5}\%$  (B)  $28\frac{5}{5}\%$ 

Mohan's income is 40% more than Shyam's income.

A) 
$$28\frac{1}{7}\%$$
 (B)  $28\frac{1}{7}\%$   
C)  $28\frac{3}{7}\%$  (D)  $28\frac{4}{7}\%$ 

25.

- approximately what percent should he decrease his consumption? [SSC CGL 2018] (A) 10.3% **(B)** 10.7% (C) 10.9% **(D)** 9.9% The radius of a sphere is reduced by 40%. By what 9. per cent will its volume decrease? [SSC CGL 2019] (A) 60% **(B)** 64% (D) 78.4% (C) 72.5% **10.** The salaries of P and Q together amount to ₹ 1,20,000. P spends 95% of his salary and Q 85% of his. If their savings are the same, then what is P's salary? [SSC CHSL 2022] (A) ₹ 80,000 **(B)** ₹ 72,000 (C) ₹ 90,000 (D) ₹ 60,000 11. The price of a TV has been reduced by 20%. In order to restore the original price, the new price must be increased by: [SSC CHSL 2022] (A) 20% **(B)** 28% (C) 31% (D) 25% The monthly income of Manisha was ₹ 1,20,000 and 12. her monthly expenditure was ₹ 55,000. Next year, her income increased by 22% and her expenditure increase by 10%. Find the percentage increase in her savings (correct to 2 decimal places). [SSC CHSL 2022] (A) 28.16% **(B)** 26.25% (D) 30.08% (C) 32.15% 13. If A is 28% more than B and C's 25% less than the sum of A and B, then by what per cent will C be more than A? [SSC CGL 2018] (A) 32.2% **(B)** 28% (C) 43% (D) 33.6% 14. A spends 65% of his income. His income is increased by 20.1% and his expenditure increased by 25%. His savings: [SSC CGL 2018] (A) increase by 11% (B) increase by 5% (C) decrease by 5% (D) decrease by 11% **15.** If 25% of half of *x* is equal to 2.5 times the value of 30% of one-fourth of y, then x is what per cent more or less than *y*? [SSC 2018] (A)  $33\frac{1}{3}\%$  more (B) 50% more
  - (C)  $33\frac{1}{3}\%$  less (D) 50% less

- 16. The income of A is 24% more than the income of B. By what per cent is the income of B is less than income of A? [SSC CPO 2018]
- (A)  $\frac{600}{31}\%$  (B)  $\frac{150}{7}\%$ (C)  $\frac{600}{29}\%$  (D)  $\frac{500}{31}\%$ 17. If  $\left[3\frac{6}{7} \div \frac{54}{7} - \left\{3 - \left(2\frac{3}{4} - \frac{3}{2}\right)\right\}\right] + A \div 4 = 0$ , then what is the value of A? [SSC CHSL 2022] (A) 9 (B) 6 (C) 5 (D) 4

#### 3 Level Expert

(A) 30%

 If (x + 20)% of 250 is 25% more than x% of 220, then 10% of (x + 50) is what % less than 15% of x?

[SSC CGL 2019]

(A) 
$$16\frac{2}{3}$$
 (B)  $8\frac{1}{3}$  (C)  $13\frac{1}{3}$  (D)  $33\frac{1}{3}$ 

- Bushan's monthly income is ₹45,000 and his monthly expenditure is ₹33,000. If his monthly income is increased by 22% while monthly expenditure is increased by 11%, then what is his new monthly savings (in ₹)?

   (A) 18,270
   (B) 18,690
   (C) 18,000
   (D) 19,000
- 3. During his entire school life, John's average marks in science was 80% and his average marks in mathematics was 90%. If his combined average marks in science and mathematics was 84%, while the total marks obtained by him in science was 54,000, what was John's total marks obtained in mathematics?

[SSC CHSL 2022]

(A) 90000 (B) 81000 (C) 36000 (D) 60000

4. Lucky spends 85% of her income. If her expenditure increases by *x*%, savings increase by 60% income increases by 26%, then what is the value of *x*?

5. The price of a commodity increases by 28%. However, the expenditure of it increases by 12%. What is the percentage increase or decrease in consumption?

**(B)** 34%

 [SSC CHSL 2021]

 (A) 16% increase
 (B) 12.5% decrease

 (C) 12.5% increase
 (D) 16% decrease

6. By mistake, the reciprocal of a positive fraction got typed in place of itself and there by, its value got reduced by  $\frac{175}{4}\%$ . What was the value of fraction?

1 4 3 1

(A) 
$$\frac{1}{2}$$
 (B)  $\frac{4}{3}$  (C)  $\frac{5}{4}$  (D)  $\frac{1}{4}$ 

18. A's salary is 35% more than B's salary. How much per cent in B's salary less than that of A's? [SSC CGL 2019]
(A) 20%
(B) 35%
(C) 26%
(D) 17.5%

19. Amrya owns 66<sup>2</sup>/<sub>3</sub>% of a property. If 30% of the property that she owns is ₹ 1,25,000, then 45% of the value of property is: [SSC 2019]
(A) ₹ 2,70,000
(B) ₹ 2,81,250
(C) ₹ 2,25,000
(D) ₹ 2,62,500

 Two students A and B appeared for an examination. A secured 8 marks more than B and the marks of the former was 55% of the sum of their marks. The marks obtained by A and B, respectively, are:

[SSC CHSL 2021]

- (A) 44, 36 (B) 36, 28 (C) 38, 30 (D) 40, 32
  8. If decreasing 180 by *x*% gives the same result as increasing 60 by *x*%, then *x*% of 410 will be more than (*x* + 20)% of 210 by: [SSC CHSL 2021]
  (A) 36.57% (B) 31.67%
  - (C) 33.33% (D) 39.46%
- 9. The income of A is 25% more than that of B and the income of C is 65% less than the sum of the income of A and B. Income of C is what per cent less than the income of A?
  (A) 28%
  (B) 32%
  (C) 32%
  (D) 37%

**10.** If 60% of 
$$(x - y) = 45\%$$
 of  $(x + y)$  and  $y = k\%$  of x, then 21% of k is equal to: [SSC CGL 2019]

11. If A is 48% more than B and C is 60% less than the sum of A and B, then A is what % more than C? [SSC CGL 2019]

- (A) 50.2%
   (B) 49.8%

   (C) 49.2%
   (D) 50.8%
- 12. In an election between Ram and Shyamal, one got 30% of the total votes and thus lost by 900 votes. If 90% of the voters voted and no invalid or illegal votes were cast, then what was the numbers of voters in the voting list? [SSC CHSL 2022]
  (A) 2800 (B) 2500 (C) 2700 (D) 2300
- 13. Rajiv scored 20 percent marks in an exam and failed by 25 marks. If he scores 50 percent marks, then he gets 20 marks more than passing marks. What is the passing marks for the exam? [SSC CHSL 2023]
  (A) 40
  (B) 35
  (C) 55
  (D) 45
- 14. The sum of salaries of A and B together is ₹ 43,000. A spends 95% of his salary and B spends 80% of his salary. If now their savings are the same, what is B's salary? [SSC CGL 2019]
  (A) ₹ 8,000
  (B) ₹ 34,400

(A) < 8,000	<b>(B)</b> ₹ 34,40
(C) ₹ 10,600	<b>(D)</b> ₹ 8,600

- 15. Sudha spends 80% of her income. When her income is increased by 30%, she increases her expenditure by 25%. Her savings: [SSC CHSL 2018]
  (A) increased by 5% (B) decreased by 30%
  (C) decreased by 5% (D) increased by 50%
- 16. The price of an article increases by 20% every year. If the difference between the price at the end of third and fourth years is ₹ 259.20, then 40% of the price at the end of 2<sup>nd</sup> year is: [SSC CHSL 2018]
  - (A) 484
    (B) 432
    (C) 384
    (D) 472
- **17.** The ratio of the income of A to that of B is 5 : 7. A and B save ₹ 4,000 and ₹ 5,000, respectively. If the expenditure of A is equal to  $66\frac{2}{3}\%$  of the expenditure

of B, then the total income of A and B is:

[SSC CGL 2018]

- (A) ₹ 25,200
  (B) ₹ 24,000
  (C) ₹ 26,400
  (D) ₹ 28,800
- 18. A is 25% more than B and B is 40% less than C. If C is 30% more than D, then by what per cent is A less than D? [SSC CGL 2018]
- (A) 1.5%
  (B) 2.5%
  (C) 4%
  (D) 5%
  19. If decreasing 110 by *x*% gives the same result as increasing 50 by *x*%, then *x*% of 650 is what percentage more than (*x* 10)% of 780?
  (SSC CGL 2019]
  (A) 17%
  (B) 12%
  (C) 18%
  (D) 14%
- **20.** A man spends  $10\frac{1}{2}\%$  of his salary on items of daily

use and 30% of the remainder on house rent; after<br/>that, he is left with ₹ 12,000. How much is his salary<br/>(consider the round-up value)? [SSC CHSL 2022]<br/>(A) ₹ 18,050 (B) ₹ 19,154<br/>(C) ₹ 10,054 (D) ₹ 19,000

#### ANSWER KEY

#### Level-1: Beginner

1.	(C)	2.	(A)	3.	(A)	4.	(A)	5.	(B)	6.	(D)	7.	(D)	8.	(C)	9.	(C)	10.	(A)
11.	(D)	12.	(B)	13.	(D)	14.	(B)	15.	(C)	16.	(A)	17.	(C)	18.	(A)	19.	(B)	20.	(C)
21.	(C)	22.	(D)	23.	(C)	24.	(B)	25.	(D)										

Level-2: Intermediate

1.	(D)	2.	(B)	3.	(A)	4.	(D)	5.	(B)	6.	(A)	7.	(A)	8.	(A)	9.	(D)	10.	(C)
11.	(D)	12.	(C)	13.	(D)	14.	(A)	15.	(B)	16.	(A)	17.	(C)	18.	(C)	19.	(B)		

1.	(A)	2.	(A)	3.	(C)	4.	(D)	5.	(B)	6.	(B)	7.	(A)	8.	(D)	9.	(D)	10.	(D)
11.	(C)	12.	(B)	13.	(C)	14.	(D)	15.	(D)	16.	(B)	17.	(B)	18.	(B)	19.	(D)	20.	(B)

Level-3: Expert

#### **Solutions with Detailed Explanations**

#### Level-1: BEGINNER

- 1. Option (C) is correct. *Explanation:* Required percentage =  $\frac{24}{40} \times 100 = 60\%$
- 2. Option (A) is correct. *Explanation:*  $\frac{1}{100} \times \frac{1}{100} \times \frac{25}{100} \times 1,000 = 0.025$
- 3. Option (A) is correct. Explanation: R = S + 0.2S = 1.2SRequired%  $= \left(\frac{R-S}{R}\right) \times 100 = \left(1-\frac{S}{R}\right) \times 100$

$$= \left(1 - \frac{1}{1.2}\right) \times 100 = \frac{100}{6} = 16\frac{2}{3}\%$$

4. Option (A) is correct. *Explanation:* 

 $\Rightarrow$ 

$$\frac{125}{100} \times x = 100$$

$$x = \frac{100 \times 100}{125} \Longrightarrow 80$$

5. Option (B) is correct. *Explanation:* 

Let the number = x

$$\frac{40}{100} \times \frac{4}{5} \times \frac{3}{4} \times x = 48$$
$$\frac{6}{25}x = 48$$
$$x = \frac{48 \times 25}{6} = 200$$

 $\Rightarrow$  1% of 200 = 2

 Option (D) is correct. *Explanation:* Let the total number of students be *x*. Let A and B represent the sets of students who passed in English and Mathematics, respectively.

$$\Rightarrow n(A \cup B) = n(A) + n(B) - n(A \cap B) = 75\% \text{ of } x + 60\% \text{ of } x - (x - 25\% \text{ of } x) = \frac{3}{4}x + \frac{3}{5}x - \frac{3}{4}x = \frac{3}{5}x So, \qquad \frac{3}{5}x = 240 x = 400$$

7. Option (D) is correct.

Explanation:

Total C.P. = 
$$200 \times 10 = ₹ 2,000$$
  
Total S.P. =  $12 \times 195 = ₹ 2,340$   
% profit =  $\frac{2,340 - 2,000}{2,000} \times 100 = 17\%$ 

8. Option (C) is correct.

*Explanation:* Increase in salary = ₹ 900. i.e., 8,100 → 9,000

Percentage increase =  $\frac{900}{8,100} \times 100 = 11\frac{1}{9}\%$ 

9. Option (C) is correct.

*Explanation:* Let total number of students who appeared in an examination be *x*. According to the question,

$$x \times \frac{8}{100} = 480$$

$$x = 6,000$$

10. Option (A) is correct. *Explanation:*  $\frac{18}{100} \times \frac{15}{100} \times \frac{25}{9} \times 3,800 = 285$ 

11. Option (D) is correct.

 $\Rightarrow$ 

Explanation: 
$$\frac{9}{40} \times 100 = \frac{45}{2}\% = 22\frac{1}{2}\%$$

12. Option (B) is correct.

Explanation:

$$5 \text{ litres} = 5,000 \text{ ml}$$
  
 $8\% \text{ of } 5 \text{ litres} = 5,000 \times \frac{8}{100}$   
 $= 400 \text{ ml}$ 

13. Option (D) is correct.

Explanation:

 $\Rightarrow$ 

According to the question,

 $124 \times x\% = 49.60$ 

$$x = \frac{4,960}{124} = 40$$

14. Option (B) is correct. *Explanation:* 

$$12\% = \frac{3 \rightarrow \text{Saving}}{25 \rightarrow \text{Income}}$$
  
Expenditure = 22 units = 2,16,128

$$1 \text{ unit } = 9824$$

25 units = 245600

So, total income = ₹ 2,45,600

15. Option (C) is correct.

Explanation:

Let salary of A and B are A and B, respectively.

So, according to the question,

A: B = 160 : 100  
Required% = 
$$\frac{60}{160} \times 100 = 37.5\%$$

16. Option (A) is correct.



$$x - 29 = 27 \Rightarrow x = 56\%$$

17. Option (C) is correct.*Explanation:* Value after two years

$$= 75,000 \times \frac{96}{100} \times \frac{96}{100} = ₹ 69,120$$

18. Option (A) is correct.

Explanation:

Saving percentage = (100 - 55)% = 45%If the income of Ajay be  $\mathfrak{T}_x$ , then,

$$\frac{45 \times x}{100} = 27,000$$

#### 19. Option (B) is correct.

 $\Rightarrow$ 

*Explanation:* Let salary of Som = ₹100

∴ His salary after 40% increment = ₹140

His salary after 15% reduction  $= \left[\frac{100-15}{100}\right] \times 140$ 

$$=\frac{85 \times 14}{10}=119$$

... Net change in his salary is 19% increase.

#### 20. Option (C) is correct.

*Explanation:* Let the total number of students in class be *x*.



#### 21. Option (C) is correct.

*Explanation:* Let her income = ₹100 Expenditure on food = ₹25 Expenditure on children's book = ₹15 Expenditure on uniform =  $\frac{75}{100}$  [100 – 40] = ₹45

∴ Remaining amount = ₹15

 $\Rightarrow$  Remaining percentage of income = 15%

#### 22. Option (D) is correct.

**Explanation:** % of votes secured by the second candidate = (100 - 57)% = 43%Let total votes polled be *x*. According to question, (57 - 43)% of x = 42,000

 $\Rightarrow$  14% of x = 42,000

$$\Rightarrow \qquad x = 3,00,000$$

23. Option (C) is correct.

*Explanation:* Let the side of cube = *a* units

 $\therefore$  Surface area of cube =  $6a^2$  sq. units

New side of cube = 
$$6 \times \left(\frac{22}{25}a\right)^2$$
 sq. units

 $\therefore$  Decrease in the surface area

$$= \frac{6a^2 - 6 \times \left(\frac{22}{25}a\right)^2}{6a^2} \times 100$$
  
= 22.56%

#### 24. Option (B) is correct.

*Explanation:* According to the question, Number of girls = (100 - 60)% = 40% $\Rightarrow 40\% = 36$ 

So, 60% = 54

Number of boys = 54

#### 25. Option (D) is correct.

Explanation:

Mohan : Shyam = 7:5

Shyam's income is less by 
$$=\frac{2}{7} \times 100\% = 28\frac{4}{7}\%$$

#### Level-2: INTERMEDIATE

**Explanation:** Quantity of salt = 5% of 6 litres = 300 mlQuantity of water = 6,000 ml - 300 ml = 5,700 mlQuantity of water left after evaporation

= (5,700 - 1000) ml = 4,700 ml

% of salt = 
$$\frac{300 \text{ m}}{(4,700+300)\text{ml}} \times 100 = 6\%$$

2. Option (B) is correct.



10% decrease in savings.

3. Option (A) is correct. *Explanation:* Required percentage change

$$= \frac{\frac{3}{2} - \frac{7}{5}}{\frac{3}{2}} \times 100\% = \frac{20\%}{3} \Longrightarrow 6\frac{2}{3}\%$$

4. Option (D) is correct. *Explanation:* D = 100 124

$$P = 100 - 124$$
  
C = 124 - 100 118

Consumption decrease =  $\frac{6}{124} \times 100 = 4.8\%$ 

5. Option (B) is correct.

*Explanation:* As price is reduced by 20% or  $\frac{1}{5}$  factor. Then consumption will increase by a factor of  $\frac{1}{4}$ , as

expenditure is constant.

According to question,

$$\frac{1}{4} \times x = 4 \text{ kg}$$

$$x = 16 \text{ kg}$$

Price of 
$$16 \text{ kg} = 160$$

$$\therefore \quad \text{Price of 1 kg} = \frac{160}{16} = ₹ 10$$

So, price of sugar is ₹ 10/ kg

#### 6. Option (A) is correct.

*Explanation:* Let the monthly salary of A be x, monthly salary of B is (40,000 - x)

Savings of A = 
$$(100 - 85)\%$$
 of  $x = 0.15 x$   
Savings of B =  $(100 - 95)\%$  of  $(40,000 - x)$   
=  $0.05 (40,000 - x)$   
 $0.15x = 0.05 (40,000 - x)$   
 $\Rightarrow 0.15x + 0.05x = 40,000 \times 0.05$ 

$$\Rightarrow \qquad 0.2x = 2,000$$

⇒ x = ₹ 10,000Option (A) is correct.

Explanation:

Let passing marks = p

 $p \times 1.05 = 273$ 

$$p = 260$$

Lokesh passing% = 
$$\frac{312 - 260}{260} \times 100 = 20\%$$

- 8. Option (A) is correct.
  - Explanation:

$$100 \longrightarrow 117 -12$$
  
 $1052 -12$   
% decrease =  $\frac{12}{117} \times 100 = 10.3\%$ 

9. Option (D) is correct.

Explanation:

$$\frac{R_1}{R_2} = \frac{60}{100} = \frac{3}{5}$$
Volume = V<sub>1</sub>: V<sub>2</sub> = 27 : 125
Volume decrease =  $\frac{98}{125} \times 100 = 78.4\%$ 

#### 10. Option (C) is correct.

Explanation: Given, Total salary of P and Q = ₹ 120000 Let salary of  $P = \mathcal{F} x$ And salary of Q = ₹ 120000 - xAccording to the question,

$$x \times \frac{5}{100} = (120000 - x) \times \frac{15}{100}$$
  
$$\Rightarrow 5x = 1800000 - 15x$$
  
$$\Rightarrow x = 90000$$

So, salary of P = ₹ 90000

#### 11. Option (D) is correct.

*Explanation:* Let the price of T.V = ₹ 100 After decreasing price by 20%, new price = ₹ 80Required percentage increase in price  $= \frac{100 - 80}{80} \times 100 = 25\%$ 

#### 12. Option (C) is correct.

Explanation: Given, Monthly income of Manisha = ₹ 120000 And monthly expenditure = ₹ 55000 So, savings = 120000 – 55000 = ₹ 65000 According to the question, 100

Next year her salary = 
$$120000 \times \frac{122}{100} = ₹ 146400$$

And the new expenditure =  $55000 \times \frac{110}{100} = ₹60500$ So, new savings = 146400 – 60500 = ₹ 85900

Now, required percentage increase

$$= \frac{85900 - 65000}{65000} \times 100 = 32.15\%$$

#### 13. Option (D) is correct.

Explanation:  
Suppose 
$$B = 100$$
, then  $A = 128$ ,  
 $C = \frac{3}{4}(A + B) = \frac{3}{4} \times 228 = 171$   
 $128 : 100 : 171$   
 $+43$   
Required percentage  $= \frac{43}{128} \times 100$   
 $= \frac{1,075}{32} = 33.59 \approx 33.6\%$ 

14. Option (A) is correct.

Explanation:

$$I = E : S$$

$$+20.1\% \begin{pmatrix} 400 &= 260 : 140 \\ 480.4 &= 325 : 155.4 \end{pmatrix} + 15.4$$

$$\Rightarrow \quad \text{Savings\%} = \frac{15.4}{140} \times 100 = 11\%$$

15. Option (B) is correct.

$$\frac{1}{4} \times \frac{1}{2} \times x = \frac{5}{2} \times \frac{3}{10} \times \frac{1}{4} \times y$$
$$\frac{x}{y} = \frac{3}{2}$$

Required  $\% = 3 - 2/2 \times 100 = 50\%$  $x \rightarrow 50\%$  more than y

16. Option (A) is correct.  
*Explanation:* According to the question,  

$$A \cdot B = 124 \cdot 100 = 31 \cdot 25$$

So, required% = 
$$\frac{6}{31} \times 100 = \frac{600}{31}\%$$

17. Option (C) is correct. Explanation:

Value of expression

 $\Rightarrow$ 

 $\Rightarrow$ 

$$\begin{bmatrix} 3\frac{6}{7} \div \frac{54}{7} - \left\{ 3 - \left( 2\frac{3}{4} - \frac{3}{2} \right) \right\} \end{bmatrix} + A \div 4 = 0$$
$$\Rightarrow \qquad \begin{bmatrix} \frac{27}{7} \div \frac{54}{7} - \left\{ 3 - \left( \frac{5}{4} \right) \right\} \end{bmatrix} + A \div 4 = 0$$

$$\begin{bmatrix} \frac{27}{7} \div \frac{54}{7} - \frac{7}{4} \end{bmatrix} + \mathbf{A} \div \mathbf{4} = \mathbf{0}$$

$$\begin{bmatrix} \mathbf{1} & 7 \end{bmatrix} \leftarrow \mathbf{1} = \mathbf{0}$$

$$\Rightarrow \qquad \left\lfloor \frac{1}{2} - \frac{1}{4} \right\rfloor + A \div 4 = 0$$
$$\Rightarrow \qquad \left\lfloor \frac{-5}{4} \right\rfloor + A \div 4 = 0$$
$$\Rightarrow \qquad A \div 4 = 5$$

$$A \div 4 = \frac{1}{4}$$
$$A = 5$$

 $\overline{4}$ 

18. Option (C) is correct. *Explanation:* A : B = 135 : 100Required% =  $\frac{35}{135} \times 100 \approx 26\%$ 

7.

19. Option (B) is correct. Explanation: Let total property be x.  $x \times \frac{2}{3} \times \frac{3}{10} = 12,500$   $\Rightarrow \qquad x = 6,25,000$   $x \times \frac{45}{100} = ₹ 2,81,250$ Level-3: EXPERT 1. Option (A) is correct. Explanation:  $\frac{(x+20)}{100} \times 250 = \frac{125}{100} \times \frac{x}{100} \times 220$ 

$$x = 200$$

$$\Rightarrow 10\% \text{ of } (x + 50) = \frac{10}{100} \times 250 = 25$$

$$\Rightarrow 15\% \text{ of } x = \frac{15}{100} \times 200 = 30$$

$$\Rightarrow \text{ Required}\% = \frac{30 - 25}{30} \times 100$$

$$= \frac{5}{30} \times 100 = 16\frac{2}{3}\%$$

2. Option (A) is correct. Explanation:

Monthly income = ₹45000 and monthly expenditure = ₹33000

New saving after increment

$$= \frac{122}{100} \times 45000 - \frac{111}{100} \times 33000$$
  
= 122 × 450 - 111 × 330 = ₹18270

3. Option (C) is correct.



Ratio  $\Rightarrow$  6 : or 3 :

Given that total marks obtained in Science = 54000

 $\therefore$  Marks obtained in Maths =  $\frac{54000}{3} \times 2 = 36000$ 

2

4. Option (D) is correct.

Explanation:

Income	Expenditure	Saving
200	170	30
↓ 26% In	$\downarrow 60\%$	
252		48

As, 252 - 48 = 204

% Expenditure increase =  $\frac{204 - 170}{170} = \frac{34}{170} = 20\%$ 

5. Option (B) is correct.

*Explanation:* Let price, consumption and expenditure are P, C and E, respectively.

$$P \times C = E$$

Let,  $25 \times 4 = 100$ Then, after changes new expenditure  $= 32 \times 3.5 = 112$ 

So, percentage decrease =  $\frac{0.5}{4} \times 100$ 

= 12.5% (decrease)

6. Option (B) is correct. *Explanation:* 

Correct 
$$\rightarrow \frac{4}{3} \times 12 \longrightarrow 16$$
  
Wrong  $\rightarrow \frac{3}{4} \times 12 \longrightarrow 9 \varkappa$  -7 (By option)

% reduction = 
$$\frac{7}{16} \times 100 = \frac{175}{4}$$
%

7. Option (A) is correct. *Explanation:* 

$$A-B = 8$$

$$A = (A+B) \times \frac{55}{100}$$

$$\frac{A}{A+B} = \frac{11}{20} \Rightarrow \frac{A}{B} = \frac{11 \rightarrow 44}{9 \rightarrow 36}$$

8. Option (D) is correct. Explanation:  $180 \quad (100 + x)\%$ 

$$\frac{100}{60} = \frac{(205 + 47)}{(100 - x)\%}$$

$$\Rightarrow \qquad x = 50$$

$$50\% \text{ of } 410 = 205$$

$$70\% \text{ of } 210 = 147$$
So, required% =  $\frac{205 - 147}{147} \times 100 = 39.46\%$ 

9. Option (D) is correct.

Explanation:

25% more = 
$$\frac{5}{4}$$
  
C = 35% of (A + B)  
A : B : C  
500 400 315  
-185  
Required% =  $\frac{185}{500} \times 100 = 37\%$   
10. Option (D) is correct.  
Explanation:

$$60\% \text{ of } (x - y) = 45\% \text{ of } (x + y)$$

$$\Rightarrow \qquad \frac{3}{5}(x - y) = \frac{9}{20}(x + y)$$

$$\Rightarrow \qquad 4(x-y) = 3x + 3y$$

$$\Rightarrow \qquad x = 7y$$
  

$$\Rightarrow \qquad x:y = 7:1$$
  

$$7 \times \frac{k}{100} = 1 \Rightarrow k = \frac{100}{7}$$
  

$$\Rightarrow \qquad 21\% \text{ of } k = \frac{21}{100} \times \frac{100}{7} = 3$$

11. Option (C) is correct. Explanation:

$$A:B:C = 148:100: \frac{248 \times 40}{100}$$
$$= 148:100:99.2$$
Required% =  $\frac{48.8}{99.2} \times 100 = 49.2\%$ 

#### 12. Option (B) is correct.

*Explanation:* Let the total number of voters = xSo, number of voters voted in the election = 0.9xAccording to the question,

$$\Rightarrow 0.9x \times \frac{30}{100} + 900 = 0.9x \times \frac{70}{100}$$
$$\Rightarrow 0.9x \times \frac{40}{100} = 900$$
$$\Rightarrow x = 2500$$

So, total number of voters = 250013. Option (C) is correct.

> *Explanation:* Let the total marks = xAccording to the question,

$$\Rightarrow \frac{20}{100}x + 25 = \frac{50}{100}x - 20$$
$$\Rightarrow \frac{1}{5}x + 45 = \frac{1}{2}x \Rightarrow \frac{3}{10}x = 45$$
$$\Rightarrow x = 150$$

So, the passing marks = 
$$\frac{20}{100} \times 150 + 25 = 55$$

14. Option (D) is correct.

Explanation:

5% of A = 20% of B  
$$\frac{A}{A} = \frac{4}{4}$$

$$\overline{B}$$
 1

$$\Rightarrow$$
 5 units = 43,000

- B's salary = 8,600*.*..
- 15. Option (D) is correct. Explanation:

$$I = E S$$
  
100 = 80 20  
130 = 100 30

#### 16. Option (B) is correct.

Explanation:

 $20\% = \frac{1}{5}$ We know,

Let price = 625end of  $1^{st}$  year = 750  $2^{nd}$  year = 900  $3^{rd}$  year = 1,080  $4^{\text{th}} \text{ year} = 1,296$ Difference = 216 = 259.2040% of 900 = 360 = 43217. Option (B) is correct. Explanation: 2

$$66\frac{2}{3}\% = \frac{2}{3}$$

$$I = 5 : 7$$

$$E \rightarrow 2 : 3$$

$$S \rightarrow 4,000 : 5,000$$

$$12,000 : 10,000$$

$$15 - 14 \text{ unit} = 12,000 - 10,000$$

$$1 \text{ unit} - 2,000$$

$$12 \text{ units} \rightarrow 24,000$$

18. Option (B) is correct.

1

Explanation: According to the question, A:B:C:D = 195 : 156 : 260 : 200

Required% = 
$$\frac{5}{200} \times 100 = 2.5\%$$

19. Option (D) is correct.

Explanation:

$$110\left(\frac{100 - x}{100}\right) = 50\left(\frac{100 + x}{100}\right)$$
$$x = \frac{75}{2}\%$$
$$x\% \text{ of } 650 = 243.75$$

(x - 10)% of 780 = 214.50

Required more% =  $\frac{29.25}{214.5} \times 100 = 13.63\% \approx 14\%$ 

#### 20. Option (B) is correct.

*Explanation:* Let the salary of the person  $= \mathbb{R} x$ So, amount left after his daily use items spendings

$$= x - \frac{21}{200}x = \frac{179}{200}x$$

According to the question,

$$\Rightarrow \frac{179}{200} \times \frac{70}{100} x = 12000$$

x = 19154 $\Rightarrow$ 

So, the salary of the person = ₹ 19154



Chapter

# Profit, Loss and Discount

#### LEARNING OBJECTIVES:

- Method of calculating profit and loss while selling an article.
- Concepts related to marked price, discount, cost price and selling price.
- Concept of dishonest shopkeeper.
- Various types of questions asked in competitive exams related to profit, loss and discount.

When we buy a thing, in the market for a given price and subsequently sell it for a different price, we can make a profit or a loss. It is one of the most useful mathematical notions. Several forms of transactions occur in every day life, and they all incorporate the concept of profit and loss. Profit and loss concepts are deal with using numerous phrases such as cost price, selling price, discount, marked price, profit and loss.

- Cost price: The price at which someone bought an item.
- Selling price: The price at which someone sells the article.
- Profit: When the selling price of an article is more than its cost price.
- Loss: When the cost price of an article is more than its selling price.
- > Marked price: The price printed on the product.
- Discount: The rebate provided by a shopkeeper to the customer when the customer buys a product.



S Example 1: Rahul bought an article for ₹ 500 and sells it at 10% profit. Find the selling price of the article.

(a) ₹ 550 (b) ₹ 600  
(c) ₹ 750 (d) ₹ 450  
Sol. (a) Using, selling price = 
$$\frac{CP(100 + Profit\%)}{100}$$
  
=  $\frac{500(100 + 10)}{100}$ 

$$= \frac{500 \times 110}{100} = ₹ 550$$

**Example 2:** Two successive discounts of 10% and 5% is equivalent to single discount of:

(a) 
$$12\%$$
 (b)  $14.5\%$ 

(c) 15% (d) 18% Sol. (b) Using, equivalent single discount

$$= d_1 + d_2 - \frac{(d_1 \times d_2)}{100} = 10 + 5 - \frac{(10 \times 5)}{100}$$
$$= 15 - \frac{50}{100} = \frac{29}{2} = 14.5\%$$

**Example 3:** The ratio of cost price to selling price is 5:4. Find loss or profit per cent.

(a) 20% loss (b) 10% profit (c) 20% profit (d) 10% loss Sol. (a) Since,  $\frac{CP}{SP} = \frac{5}{4}$ Assuming, CP = 5xand SP = 4xHere CP > SP so in this case loss i

Here, CP > SP, so in this case, loss is occured.

Using, 
$$loss\% = \frac{(CP - SP)}{CP} \times 100$$
$$= \frac{(5x - 4x)}{5x} \times 100$$
$$= 20\%$$

• **Example 4:** A man bought an article for ₹ 700. At what price should he sell the article to gain 10%?

(a)	₹ 870	(b) ₹ 850
(c)	₹ 770	(d) ₹780

SP = CP + profit% of CPSol. (c) Using, SP = 700 + 10% of 700 = 700 + 70 = ₹ 770

S Example 5: By selling an article for ₹ 550, Rahul gains 10% of profit. To get a profit of 20%, Rahul should sell the article for:

(a) ₹600 (b) ₹ 500 (c) ₹400 (d) ₹ 300 SP = ₹ 550 Sol. (a) Profit% = 10%Let, CP = xx + 10% of x = 550⇒  $x + \frac{x}{10} = 550$  $\Rightarrow$ 11x = 5,500 $\Rightarrow$  $\rightarrow$ *x* = ₹ 500

> Now, to get 20% profit, the article should be sold at 120% value of cost price.

So, new selling price = 120% of cost price =  $\frac{120}{100} \times 500$ 

=₹600

- S Example 6: A sells an article to B on 10% profit, B sold the article to C on 5% profit. If C pays ₹ 1,155, then find the cost price of article for A.
  - (a) ₹900 (b) ₹800
  - (c) ₹1,200 (d) ₹ 1,000
- **Sol. (d)** Assuming CP for  $A = \overline{\mathbf{x}} x$ According to the question,

#### Beginner \_eve

- If the ratio of cost price and selling price of an article 1. is 10:11, the percentage of profit is: [SSC CGL 2021] (A) 8 **(B)** 10 (C) 11 **(D)** 15
- By selling an article, a man makes a profit of 25% of its 2. selling price. His profit per cent is: [SSC CGL 2012]

(D)  $33\frac{1}{2}$ (C)  $16\frac{2}{3}$ (A) 20 **(B)** 25

- If the cost price of 15 books is equal to the selling price 3. of 20 books, then the loss per cent is: [SSC CGL 2011] (A) 16 **(B)** 20 (C) 24 (D) 25
- If a tradesman marks his goods 25% above the 4. costprice and allows his customers a 12% reduction on their bill, then the percentage profit he makes is: ISSC CHSL 2022]

- (A) 30% Sucessive discounts of 10%, 20% and 30% is equivalent 5. to single discount of: [SSC CGL 2010] (C) 40.5% (A) 60% **(B)** 49.6% (D) 36%
- What single discount is equivalent to two successive 6. discount of 20% and 15%? [SSC 2011] (A) 35% **(B)** 32% (C) 34% (D) 30%

$$x \times \frac{110}{100} \times \frac{105}{100} = 1155$$
$$x = 1000$$

- **Example 7:** An article is sold for 10% profit. If it was sold for 5% loss, then the shopkeeper got ₹ 75 less as compared to 10% profit. Find the cost price of the article.
  - (a) ₹ 500 (b) ₹700
  - ₹1000 (d) ₹ 300 (c)
- **Sol. (a)** We know that, CP = 100%When sold for 10% profit

SP = 110%  
SP = 110%  
When sold for 5% loss  
SP = 95%  
According to the question,  

$$110\% - 95\% = 75$$
  
 $15\% = 75$ 

**Example 8:** An article is marked 10% above CP, then 10% discount is given by the shopkeeper. Find profit or loss per cent in the whole transaction.

- (b) No loss, no profit (a) 1% loss (c) 1% profit (d) 2% loss CP = 100%Sol. (a) Assuming, Marked price = 110%SP = 110% - [10% of 110%]= 99%Hence, loss = 100% - 99%[CP - SP]= 1% loss
- If the selling price of 10 articles is equal to the cost 7. price of 11 articles, then the gain per cent is:

[SSC CGL 2011]

**(A)** 10 **(B)** 11 (C) 15 **(D)** 25 The cost price of an article is 40% of its selling price.

What per cent of the cost price is the selling price? [SSC CGL 2011]

8.

- (A) 140% **(B)** 200% (C) 220% (D) 250% There is a 20% discount on a dozen pairs of shoes 9. marked at ₹ 7,200. How many pair of shoes can be bought with ₹ 1,440? [SSC CHSL 2022] (A) 3 **(B)** 5 (C) 2 (D) 4
- 10. A fruit seller purchased 300 bananas at the rate of ₹ 18 per dozen and sold 200 bananas at the rate of ₹ 24 per dozen and the remaining bananas at the rate of ₹ 21 per dozen. What is his net profit percentage?

[SSC CHSL 2022]

- **(B)** 26% (A) 28%
- (D)  $27\frac{7}{9}\%$ (C) 27%

**11.** By selling an article for ₹ 21,000, a man gains 5% of profit. To get a profit of 15%, he has to sell it for:

	[SSC Sub. Inspector 2012]
<b>(A)</b> ₹ 19,800	<b>(B)</b> ₹ 20,700
(C) ₹ 23,000	<b>(D)</b> ₹ 25,000

- 12. The profit% of a bookseller if he sells a book at marked price after enjoying a commisison of 25% on marked price will be: [SSC CHSL 2012] (A) 30% **(B)** 25% (C) 20% (D) 33.33%
- 13. A sells an article to B at a gain of 10%, B sells it to C at a gain of 5%. If C pays ₹ 462 for it, what did it cost to A? [SSC CHSL 2012] (A) ₹ 500 (B) ₹ 450

(C) ₹ 600	<b>(D)</b> ₹ 400

14. A seller gives 4 toys free of cost on buying 14 toys. What percent does the customer get as a discount?

[SSC CHSL 2022]

(A) $21\frac{2}{9}\%$	<b>(B)</b> $22\frac{2}{9}\%$
(C) $24\frac{2}{9}\%$	(D) $23\frac{2}{9}\%$

- 15. A watch is sold at a profit of 30%. Had it been sold for ₹ 80 less, there would have been a loss of 10%. What is the cost price of the watch? [SSC CGL 2012] **(B)** ₹ 200 (D) ₹ 800 (A) ₹ 150 (C) ₹ 400
- 16. A dealer offered a machine for sale for ₹ 27,500 but even if he had charged 10% less, he would have made a profit of 10%. The actual cost of the machine is:

	[SSC CGL 2012]
(A) ₹ 22,000	<b>(B)</b> ₹ 24,250
(C) ₹ 22,500	<b>(D)</b> ₹ 22,275

17. A man sold an article at a loss of 20%. If he sells the article for ₹ 12 more, he would have gained 10%. The cost price of the article is: [SSC CGL 2012] (A) ₹ 60 (B) ₹ 40 (C) ₹ 30 (D) ₹ 22



# Intermediate

1. A manufacturer marked an article at Rs. 50 and sold it allowing 20% discount. If his profit was 25%, then the cost price of the article was: [SSC CGL 2010] (A) ₹ 40 **(B)** ₹ 35 (C) ₹ 32 (D) ₹ 30

A person sells wheat at a profit of 25 percent. If he 2. reduces its selling price by Rs. 40, then he suffers a loss of 25 percent. What was the initial selling price of the wheat? [SSC CHSL 2023] (C) ₹ 60 (A) ₹ 80 **(B)** ₹ 120 (D) ₹ 100

- By selling a bicycle fo ₹ 2,850, a shopkeeper gains 3. 14%. If the profit is reduced to 8%, then the selling price will be: [SSC CGL 2011] (A) ₹ 2,600 (B) ₹ 2,700
  - (C) ₹ 2,800 (D)₹3,000

18.	An article is so it been sold ₹	old for ₹ 300 235, the los	) at a profit o s percentage	of 20%. Had would have
	been:		[SS	C CGL 2013]
	(A) 5	<b>(B)</b> 6	<b>(C)</b> 16	<b>(D)</b> 3
19.	The marked pr for ₹ 10,500 after rate of discours	rice of a table er allowing a t is:	e is ₹ 12,000. I certain disco	If it was sold unt, then the
	(A) 12.5%	<b>(B)</b> 15%	(C) 17.5%	(D) 10%
20.	On the eve	of Gandhi	Iavanti, Gan	dhi Ashram
20.	declared a 25%	discount on	silk. If the se	lling price of
	a slik saree is <	525, then w	nat is its mark	ked price?
			[55	C CGL 2013]
	(A) ₹ 700		<b>(B)</b> ₹ 725	
	(C) ₹ 750		<b>(D)</b> ₹ 775	
21.	A shopkeeper	marks his g	oods 20% ab	ove his cost
	price and give	s 15% disco	unt on the m	narked price.
	His gain per ce	ent is:	Isso	C CGL 2014]
	(A) 5%	<b>(B)</b> 4%	(C) 2%	(D) 1%
22.	If a shopkeeper sells it at ₹ 10 p	r purchases c per 50 grams,	ashew nut at then he will	₹ 250/kg and have:
			[SSC Sub. Ins	spector 2015]
	(A) 25% profit		<b>(B)</b> 20% pr	ofit
	(C) 20% loss		<b>(D)</b> 25% los	ss
23.	By selling an a amount, should	article for ₹ d I sell it to g	450. I lose 20 ain 20%?	%. For what
	,	0	[SSC	CHSL 2015]
	<b>(A)</b> ₹ 490		<b>(B)</b> ₹ 470	1
	(C) ₹ 562.50		(D)₹ 675	
24.	A fruit seller b	uvs oranges	at the rate o	f₹ 10/dozen
	and sells at the	rate of ₹ 12/0	dozen. His ga	in per cent is
	:		ISSC	CHSL 2015]

- (C)  $8\frac{1}{2}\%$ **(B)** 20% **(D)** 12% (A) 15%
- 25. 10% discount and then 20% discount in succession is equivalent to the total discount of: [SSC CGL 2016] **(B)** 30% (A) 15% (C) 24% (D) 28%
- While selling a watch, a shopkeeper gives a discount 4 of 5%. If he gives a discount of 6%, he earns ₹ 15 less as profit. What is the marked price of the watch?

[SSC CGL 2011]

(**D**) Gain  $8\frac{1}{2}\%$ 

(A) ₹ 1,250	<b>(B)</b> ₹ 1,400
(C) ₹ 1,500	<b>(D)</b> ₹ 750

5. Krishna purchased a number of articles at ₹ 10 for each and the same number for ₹ 14 each. He mixed them together and sold them for ₹ 13 each. Then, his gain or loss per cent is: [SSC CGL 2011]

(A) Loss 
$$8\frac{1}{3}\%$$
 (B) Gain  $8\frac{2}{3}\%$   
(C) Loss  $8\frac{2}{3}\%$  (D) Gain  $8\frac{1}{3}\%$ 

 X sells two articles for ₹ 4,000 each with no loss and no gain in the transaction. If one was sold at a gain of 25%, the other is sold at a loss of: [SSC CGL 2012]

<b>(A)</b> 2.5%	(B) $18\frac{2}{9}\%$
(C) $16\frac{2}{3}\%$	<b>(D)</b> 20%

 After allowing 15% discount, a dealer wishes to sell a machine for ₹1,22,700. At what price must the machine be marked? (Consider up to two decimals)

	[SSC CHSL 2022]
<b>(A)</b> ₹1,22,352.94	<b>(B)</b> ₹1,44,352.94
(C) ₹1,48,352.94	<b>(D)</b> ₹1,36,352.94

8. A businessman allows a discount of 10% on the written price. How much above the cost price must he mark on his goods to make a profit of 17%?

		[SS	C CGL 2012]
<b>(A)</b> 30%	<b>(B)</b> 20%	(C) 27%	<b>(D)</b> 18%

9. The price of an original article is first decreased by 20% and then increased by 30%. If the resultant price is ₹ 416, then the original price of the article is:

	[SSC CGL 2013]
<b>(A)</b> ₹ 350	<b>(B)</b> ₹ 450
(C) ₹ 405	<b>(D)</b> ₹ 400

10. A bookseller sells a book at a profit of 10%. If he had bought it at 4% less and sold it for ₹ 6 more, he would

have gained $18\frac{3}{4}\%$ profit.	The cost price of the	book
4 is:	[MTS 2	2014]
(A) ₹ 160	<b>(B)</b> ₹ 170	
(C) ₹ 150	(D)₹155	

11. A man sells two watches at ₹ 99 each. On one, he gets 10% profit and on the other, he loses 10%. His net gain or loss per cent is: [MTS 2014]

(A) 1% loss	(B) no loss no profit
(C) 1% gain	<b>(D)</b> 10% loss

- 12. A shopkeeper makes a profit of 12.5% after allowing a discount of 10% on the marked price of an article. Find his profit percentage if the article is sold at the marked price, allowing no discount. [SSC CHSL 2022]
  (A) 25% (B) 30% (C) 22.5% (D) 27%
- 13. A shopkeeper sold an item for ₹ 1,800 at a discount of 10% and gained ₹ 200. He had not given the discount, his gain would be: [SSC MTS 2014]
  (A) ₹ 300
  (B) ₹ 400

(11) ( 500	(D) ( 100
(C) ₹ 180	<b>(D)</b> ₹ 200

**14.** A tea merchant professes to sell tea at the cost price but uses a false weight of 900 gram for a kilogram. The profit per cent in his transaction is:

[SSC Sub. Inspector 2014]

(A)  $11\frac{1}{9}\%$  (B) 10% (C)  $9\frac{1}{11}\%$  (D) 15%

A shopkeeper allows 10% discount on goods when 15. he sells without credit. Cost price of his goods is 80% of his selling price. If he sells his goods by cash, then his profit is: [SSC CGL 2015] (A) 50% **(B)** 70% (C) 25% (D) 40% 16. Ram bought a T.V. with 20% discount on the labelled price. If he had bought it with 30% discount, he would have saved ₹ 800. The value of the T.V. set that he bought is: [SSC CGL 2014] (A) ₹ 5,000 **(B)** ₹ 8,000 (C) ₹ 9,000 (D) ₹ 1,000 17. A trader marks his goods 20% above C.P but allows his customers a discount of ₹ 10%. The C.P. of a black board, which is sold for ₹ 216 is: [SSC Sub. Inspector 2015] (A) ₹ 200 **(B)** ₹ 180 (C) ₹ 108 (D)₹196 18. A fan is listed at ₹ 150/- with a discount of 20%. What additional discount must be offered to the customer to bring the net price to ₹ 108/-? [SSC MTS 2017] (A) 15% **(B)** 5% (C) 10% (D) 20% 19. At what per cent above the cost price must a person mark the price of an article so that he can enjoy 20% profit after allowing 20% discount?

> [SSC MTS 2017] % (D) 40%

- (A) 60% (B) 30% (C) 50%
- 20. A man bought 15 mangoes for a rupee. How many mangoes were sold for a rupee so that there is a loss of 25%? [SSC Sub. Inspector 2017]
  (A) 10
  (B) 12
  (C) 18
  (D) 20
- **21.** A merchant allows a discount of 20 percent on marked price. If he wants to earn a profit of 20 percent, then marked price will be how much percentage more than the cost price?

[SSC CHSL 2023]

(D) 37.5%

- (A) 50% (B) 40% (C) 45%
- 22. The difference between successive discounts of 40% followed by 30% and 45% followed by 20% on the marked price of an article is ₹ 12. The marked price of the article is: [SSC CGL 2015]
  (A) ₹ 400
  (B) ₹ 200
  - (C) ₹ 800 (D) ₹ 600
- 23. A man purchased an article for ₹ 1,500 and sold it at 25% above the cost price. If he has to pay Rs. 75 as tax on it, his net profit percentage will be:

[SSC CHSL 2015]

(A) 25% (B) 30% (C) 15% (D) 20%
24. A man sold his watch at a loss of 5%. Had he sold it for ₹ 56.25 more, he would have gained 10%. What is the cost price of the watch (in Rs)? [SSC CHSL 2014]
(A) ₹ 370 (B) ₹ 365 (C) ₹ 375 (D) ₹ 390

# Expert

1.	If on a marked price, the difference of selling prices with a discount of 30% and two successive discounts of 20% and 10% is Rs. 72, then the marked price (in rupees) is: [SSC CGL 2011] (A) 3,600 (B) 3,000 (C) 2,500 (D) 2,400	9.	(A) $\notin 0$ (B) $\notin 2$ (C) $\notin 1.93$ (D) $\notin 7.20$ A man purchased some eggs at 3 for $\notin 5$ and soldthem at 5 for $\notin 12$ . Thus, he gained $\notin 143$ in all. Thenumber of eggs he bought is:[SSC CGL 2012]]
2.	If $P : Q = 10 : 11$ and $Q : R = 11 : 12$ , then $P + Q : Q$ $+ R : R + P$ is:[SSC CHSL 2022](A) $21 : 23 : 22$ (B) $22 : 21 : 23$ (C) $11 : 12 : 10$ (D) $23 : 22 : 21$	10.	(A) 210 (B) 200 (C) 195 (D) 190 Rahul bought two cycles for a total sum of $₹$ 1,500. He sold one cycle at 20% loss and the other cycle at 20% gain. If the selling price of both the cycles is the same,
3.	A trader bought two horses for ₹ 19,500. He sold one at a loss of 20% and other at a profit of 15%. If the selling prices of each horse is the same, then their C.P. are respectively. [SSC CGL 2011] (A) ₹ 10.000 and ₹ 9.500 (B) ₹ 11.500 and ₹ 8.000	11	find the cost price of two cycles (in ₹).         [SSC Sub. Inspector 2012]         (A) ₹ 500, 1000       (B) ₹ 600, 900         (C) ₹ 750, 750       (D) ₹ 550, 950         A men sold two articles at ₹ 275 each On one ho
4.	(C) $\notin$ 12,000 and $\notin$ 7,500 (D) $\notin$ 10,500 and $\notin$ 9,000 Under a sale offer, Tanvir was offered a 32% discount on the part of the marked price that was paid in cash, but had to add 1.2% on the part of the marked price	11.	gains 25% and on the other, he loses 25%. The gain or loss % in the whole transaction is: [SSC CHSL 2012] (A) 6% (B) $4\frac{1}{7}$ % (C) 50% (D) $6\frac{1}{4}$ %
	paid through a credit card. If Tanvir paid 75% of the marked price in cash and the rest through a credit card, what percentage of the marked price was his total final payment? [SSC CHSL 2022] (A) 76.6% (B) 75.9% (C) 76.1% (D) 76.3%	12.	A shopkeeper blends to varieties of tea costing ₹ 18 and ₹ 13 per 100 gram in the ratio 7:3. He sells the blended variety at the rate of ₹ 18.15 per 100 gm. His percentage gain in the transaction is:
5.	If the price of sugar is raised by 25%. Find how much per cent a householder must reduce his consumption of sugar so as not to increase his expenditure? [SSC CGL 2011]	13.	[SSC CHSL 2013] (A) 8% (B) 10% (C) 12% (D) 14% If books bought at prices ranging from ₹ 150 to ₹ 300 are sold at prices ranging from ₹ 250 to ₹ 350,
6.	(A) 10% (B) 20% (C) 18% (D) 25% Vijay sells bananas at the rate of Rs. 14 per dozen and earns a profit of 40 percent. The cost price of the bananas increases by 30 percent. If the selling		then what is the greatest possible profit that might be made in selling 15 books?[SSC CHSL 2013](A) Cannot be determined(B) ₹ 3,000(C) ₹ 750(D) ₹ 4,250
7.	percent?[SSC CHSL 2023](A) 7.69%(B) 9.09%(C) 7.14%(D) 8.83%The price of a commodity rises from ₹ 6 per kg to₹ 7.50 per kg. If the expenditure cannot increase, the	14.	The marked price of a mixie is ₹ 1600. The shopkeeper gives successive discount of 10% and $x$ % of the customers. If the customer pays ₹ 1,224 for the mixie, then find the value of $x$ . [SSC CGL 2013] (A) 8% (B) 10% (C) 12% (D) 15%
8.	percentage of reduction in consumption is:       [SSC CGL 2011]         (A) 15%       (B) 20%       (C) 25%       (D) 30%         The difference between a discount of 40% on ₹ 500	15.	A reduction in the price of apples enables a person to purchase 3 apples for ₹ 1 instead of ₹ 1.25. What is the % reduction in price (approx.)? [SSC CGL Tier-II 2013]
	and two successive discounts of 36%, 4% on the same amount is: [SSC CHSL 2011]		(A) 20 (B) 25 (C) 30 (D) 33

### ANSWER KEY

Level-1: Beginner

1.	(B)	2.	(D)	3.	(D)	4.	(D)	5.	(B)	6.	(B)	7.	(A)	8.	(D)	9.	(A)	10.	(D)
11.	(C)	12.	(D)	13.	(D)	14.	(B)	15.	(B)	16.	(C)	17.	(B)	18.	(B)	19.	(A)	20.	(A)
21.	(C)	22.	(C)	23.	(D)	24.	(B)	25.	(D)										

1.	(C)	2.	(D)	3.	(B)	4.	(C)	5.	(D)	6.	(C)	7.	(B)	8.	(A)	9.	(D)	10.	(C)
11.	(A)	12.	(A)	13.	(B)	14.	(A)	15.	(C)	16.	(B)	17.	(A)	18.	(C)	19.	(C)	20.	(D)
21.	(A)	22.	(D)	23.	(D)	24.	(C)												

Level-2: Intermediate

#### Level-3: Expert

1.	(A)	2.	(A)	3.	(B)	4.	(D)	5.	(B)	6.	(A)	7.	(B)	8.	(D)	9.	(C)	10.	(B)
11.	(D)	12.	<b>(B)</b>	13.	<b>(B)</b>	14.	(D)	15.	(A)										

#### **Solutions with Detailed Explanations**

#### Level-1: BEGINNER

1. Option (B) is correct.

*Explanation:* Cost Price/Selling Price = 10/11 Cost Price = ₹ 10xLet and Selling Price =  $\mathbf{E} \ 11x$ (CD CD)

$$\therefore \qquad \text{Profit}\% = \left(\frac{\text{SP}-\text{CP}}{\text{CP}}\right) \times 100$$

$$= \frac{(11x - 10x)}{10x} \times 100 = 10\%$$

Option (D) is correct. 2. Explanation: Assuming SP = ₹ 100 Then profit will be ₹ 25

So, 
$$CP = 100 - 25 = ₹75$$
  
Using;  $CP = SP - Profit$ 

Hence, profit % on CP =  $\frac{\text{Profit}}{\text{CP}} \times 100$ 

$$= \frac{25}{75} \times 100 = 33\frac{1}{3}\%$$

3. Option (D) is correct.

Explanation: According to question,

$$15 \text{ CP} = 20 \text{ SP}$$
$$\frac{\text{CP}}{\text{SP}} = \frac{20}{15} = \frac{4}{3}$$
$$\text{Let} \qquad \text{CP} = ₹ 4x$$
$$\text{and} \qquad \text{SP} = ₹ 3x$$
$$(4x - 3x)$$

$$\therefore \text{ Loss percentage } = \frac{(4x - 3x)}{4x} \times 100$$
$$= \frac{1}{4} \times 100 = 25\%$$

4. Option (D) is correct. *Explanation:* Let the cost price of article = ₹ 100 So, marked price = ₹ 125

Now selling price = 
$$125 \times \frac{100 - 12}{100} = \text{Rs. } 110$$

So, profit percentage =  $\frac{110 - 100}{100} \times 100 = 10\%$ 

5. **Option (B) is correct.** *Explanation:* Successive discount [10%, 20%, 30%]

 $= 100 - \left[100 \times \frac{90}{100} \times \frac{80}{100} \times \frac{70}{100}\right] = 49.6\%$ 

Option (B) is correct. 6.

*Explanation:* Using; successive discount =  $a + b - \frac{ab}{100}$ 

[Here, *a* and *b* are two discounts]

$$= 20 + 15 - \frac{20 \times 15}{100} = 32\%$$

$$10.SP = 11.CP$$
$$\frac{SP}{CP} = \frac{11}{10}$$
Hence, Profit% =  $\frac{(11-10)}{10} \times 100 = 10\%$ 

8. **Option** (D) is correct.

> Explanation: Assuming, SP = ₹100 40% of SP = ₹ 40 CP = ₹ 40 So, Hence, required% =  $\frac{100}{40} \times 100 = 250\%$

#### 9. Option (A) is correct.

Explanation: Given,

Marked price of a dozen pairs of shoes = ₹ 7200 So, marked price of one pairs of shoes

$$= \frac{7200}{12} = ₹600$$

So, selling price of one pairs of shoes

$$= 600 \times \frac{80}{100} = ₹480$$

Required number of pairs of shoes

$$=\frac{1440}{480}=3$$

10. Option (D) is correct.

Explanation: The cost price of 300 bananas

$$=\frac{18}{12}$$
 × 300 = ₹450

And selling price of 300 bananas

$$= \frac{24}{12} \times 200 + \frac{21}{12} \times 100 = 400 + 175 = 575$$
  
So, the net profit percentage

$$= \frac{575 - 450}{450} \times 100 = 27\frac{7}{9}\%$$

11. Option (C) is correct.

Explanation: According to question, 105% = 21,000

$$100\% = 21,000 \times \frac{100}{105} = 20,000$$

[CP = 100% = 20,000]Hence, SP with 15% profit =  $20,000 \times \frac{115}{100} = ₹ 23,000$ 

12. Option (D) is correct.

*Explanation:* Assuming price of book = ₹ 100 25% of 100 = 25 [Commission amount] Actual rate = 100 – 25 = ₹ 75 Profit = 100 – 75 = ₹ 25 profit% =  $\frac{25}{75} \times 100 = 33.33\%$ Hence,

13. Option (D) is correct. Explanation: According to question, Assuming, CP to  $A = \mathbb{R} x$ 

$$x \times \frac{110}{100} \times \frac{105}{100} = 462$$
  
$$\Rightarrow \qquad x = 400$$
  
Hence, cost to A = ₹ 400

14. Option (B) is correct.

 $\Rightarrow$ 

Explanation: Given: A seller gives 4 toys free of cost on buying 14 toys.

So, profit percentage = 
$$\frac{4}{18} \times 100 = 22\frac{2}{9}\%$$

#### 15. Option (B) is correct.

Explanation: CP = 100%Assuming According to question, 130% = 90% + 8040% = 801% = 2100% = 200Hence, So, the CP is Rs. 200 16. Option (C) is correct. Explanation:  $CP = \mathbb{Z} x$ Assuming

According to question, 110% of  $x = 27,500 \times \left(\frac{100 - 10}{100}\right)$  $x = 27,500 \times \frac{9}{10} \times \frac{10}{11} = 22,500$ Hence, 17. Option (B) is correct. Explanation: Assuming CP = 100%According to question, 80% = 110% - 1230% = 12 $100\% = \frac{12}{30} \times 100 = 40$ Hence, So, the CP of article = Rs. 4018. Option (B) is correct. Explanation: Actual price = 300 [Selling price] Profit = 20%120% of CP = 300CP = (300/120)100 = ₹ 250 According to question, New selling price = Rs. 235 So, loss percentage = [(250 - 235)/250]100 = 6%Hence, loss% = 6%19. Option (A) is correct. *Explanation:* Assuming discount = *d*% According to question,  $\frac{d}{100} \times 12,000 = 12,000 - 10,500$  $\frac{d}{100} \times 12,000 = 1,500$ Hence, d = 12.5%20. Option (A) is correct. Explanation: SP = ₹ 525 Assuming marked price = xSP after 25% discount = x - 0.25 x = 0.75 xAccording to question, 525 = 0.75 xx = ₹ 700Hence, 21. Option (C) is correct. Explanation: CP = ₹100 Let MP = ₹120 Then, Discount = 15% of MP $= \frac{15 \times 120}{100} = ₹ 18$ Selling Price = MP – Discount = 120 - 18 = ₹ 102  $gain\% = \frac{(102 - 100)}{100} \times 100\% = 2\%$ Hence,

- 22. Option (C) is correct. *Explanation:* SP = ₹ 10/50 grams SP of 1 gm = ₹  $\frac{10}{50}$ SP of 1000 gm =  $\frac{10}{50} \times 1000 = \text{Rs.200}$ So,  $\log \% = \frac{(250 - 200)}{250} \times 100 = 20\%$
- 23. Option (D) is correct.

Explanation: According to question,

$$\frac{450}{100 - 20} = \frac{SP_2}{100 + 20}$$
$$SP_2 = 450 \times \frac{120}{80} = Rs. 675$$

#### 24. Option (B) is correct.

*Explanation:* Cost price of 1 dozen oranges = Rs. 10 Selling price of 1 dozen oranges = Rs. 12

So, gain percentage = 
$$\frac{(12-10)}{10} \times 100 = 20\%$$

#### 25. Option (D) is correct.

Explanation: Using, successive discount formula

Discount = 
$$a + b - \frac{ab}{100} = 10 + 20 - \frac{(10 \times 20)}{100} = 28\%$$
  
Level-2: INTERMEDIATE

#### 1. Option (C) is correct.

Explanation:

Marked price = ₹ 50 (Given)

So, 
$$SP = \frac{50 \times 80}{100} =$$
  
Hence,  $CP = \frac{40 \times 100}{125} =$ 

#### 2. Option (D) is correct.

Explanation:

Let the cost price of wheat = ₹ x per kg Then selling price of wheat = ₹ 1.25x per kg According to the question,  $\Rightarrow 1.25x - 40 = .75x$  $\Rightarrow .50x = 40$  $\Rightarrow x = 80$ So, the cost price of wheat = ₹ 80 per kg And selling price of wheat =  $1.25 \times 80$ 

₹ 40

₹ 32

3. Option (B) is correct.

Explanation: According to the question,

CP = 
$$\frac{100}{114} \times 2,850 = ₹ 2,500$$
  
So, SP [Profit of 8%] =  $\frac{108}{100} \times 2,500 = ₹ 2,700$ 

#### 4. Option (C) is correct.

Explanation: Discount 1 = 5%Discount 2 = 6%Assuming marked price  $= \notin P$ 

$$d_2 - d_1 = (6\% - 5\%) = 1\%$$
  
1% of P = 15  
100% of P = ₹ 1.500

5. Option (D) is correct.

Hence,

*Explanation:* Let Krishna bought two articles, one for ₹ 10 and other for ₹ 14.

CP of both = 
$$10 + 14 = ₹ 24$$
  
SP of both =  $13 \times 2 = ₹ 26$   
Hence, profit% =  $\frac{(26-24)}{24} \times 100$   
=  $8\frac{1}{2}\%$ 

6. Option (C) is correct.

Explanation:

SP of 1<sup>st</sup> = ₹ 4,000  
Gain% = 25%  
CP of 1<sup>st</sup> = 
$$\frac{100}{125} \times 4,000 = ₹ 3,200$$

So,  $2^{nd}$  article's CP = 8,000 - 3,200 = ₹ 4800  $2^{nd}$  article's SP = ₹ 4,000

Hence, loss percentage for 2<sup>nd</sup> article

$$= \frac{800}{4800} \times 100 = 16\frac{2}{3}\%$$

7. Option (B) is correct.

*Explanation:* Given: Selling price of machine = ₹ 122700 And discount percentage = 15%Let the marked price of machine = ₹ *x* According to the question,

$$\Rightarrow x \times \frac{100 - 15}{100} = 122700$$
$$\Rightarrow x = 122700 \times \frac{100}{85}$$

$$\Rightarrow \qquad x = 144352.94$$

So, the marked price of machine = ₹ 144352.94

#### 8. Option (A) is correct.

*Explanation:* Assuming CP = ₹ 100Let marked or written price = ₹ xAccording to question,

$$x \times \frac{90}{100} = 117$$

 $x = \frac{117 \times 100}{90} = 130$ 

Hence,

i.e., 30% above CP.

#### 9. Option (D) is correct.

*Explanation:* Assuming original price = ₹ P According to question,

$$P \times \frac{80}{100} \times \frac{130}{100} = 416$$

Hence,  $P = \frac{416 \times 100 \times 100}{80 \times 130} = ₹400$ 

10. Option (C) is correct. Explanation: Assuming CP= ₹ 100 Profit = 10%CP = ₹ 96 [4% less] New gain =  $18\frac{3}{4}\%$ If, SP =  $118\frac{3}{4}\%$  of ₹ 96 = ₹ 114 According to question, Difference (in SP) = 114 – 110 = ₹ 4 CP = ₹100 So, if difference in SP =  $\gtrless 6$  $CP = \frac{100}{4} \times 6 = ₹ 150$ then, 11. Option (A) is correct. Explanation: Given that, the selling price of each watch =₹99 For 10% loss, CP = (99/90)100 = ₹ 110 For 10% profit, CP = (99/110)100 = ₹ 90 Total CP = (110 + 90) = ₹ 200

So,  $\text{Loss\%} = \frac{(200 - 198)}{200} \times 100 = 1\%$ 

12. Option (A) is correct.

*Explanation:* Let the marked price of article = ₹ 100 According to the question,

C.P.  $\times \frac{112.5}{100} = 100 \times \frac{90}{100}$ 

C.P. = ₹ 80

So, profit percentage when the article sold at marked price

$$= \frac{100 - 80}{80} \times 100 = 25\%$$

#### 13. Option (B) is correct.

 $\Rightarrow$ 

*Explanation:* CP = 1,800 - 200 = ₹ 1,600

Marked price = 
$$\frac{1,800}{100-10} \times 100 = ₹ 2,000$$

Hence, if no discount given

Profit = 2,000 - 1,600 = ₹ 400

14. Option (A) is correct.

Explanation:

Profit = 
$$1000 - 900 = 100$$
  
Profit% =  $\frac{100}{900} \times 100 = 11\frac{1}{9}\%$ 

15. Option (C) is correct.

*Explanation:* Assuming marked price =  $\mathbb{P} x$ 

$$\Rightarrow \qquad \text{SP} = \frac{90x}{100} = ₹ \frac{9x}{100}$$

$$\Rightarrow \qquad \text{CP} = \frac{80 \times 9x}{100 \times 10} = \mathbf{\overline{\xi}} \frac{36}{50}x$$

So, 
$$gain = \frac{45x - 36x}{50} = ₹ \frac{9x}{50}$$

Hence, Gain% =  $\frac{9x/50}{36x/50} \times 100 = 25\%$ 

16. Option (B) is correct. *Explanation:* According to question,[*x* = MRP of T.V.]  $\frac{x \times 80}{100} - \frac{x \times 70}{100} = 800$  $\frac{10x}{100} = 800$  $x = \frac{800 \times 100}{10} = ₹8,000$ Hence, 17. Option (A) is correct. Explanation: Assuming  $CP = \mathbb{R} x$ Marked price = ₹ 1.2 x $\Rightarrow$ According to question, 1.2x = 12x - 2,16010.8x = 2.160x = 2,160 / 10.8 = 200Hence, CP of blackboard = ₹ 200 18. Option (C) is correct. Explanation: SP (after 20% discount)  $= 150 \times \frac{80}{100} = ₹ 120$  $x \times \frac{120}{100} = 108$ So, *x* = ₹ 90  $\Rightarrow$ Hence, required discount = (100 - 90)% = 10%19. Option (C) is correct. Explanation: Assuming CP = ₹100  $\Rightarrow$ SP = ₹ 120 Assuming marked price =  $\mathbf{R} \mathbf{x}$ 80% of x = 120 $\Rightarrow$  $x = \frac{120}{0.8} = 150$  $\Rightarrow$ Hence, required% =  $\frac{150 - 100}{100} \times 100 = 50\%$ 

20. Option (D) is correct. *Explanation:* 

$$Loss\% = \frac{(CP - SP)}{CP} \times 100$$
$$SP = \frac{3CP}{4}$$
$$CP \text{ of } 1 \text{ mango } = \frac{1}{15}$$
$$So, SP \text{ of } 1 \text{ mango } = \frac{1}{20}$$

Hence, he sold 20 mangoes for a rupee.

Option (A) is correct.
 *Explanation:* Let the marked price of article = ₹ 100
 So, selling price = ₹ 80

According to the question:

Cost price of article =  $80 \times \frac{100}{120} = ₹ \frac{200}{3}$ 

=

Required percentage

$$= \frac{100 - \frac{200}{3}}{\frac{200}{3}} \times 100 = \frac{\frac{100}{3}}{\frac{200}{3}} \times 100 = 50\%$$

#### 22. Option (D) is correct.

Explanation: For 40% and 30%

Single discount = 
$$\left[40 + 30 - \frac{40 \times 30}{100}\right] = 58\%$$

For 45% and 20%

Single discount = 
$$\left(45 + 20 - \frac{45 \times 20}{100}\right) = 56\%$$
  
Assuming marked price = ₹ P

According to question,

P × (58 - 56)% = 12  
⇒ 
$$\frac{P \times 2}{100}$$
 = 12  
Hence, P =  $\frac{1,200}{2}$  = ₹ 600

Hence,

23. Option (D) is correct. *Explanation:* CP = ₹ 1,50025% of 1500 = 375SP = 1,500 + 375 = ₹ 1,875 So, Profit = 1.875 - 1.500 - 75 [75 = tax]

$$= 300$$
ence, required profit% =  $300 \times \frac{100}{200} = 20\%$ 

Hence, required profit% = 
$$300 \times \frac{100}{1500} = 2$$

24. Option (C) is correct.



#### Level-3: EXPERT

1. Option (A) is correct. Explanation:

> Successive discount =  $20 + 10 - \frac{(20 \times 10)}{100} = 28\%$ Difference in discount = (30 - 28)% = 2%Given (30% - 28%) = 72So, 2% = 721% = 36 $\Rightarrow$ 100% = ₹ 3,600 Hence,

2. **Option** (A) is correct.

*Explanation:* Given, P : Q = 10 : 11 And Q : R = 11 : 12So, P : Q : R = 10 : 11 : 12So, P+Q: Q+R: R+P = (10+11): (11+12): (12+10) $\Rightarrow$  P+Q:Q+R:R+P = 21:23:22

3. Option (B) is correct. Explanation:

Assuming CP of first = ₹ P CP of second = ₹ (19,500 - P)According to the question,

$$\frac{80}{100} P = (19,500 - P) \times \frac{115}{100}$$
$$P = \frac{4,48,500}{20} = ₹ 11,500$$

39 ⇒ CP of second horse = 19,500 – 11,500 = ₹ 8,000

**Option (D) is correct.** 4. *Explanation:* Let the marked price = ₹ 100 According to the question, Amount paid by Tanvir

$$= 75 \times \frac{100 - 32}{100} + 25 + 25 \times \frac{1.2}{100} = ₹ 76.3$$

So, required percentage = 76.3%

**Option (B) is correct.** 5.

Explanation:  $25\%\uparrow \Rightarrow 125$ 

 $\Rightarrow$ 

 $x\%\downarrow \Rightarrow 100$ 

Hence, 
$$x = \frac{25}{125} \times 100 =$$

Option (A) is correct. 6. Explanation:

> Selling price of banana = ₹  $\frac{14}{12}$ So, cost price =  $\frac{14 \times 100}{12 \times 140} = ₹ \frac{5}{6}$ New cost price of banana =  $\frac{5}{6} \times \frac{130}{100} = ₹ \frac{13}{12}$ So, profit percentage

$$= \frac{\frac{14}{12} - \frac{13}{12}}{\frac{13}{12} \times 100} = \frac{\frac{1}{12}}{\frac{13}{12}} \times 100 = \frac{100}{13} = 7.69\%$$

20%

7. **Option (B) is correct.** *Explanation:* Assuming consumption = 100 kg New consumption = x kgAccording to the question,  $100 \times 6 = x \times 7.5$  $x = 80 \, \text{kg}$ 

Hence, reduction is consumption

$$= (100 - 80) \times \frac{100}{100} = 20\%$$

Option (D) is correct. 8. Explanation:

Marked price = ₹ 500 Discount = 40%SP = 500 - 40% of 500= ₹ 300 ...(1) 36% and 4% successive discount SP after 36% discount =  $500 - \frac{36}{100} \times 500 = ₹ 320$ SP after 4% discount =  $320 - \frac{4}{100} \times 320$ = ₹ 307.20 ...(2) From (2) and (1), we get 307.20 - 300 = ₹ 7.20 Option (C) is correct. 9. *Explanation:* Cost price of each egg = ₹  $\frac{5}{2}$ Selling price of each egg = ₹  $\frac{12}{5}$ So, profit on each egg =  $\frac{12}{5} - \frac{5}{3} = \underbrace{\gtrless \frac{11}{15}}$ Given that total profit = ₹ 143 Let number of eggs he bought = x $\frac{11}{15} \times x = 143$ So, x = 195Hence, he bought 195 eggs. 10. Option (B) is correct. *Explanation:* Assuming CP of 1<sup>st</sup> cycle = ₹ C CP of other  $= \mathbf{E} (1,500 - C)$ According to the question,  $C + \frac{20}{100}C = (1,500 - C) - \frac{20}{100}(1,500 - C)$ 2C = 1,200C = ₹ 600 Hence, and CP of other cycle = 1,500 - 600 = ₹90011. Option (D) is correct. Explanation: CP =  $\frac{100 \times 375}{125}$  = ₹ 300 1<sup>st</sup> article

II<sup>nd</sup> article CP = 
$$\frac{100 \times 375}{75} = ₹500$$
  
Total CP = 500 + 300 = ₹ 800  
Total SP = 375 + 375 = ₹ 750  
Hence, loss% =  $\frac{800 - 750}{800} \times 100$   
= 6.25% i.e.,  $6\frac{1}{4}$ %  
**12. Option (B) is correct.**  
*Explanation:* CP =  $18 \times \frac{7}{10} + 13 \times \frac{3}{10}$   
=  $\frac{165}{10} = ₹ 16.5$   
SP = ₹ 18.15 [Given]  
Hence, Gain% =  $\frac{1.65}{16.5} \times 100 = 10\%$   
**13. Option (B) is correct.**  
*Explanation:* For maximum profit  
CP must be minimum i.e., 150  
SP must be maximum = 350  
Profit = SP - CP  
=  $350 - 150 = ₹ 200/book$   
Hence, profit on 15 books =  $200 \times 15 = ₹ 3,000$   
**14. Option (D) is correct.**  
*Explanation:* MP = ₹ 1,600  
After 1<sup>st</sup> discount ( $10\%$ ) =  $1,600 \times \frac{90}{100} = ₹ 1,440$   
Final SP = ₹ 1,224 [Given]  
So,  $\frac{x}{100} \times 1,440 = 1,440 - 1,224$   
Hence,  $x = 15\%$   
**15. Option (A) is correct.**  
*Explanation:* Required % reduction  
=  $\frac{0.25}{1.25} \times 100 = 20\%$ 

