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OBJECTIVE QUANTITATIVE APTITUDE

For
All Competitive Examinations

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

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COVERED**

Objective Quantitative Aptitude



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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

This book on Objective Quantitative Aptitude will play a vital role in your Competitive Exams preparations as Quantitative Aptitude is a fundamental part of almost all Competitive Examinations in India, including 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.

The book is designed to cater to the needs of both beginners and advanced learners. The concepts are explained in a lucid and easy-to-understand language, making it easier for students to grasp the topics. The book contains numerous solved examples and practice questions that help students to enhance their problem-solving skills.

Some unique features of this book are:

- ***Crisp Revision:*** Concepts Review & Mind Maps offer bite-sized and just-in-time revision tools.
- ***Extensive Practice:*** with More than 2000 Previous year questions from various competitive exams segregated based on difficulty level.
- ***Concept Clarity:*** Easy to Grasp theory complemented by Solved examples.
- ***Expert Tips:*** Helps you get expert knowledge to master the Quantitative exam 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!

Team Oswaal

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:

- 1 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.
- 2 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.
- 3 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.
- 4 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. It is on the lines of the current syllabus and can be entrusted upon before the examination.
- 5 Schedule time 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.
- 6 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 questions that come up every year and this might give you an edge over other students. It includes all the typologies of Questions 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.
- 8 Revise whenever you get time**
Make sure you revise as much as possible. The revision will help you in keeping the concepts fresh in your mind.
- 9 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 time.

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)

- | | |
|--|---|
| <ul style="list-style-type: none"> ➤ Computation of whole numbers ➤ Decimals ➤ Fractions ➤ Relationships between numbers ➤ <u>Profit and Loss</u> ➤ Discount ➤ Partnership Business ➤ Mixture and Allegation ➤ Time and distance ➤ Time & Work ➤ Percentage ➤ Ratio & Proportion ➤ Square roots ➤ Averages ➤ Interest ➤ Basic algebraic identities of School Algebra & Elementary surds ➤ Graphs of Linear Equations ➤ Triangle and its various kinds of centres ➤ Congruence and similarity of triangles | <ul style="list-style-type: none"> ➤ 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)	
<ul style="list-style-type: none"> ➤ Simplification ➤ Simple and Compound Interest ➤ Problem on Ages ➤ Probability ➤ Cistern and Pipe ➤ Mensuration ➤ Percentage ➤ Data Sufficiency ➤ Number Series ➤ Profit and Loss ➤ Work and Time ➤ Average 	<ul style="list-style-type: none"> ➤ Quadratic Equations ➤ Ratio and Proportion ➤ Surds and Indices ➤ Data Interpretation (Bar Graph, Line Chart, Tabular, Radar/Web, Pie Chart) ➤ HCF and LCM ➤ Permutation and Combination ➤ Speed, Distance and Time ➤ Boats and Streams ➤ Approximation ➤ Partnership ➤ Mixtures & Alligations

IBPS PO – Probationary Officer	IBPS – Clerk
<ul style="list-style-type: none"> ➤ Data Interpretation ➤ Mensuration ➤ Profit ➤ Discount ➤ Probability ➤ Simple and Compound Interest ➤ Logarithms, ➤ Volume and Surface Area ➤ Partnership, Stocks and Shares ➤ Distance and Time ➤ Time and Work ➤ Ratio and Proportion ➤ Elements of Algebra ➤ Discount ➤ Trigonometry ➤ Equations ➤ Permutation and Combinations ➤ Height and Distances ➤ Clocks ➤ Percentages ➤ Mixture and Allegation ➤ Speed. 	<ul style="list-style-type: none"> ➤ Number Series ➤ Simplification/ Approximation ➤ Data Sufficiency ➤ Average ➤ Ratio and Proportion ➤ Time and Distance ➤ Relations ➤ Permutation and Combination ➤ Data Interpretation ➤ Quadratic Equation ➤ Mensuration ➤ Profit and Loss ➤ Work, Time, and Energy ➤ Probability ➤ Simple and Compound Interest

NDA/NA - National Defence Academy/Naval Academy	
Topic	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, solution of the first order, and first-degree 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 ratios. Equation 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 style="list-style-type: none"> * Basic Operations * simple factors * Remainder Theorem * H.C.F. * L.C.M. * Theory of polynomials * solutions of quadratic equations * relation between its roots and coefficients (Only real roots to be considered) * Simultaneous linear equations in two unknowns—analytical and graphical solutions * Simultaneous linear inequations in two variables and their solutions * Practical problems leading to two simultaneous linear equations or inequations in two variables or quadratic equations in one variable & their solutions * Set language and set notation * Rational expressions and conditional identities * Laws of indices
Arithmetic	<ul style="list-style-type: none"> * Number System: Natural numbers, Integers, Rational and Real numbers. * Fundamental operations: addition, subtraction, multiplication, division, Square roots, Decimal fractions * Unitary method * time and distance * time and work * percentages * applications to simple and compound interest * profit and loss * ratio and proportion * variation * Elementary Number Theory: Division algorithm * Prime and composite numbers * Tests of divisibility by 2, 3, 4, 5, 9 and 11 * Multiples and factors. Factorisation Theorem * H.C.F. and L.C.M. * Euclidean algorithm * Logarithms to base 10 * laws of logarithms * use of logarithmic tables
Trigonometry	<ul style="list-style-type: none"> * $\sin x$, $\cos x$, $\tan x$ when $0^\circ < x < 90^\circ$ * Values of $\sin x$, $\cos x$ and $\tan x$, for $x = 0^\circ, 30^\circ, 45^\circ, 60^\circ$ and 90° * Simple trigonometric identities * Use of trigonometric tables * Simple cases of heights and distances
Geometry	<ul style="list-style-type: none"> * Lines and angles * Plane and plane figures * Theorems on Properties of angles at a point * Parallel lines * Sides and angles of a triangle * Congruency of triangles * Similar triangles

	<ul style="list-style-type: none"> ★ Concurrence of medians and altitudes ★ Properties of angles ★ sides and diagonals of a Parallelogram ★ rectangle and square ★ Circles and its properties including tangents and normals ★ Loci
Mensuration	<ul style="list-style-type: none"> ★ Areas of squares ★ rectangles ★ parallelograms ★ triangle and circle ★ 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
Statistics	<ul style="list-style-type: none"> ★ Collection and tabulation of statistical data ★ Graphical representation frequency polygons ★ histograms ★ bar charts ★ pie charts etc ★ Measures of central tendency

Common Admission Test (CAT)				
Arithmetic	Algebra	Number system	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 Indices		
Simple & Compound Interest				

Trend Analysis

Chapters & Topics	Exam - wise Weightage Analysis							
	SSC - CHSL	SSC - CGL	IBPS PO	IBPS Clerk	NDA	CDS	CAT	LIC AAO
Percentage	1	1	-	1-2	-	14	-	-
Profit, Loss, and Discount	1	2	1-2	1-3	-		4	-
Simple Interest and Compound Interest	2	1	1-2	1-3	-			-
Ratio and Proportion	-	1	3-4	1-3	-		3	-
Partnership	-	-	-	-	-		-	-
Average	1	1	-	1-3	-		2	-
Mixture and Alligation	-	-	-	0-2	-		-	-
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 Determinants	-	-	-	-	9	-	-	-
Number system	-	-	-	0-1	-	18	1	-
Number Series	-	-	-	3-5	-	-	-	5
Divisibility Rules	1	-	2-5	-	-	-	-	-
Unit digit		-	-	-	-	-	-	-
Number of zeroes		-	-	-	-	-	-	-
Factors		-	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



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KOTTAYAM	Academic Book House, (0471) 2333349, 9447063349, Ponni Book Stall, 9037591721	THENI	Maya Book Centre, 9443929274
TRIVANDRUM	Aman Book Stall, (0495) 2721282,	HYDERABAD	TELANGANA Sri Balaji Book Depot, (040) 27613300, 9866355473, Shah Book House, 9849564564
CALICUT			
	MADHYA PRADESH Agarwal Book Depot, 9425116210	AGRA	UTTAR PRADESH Sparsh Book Agency, 9412257817, Om Pustak Mandir, (0562) 2464014, 9319117771
GWALIOR	Bhaiya Industries, 9893326853, Sushil Prakashan,(0731) 2503333, 2535892, 9425322330,	ALLAHABAD	Mehrotra Book Agency, (0532) 2266865, 9415636890
INDORE	Bhaiya Store, 9425318103,	AZAMGARH	Sasta Sahitya Sadan, 9450029674
JABALPUR	Vinay Pustak Sadan, 8962362667, Anand Books and Stationers, 9425323508	ALIGARH	K.B.C.L. Agarwal, 9897124960, Shaligram Agencies, 9412317800, New Vimal Books, 9997398868
SAGAR	Princi Book Depot, Sagar, 9977277011	GORAKHPUR	Central Book House, 9935454590
		JHANSI	Bhanu Book Depot, 9415031340
PUNE	MAHARASHTRA Natraj Book Depot, (020) 24485054, 9890054092, Vikas Book House, 9921331187, Pravin Sales, 9890683475, New Saraswati Granth Bhandar, 9422323859, Akshar Books & Stationary, 7385089789, Vandhaman Educational, 9860574354, Yash Book Centre, 9890156763	KANPUR	Radha News Agency, 8957247427, Raj Book Dist., 9235616506
MUMBAI	Vidyarthi Sales Agencies, 9819776110, New Student Agencies, 7045065799,	LUCKNOW	Vyapar Sadan, 7607102462, Om Book Depot, 7705871398, Azad Book Depot Pvt. Ltd, 7317000250, Book Sadan, 9839487327, Rama Book Depot(Retail), 7355078254, Ashirwad Book Depot, 9235501197, Book.com, 7458922755
LATUR	Yash Book House, 9637936999	MEERUT	Ideal Book Depot, (0121) 4059252, 9837066307
KOLHAPUR	Granth the Book World, 9922295522,	NOIDA	Prozo (Global Edu4 Share Pvt. Ltd), 9318395520
NAGPUR	Laxmi Pustakalay and Stationers, (0712) 2727354		
	Renuka Book distributor, 9765406133, Novelty Book Depot, 9657690220, Karamveer Book Depot, 9923966466	UTTARAKHAND	Inder Book Agencies, 9634045280
NASHIK	Rahul Book Centre, 9970849681, New India Book House, 9623123458		
DHULE	Navjeevan Book Stall, 7020525561	KOLKATA	WEST BENGAL Oriental Publishers & Distributor (033) 40628367, Katha 'O' Kahini, (033) 22196313, 22419071, Saha Book House, (033), 22193671, 9333416484, United Book House, 9831344622, Bijay Pustak Bhandar, 8961260603
YAVATMAL	Shri Ganesh Pustkalaya, 9423131275	COOCH BEHAR	S.B. Book Distributor, Cooch behar, 9002670771

Important Formulas 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) \times 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:

$$A - P = \left(\frac{P \times R \times T}{100}\right) \dots \dots \dots [\text{where } A - P = \text{simple interest (SI)}]$$

OR

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

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

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

- 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 $R_1, R_2, R_3, \dots, R_n$, respectively and time periods are $T_1, T_2, T_3, \dots, T_n$, 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

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

- 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

$$\text{Change in SI} = \frac{PT}{100} \times (R_1 - R_2)$$

Similarly, if principal (P) changes from P_1 to P_2 and R ,

$$T \text{ are fixed, then change in SI} = \frac{RT}{100} \times (P_1 - P_2)$$

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_1 in T_1 years and to A_2 in T_2 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_1 at $R_1\%$ per annum and to A_2 at $R_2\%$ per annum, then

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

- If an amount P_1 is lent at the simple interest rate of $R_1\%$ per annum and another amount P_2 at the simple interest rate of $R_2\%$ 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

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

- If the interest is compounded quarterly, then

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

- When the rates of interest are different for different years, say R_1, R_2, R_3 percent for the first, second and third year, respectively, then

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

- When the time is given in the form of a fraction, say $2\frac{3}{4}$ years, then,

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

- (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

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

$$\text{and, } CI - SI = \frac{R \times SI}{2 \times 100} \text{ [in terms of SI and R]}$$

- (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]

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

- 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

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

- 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

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

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

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

Time and Work

- Total Work Done = Time Taken \times Rate of Work
 ➤ Rate of Work = $1 / \text{Time Taken}$
 ➤ Time Taken = $1 / \text{Rate of Work}$
 ➤ If a piece of work is done in x number of days, then the work done in one day = $\frac{1}{x}$
 ➤ Total work done = Number of Days \times Efficiency

IMPORTANT POINTS

- Efficiency and Time are inversely proportional to each other.
- $x : y$ is the ratio of the number of men which are 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 W_1 work in D_1 days, working T_1 hours each day and the number of people can do W_2 work in D_2 days, working T_2 hours each day, then the relation between them will be

$$\frac{M_1 \times D_1 \times T_1}{W_1} = \frac{M_2 \times D_2 \times T_2}{W_2}$$

Pipe and Cistern

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

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

- 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:

$$\left[\frac{x \times y}{(x + y)} \right]$$

- If a pipe fills a tank in x hrs and another fills the same 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:

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

Speed, Time and Distance

- Speed = Distance/Time
 ➤ Time = Distance/Speed
 ➤ Distance = (Speed \times Time)
 ➤ Average Speed = Total Distance / Total Time
 ➤ $1 \text{ km/hr} = \frac{5}{18} \text{ m/sec}$
 ➤ $1 \text{ m/sec} = \frac{18}{5} \text{ km/hr}$
 ➤ 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 $\left(\frac{2xy}{x + y} \right) \text{ km/hr}$.
 ➤ If two people A and B set out from two points P and Q at the same time and cross paths after spending T_1 and T_2 hours getting to P and Q , respectively, then $(A's \text{ speed}) / (B's \text{ speed})$ equals $\sqrt{\frac{T_2}{T_1}}$

TRAINS

- If the speed of the two trains is S_1 and S_2 , respectively and lengths are L_1 and L_2
 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 = $[(L_1 + L_2) / (S_1 - S_2)]$

- 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 $S_1 + S_2 = \frac{(l_1 + l_2)}{t}$.
- When a train of length l_1 passes another train of length l_2 at a speed, the formula is expressed as $S_1 - S_2 = \frac{(l_1 + l_2)}{t}$.
- 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 \times 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.

$$\text{Distance} = \text{Speed} \times \text{Time}$$

$$D = ST$$

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 $\left(\frac{1}{a^3} : \frac{1}{b^3}\right)$.

Average

- Average = Sum of quantities / Number of quantities
- Sum of quantities = Average \times Number of quantities
- The average of the first n natural numbers is $\frac{(n+1)}{2}$.
- 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 $\frac{n(n+1)^2}{4}$.
- The average of the first n odd numbers is given by $(\text{last odd number} + 1) / 2$
- The average of the first n even numbers is given by $(\text{last even number} + 2) / 2$
- The average of squares of first n consecutive even numbers is $\frac{2(n+1)(2n+1)}{3}$.
- 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:

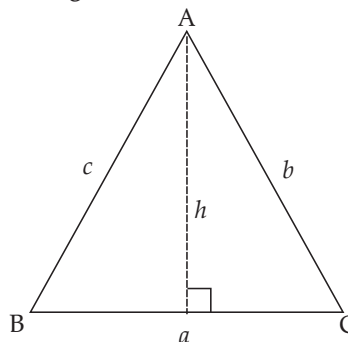
Shape	Area (Square units)	Perimeter (units)
Square	a^2	$4a$
Rectangle	$l \times b$	$2(l + b)$
Circle	πr^2	$2\pi r$
Scalene Triangle	$\sqrt{s(s-a)(s-b)(s-c)}$ where, $s = \frac{(a+b+c)}{2}$	$a + b + c$
Isosceles Triangle	$\frac{1}{2} \times b \times h$	$2a + b$
Equilateral Triangle	$\left(\frac{\sqrt{3}}{4}\right) \times a^2$	$3a$
Right Angle Triangle	$\frac{1}{2} \times b \times h$	$b + \text{hypotenuse} + h$
Rhombus	$\frac{1}{2} \times d_1 \times d_2$	$4 \times \text{side}$
Parallelogram	$b \times h$	$2(l+b)$
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^3	$4a^2$	$6a^2$
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	$\pi r^2 h$	$2\pi r h$	$2\pi r h + 2\pi r^2$
Cone	$\left(\frac{1}{3}\right) \pi r^2 h$	$\pi r l$	$\pi r (r + l)$

Mensuration Formulas in Detail

➤ Scalene Triangle:



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

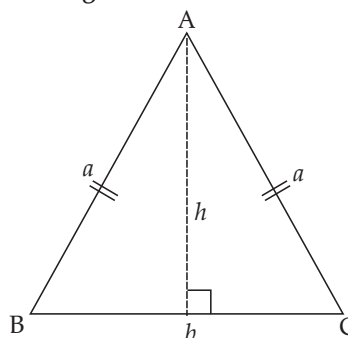
$$\text{Area} = \sqrt{s(s-a)(s-b)(s-c)}$$

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

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

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

➤ Isosceles Triangle:

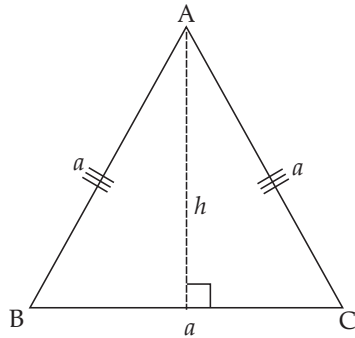


$$\text{Height (h)} = \frac{1}{2}\sqrt{4a^2 - b^2}$$

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

$$\text{Area} = \frac{1}{2}b\sqrt{4a^2 - b^2}$$

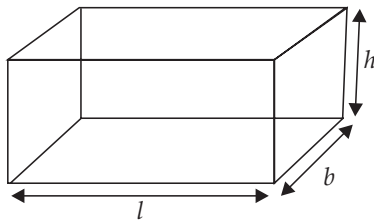
➤ **Equilateral Triangle:**



$$\text{Area} = \frac{\sqrt{3}}{4}a^2$$

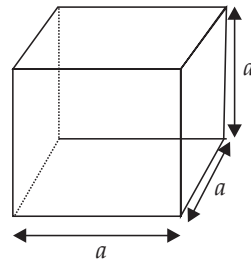
$$h = \frac{\sqrt{3}}{2}a$$

1. Cuboid



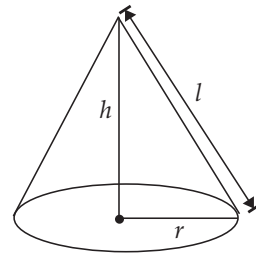
- Volume of cuboid = $l \times b \times h$
- Lateral surface Area = Perimeter of Base \times Height
Base = $2(l + b) \times h$
- Total surface area = Lateral surface Area + $2 \times$ Area of base = $2(lh + bh + lb)$
- Diagonal = $\sqrt{l^2 + b^2 + h^2}$
- $V = \sqrt{A_1 \times A_2 \times A_3}$
 $A_1 \Rightarrow$ 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 = $(\text{sum of all three side})^2 - (\text{Diagonal})^2$
- 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 in a room, we will calculate diagonal, i.e., $\sqrt{l^2 + b^2 + h^2}$.

2. Cube



- Volume = $(\text{side})^3 = a^3$
- Lateral surface area = $4a^2$
- Total surface area = $6a^2$
- Diagonal of the cube = $\sqrt{3}a$
- Face diagonal of the cube = $\sqrt{2}a$
- Volume of cube = $\left(\sqrt{\frac{\text{total surface area}}{6}} \right)^3$
- In Radius of cube = $\frac{a}{2}$
- Circumradius of cube = $\frac{\sqrt{3}}{2}a$

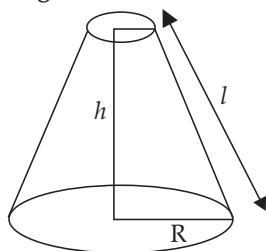
3. Right circular cone



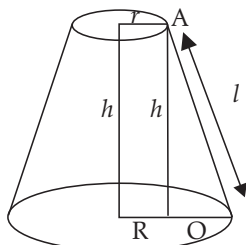
- Slant height, $l = \sqrt{r^2 + h^2}$
- Volume = $\frac{1}{3} \times \text{area of base} \times \text{height} = \frac{1}{3}\pi r^2 h$
- Curved surface area = $\frac{1}{2} (\text{Perimeter of base}) \times \text{slant height}$
 $= \frac{1}{2} \times 2\pi r \times l = \pi r \sqrt{r^2 + h^2}$
- Total surface 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
 $= (h \times r) / (l + r)$

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



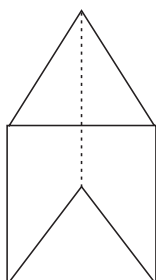
$$AC = l, AB = h, BC = R - r$$

Applying Pythagorean theorem in $\triangle ABC$

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

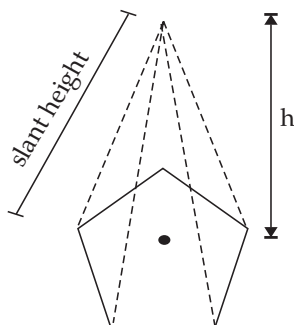
- Volume of frustum = $\frac{1}{3}\pi(R^2 + r^2 + Rr)h$
- Curved surface area = $\pi(R + r)l$
- Total surface area T.S.A = $\pi(R + r)l + \pi(R^2 + r^2)$

5. Prism



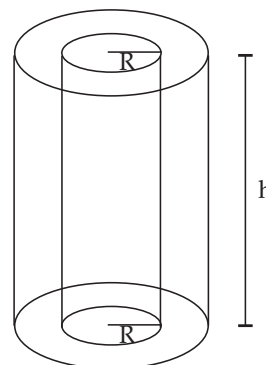
- A prism a solid object with:
 - Identical Ends
 - Flat faces
- Volume of Prism = Area of base \times height
- Lateral surface area of prism = perimeter of base \times height
- Total surface area of prism = Perimeter of base \times height + 2 \times area of base

6. Pyramids



- Volume = $\frac{1}{3}$ (area of base) \times 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 use the radius of the base not the radius of side of the base.

7. Hollow Cylinder



- Volume = $\pi(R^2 - r^2)h$
- Curved Surface Area = $2\pi(R + r)h$
- Total surface area = $2\pi(R + r)h + 2\pi(R^2 - r^2)$

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:

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

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 $\frac{m}{n}$."

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: $0 \leq P(E) \leq 1$.

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.

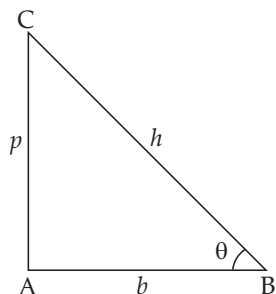
For any event E, $P(E) + P(E^c) = 1$, where E^c stands for 'not E'. E and E^c are called complementary events.

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°.



$$\sin\theta = \frac{AC}{BC} = \frac{p}{h} = \frac{\text{Perpendicular}}{\text{Hypotenuse}}$$

$$\cos\theta = \frac{AB}{BC} = \frac{b}{h} = \frac{\text{Base}}{\text{Hypotenuse}}$$

$$\tan\theta = \frac{AC}{AB} = \frac{p}{b} = \frac{\text{Perpendicular}}{\text{Base}}$$

Relations between Trigonometric Ratios

$$(i) \quad \operatorname{cosec}\theta = \frac{1}{\sin\theta} \text{ or } \operatorname{cosec}\theta \times \sin\theta = 1$$

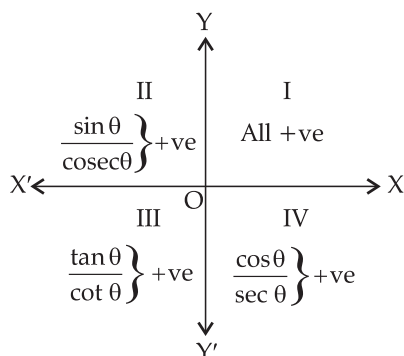
$$(ii) \quad \sec\theta = \frac{1}{\cos\theta} \text{ or } \sec\theta \times \cos\theta = 1$$

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

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

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

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°.

	0°	0°	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	$\sqrt{3}$	∞
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

- $\sin^2\theta + \cos^2\theta = 1$ or $\sin^2\theta = 1 - \cos^2\theta$ or $\cos^2\theta = 1 - \sin^2\theta$
- $1 + \tan^2\theta = \sec^2\theta$ or $\tan^2\theta = \sec^2\theta - 1$ or $\sec^2\theta - \tan^2\theta = 1$
- $1 + \cot^2\theta = \operatorname{cosec}^2\theta$ or $\operatorname{cosec}^2\theta - 1 = \cot^2\theta$ or $\operatorname{cosec}^2\theta - \cot^2\theta = 1$

Important concept to solve a specific type of question

If $A + B = 90^\circ$

Results that are true always:

- $\sin A \cdot \sec B = 1$ or $\sin A = \cos B$
- $\cos A \cdot \operatorname{cosec} B = 1$ or $\sec A = \operatorname{cosec} B$
- $\tan A \cdot \tan B = 1$ or $\tan A = \cot B$
- $\cot A \cdot \cot B = 1$
- $\sin^2 A + \sin^2 B = 1$
- $\cos^2 A + \cos^2 B = 1$

Important Trigonometry Formula for Sum and Difference of Two Angles

- $\sin(A+B) = \sin A \cdot \cos B + \cos A \cdot \sin B$
- $\sin(A-B) = \sin A \cdot \cos B - \cos A \cdot \sin B$
- $\cos(A+B) = \cos A \cdot \cos B - \sin A \cdot \sin B$
- $\cos(A-B) = \cos A \cdot \cos B + \sin A \cdot \sin B$
- $2\sin A \cdot \cos B = \sin(A+B) + \sin(A-B)$
- $2\cos A \cdot \sin B = \sin(A+B) - \sin(A-B)$
- $2\sin A \cdot \sin B = \cos(A-B) - \cos(A+B)$
- $2\cos A \cdot \cos B = \cos(A+B) + \cos(A-B)$
- $\sin^2 A - \sin^2 B = \sin(A+B) \cdot \sin(A-B)$
- $\cos^2 A - \cos^2 B = \cos(A+B) \cdot \cos(A-B)$

Trigonometry Formulas For Tangent

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

$$(iii) \cot(A+B) = \frac{\cot A \cdot \cot B - 1}{\cot A + \cot B}$$

$$(iv) \cot(A-B) = \frac{\cot A \cdot \cot B + 1}{\cot A - \cot B}$$

$$(v) \tan(45+\theta) = \frac{1+\tan\theta}{1-\tan\theta} = \frac{\cos\theta + \sin\theta}{\cos\theta - \sin\theta}$$

$$(vi) \tan(45-\theta) = \frac{1-\tan\theta}{1+\tan\theta} = \frac{\cos\theta - \sin\theta}{\cos\theta + \sin\theta}$$

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 $\sin\theta + \operatorname{cosec}\theta = 2$
 $\sin^m\theta + \operatorname{cosec}^m\theta = 2$

(b) $\cos\theta + \sec\theta = 2$
Then, $\cos^m\theta + \sec^m\theta = 2$

(c) $\tan\theta + \cot\theta = 2$
Then, $\tan^m\theta + \cot^m\theta = 2$

$$(d) \sin 15^\circ = \frac{\sqrt{3}-1}{2\sqrt{2}}$$

$$\cos 15^\circ = \frac{\sqrt{3}+1}{2\sqrt{2}}$$

$$\tan 15^\circ = 2 - \sqrt{3}$$

$$\tan 75^\circ = 2 + \sqrt{3}$$

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

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

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

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

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

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

Trigonometry Maximum & Minimum Value

Maximum & Minimum Value

	Minimum	Maximum
➤ $\sin\theta, \cos\theta$ [odd power]	-1	+1
➤ $\sin\theta, \cos\theta$ [even power]	0	+1
➤ $\tan\theta, \cot\theta$ [odd power]	$-\infty$	$+\infty$
➤ $\tan\theta, \cot\theta$ [even power]	0	$+\infty$
➤ $\sec\theta, \operatorname{cosec}\theta$ [odd power]	$-\infty$	$+\infty$
➤ $\sec\theta, \operatorname{cosec}\theta$ [even power]	+1	$+\infty$

$$a \sin^2\theta + \cos^2\theta$$

$$\text{if } a > b \quad \text{if } b > a$$

$$\max \rightarrow a \quad \max \rightarrow b$$

$$\min \rightarrow b \quad \min \rightarrow b$$

$$\theta \cdot \theta$$

$$\text{Max} \Rightarrow \frac{1}{2^n} \begin{cases} \text{Min} \rightarrow n \rightarrow \text{odd} \rightarrow -\frac{1}{2^n} \\ \text{Min} \rightarrow n \rightarrow \text{even} \rightarrow 0 \end{cases}$$

$$\theta + \theta$$

$$\text{Maximum} \rightarrow 1$$

$$\text{Min} \Rightarrow P\theta = 45^\circ$$

$$a \sin\theta + b \cos\theta$$

$$\text{Max} \Rightarrow +\sqrt{a^2 + b^2}$$

$$\text{Min} \Rightarrow -\sqrt{a^2 + b^2}$$

$$a \sin^2\theta + b \operatorname{cosec}^2\theta$$

$$\text{if } a < b$$

$$\min = a + b$$

$$\text{if } b > a$$

$$\min = 2\sqrt{ab}$$

$$a \operatorname{cosec}^2\theta + b \sec^2\theta$$

$$\text{Min} = (\sqrt{a} + \sqrt{b})^2$$

$$a \tan^2\theta + b \cot^2\theta$$

$$\text{Min} = 2\sqrt{ab}$$

$$a \cos^2\theta + b \sec^2\theta$$

$$\text{if } a < b$$

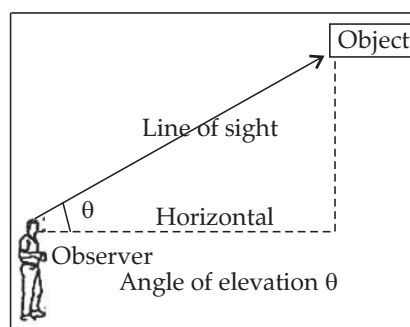
$$\min = a + b$$

$$\text{if } b > a$$

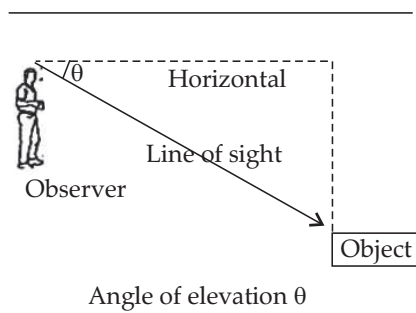
$$\min = \sqrt{ab}$$

Height and Distance

- **Line of Sight:** The imaginary horizontal straight 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 line 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 upward-placed object. (Refer the above figure.)
- **The angle of depression:** The angle of depression is the inclination of the line 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.



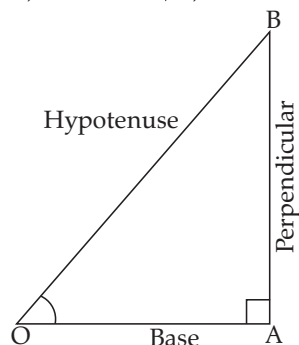
FORMULA

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 $\tan = \text{Height/Distance} = \text{Perpendicular/Base}$

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.

NOTE: $\tan 0^\circ = 0$, $\tan 30^\circ = 1/\sqrt{3}$, $\tan 45^\circ = 1$



Trigonometric Ratios

The trigonometric ratios and formulas are mentioned below:

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

Trigonometric Identities

1. $\sin^2 \theta + \cos^2 \theta = 1$
2. $1 + \tan^2 \theta = \sec^2 \theta$
3. $1 + \cot^2 \theta = \text{cosec}^2 \theta$

Algebra

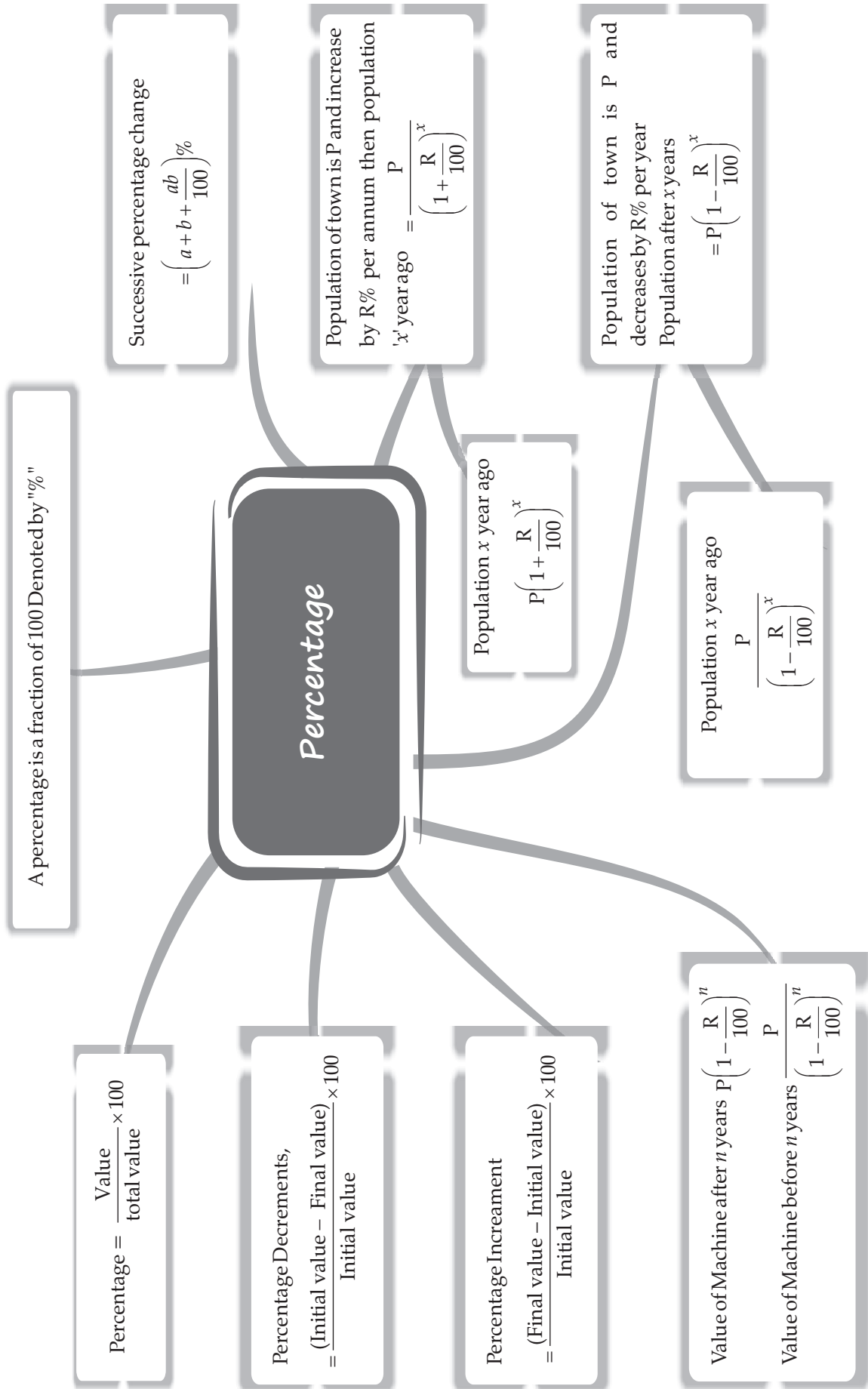
- $a^2 - b^2 = (a - b)(a + b)$
- $(a + b)^2 = a^2 + 2ab + b^2$
- $a^2 + b^2 = (a + b)^2 - 2ab$
- $(a - b)^2 = a^2 - 2ab + b^2$
- $(a + b + c)^2 = a^2 + b^2 + c^2 + 2ab + 2bc + 2ca$
- $(a - b - c)^2 = a^2 + b^2 + c^2 - 2ab + 2bc - 2ca$
- $(a + b)^3 = a^3 + 3a^2b + 3ab^2 + b^3$
- $(a + b)^3 = a^3 + b^3 + 3ab(a + b)$
- $(a - b)^3 = a^3 - 3a^2b + 3ab^2 - b^3$
- $(a - b)^3 = a^3 - b^3 - 3ab(a - b)$
- $a^3 - b^3 = (a - b)(a^2 + ab + b^2)$
- $a^3 + b^3 = (a + b)(a^2 - ab + b^2)$
- $(a + b)^4 = a^4 + 4a^3b + 6a^2b^2 + 4ab^3 + b^4$
- $(a - b)^4 = a^4 - 4a^3b + 6a^2b^2 - 4ab^3 + b^4$
- $a^4 - b^4 = (a - b)(a + b)(a^2 + b^2)$
- $a^5 - b^5 = (a - b)(a^4 + a^3b + a^2b^2 + ab^3 + b^4)$

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	$\frac{x}{a^y} = \sqrt[y]{a^x}$

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

1. $\sqrt{ab} = \sqrt{a}\sqrt{b}$
2. $\sqrt{\frac{a}{b}} = \frac{\sqrt{a}}{\sqrt{b}}$
3. $(\sqrt{a} + \sqrt{b})(\sqrt{a} - \sqrt{b}) = a - b$
4. $(\sqrt{a} + \sqrt{b})^2 = a + 2\sqrt{ab} + b$
5. $(a + \sqrt{b})(a - \sqrt{b}) = a^2 - b$



Chapter

1

Section-1 : Arithmetic

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, etc.
- ❖ Method of solving questions related to percentage.

SOME IMPORTANT CONCEPTS RELATED TO PERCENTAGE

- **Percentage:** A percentage is a fraction of 100. It is denoted by the symbol %.
- **Per cent increase or decrease:** When a value increases or decreases by a certain percentage, the new value is calculated by multiplying the original value by $(100\% + \text{percentage increase/decrease})/100\%$.
- **Percentage change:** Percentage change is the difference between the new value and the old value, expressed as a percentage of the old value.
- **Fraction to percentage conversion:** To convert a fraction to a percentage, multiply the fraction by 100.
- **Percentage to fraction conversion:** To convert a percentage to a fraction, divide the percentage by 100 and simplify the fraction.
- **Percentage to decimal conversion:** To convert a percentage to a decimal, divide the percentage by 100.
- **Decimal to percentage conversion:** To convert a decimal to a percentage, multiply the decimal by 100.
- **Percentage of a number:** To calculate the percentage of a number, multiply the number by the percentage and divide by 100.
- **Percentage point:** Percentage point is the difference between two percentages.
- **Successive percentage change:** When a value changes by successive percentage changes, the net percentage change is calculated by multiplying the individual percentage changes.

FORMULAE:

- Percentage increase = $[(\text{new value} - \text{old value})/\text{old value}] \times 100\%$
- Percentage decrease = $[(\text{old value} - \text{new value})/\text{old value}] \times 100\%$

- Percentage change = $[(\text{new value} - \text{old value})/\text{old value}] \times 100\%$

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

- Fraction to percentage = $(\text{fraction} \times 100)$

- Percentage to decimal = $\left(\frac{\text{percentage}}{100}\right)$

- Decimal to percentage = $(\text{decimal} \times 100)$

- Percentage of a number = $(\text{percentage}/100) \times \text{number}$

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

where a and b are the successive percentage changes.

- If the price of an item decreases, a person can buy a few kg more in A rupees, the actual price of that item.

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

- If the population of a city is P and it increases at the rate of $R\%$ per annum, then population after ' n ' years:

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

- If the population of a city is P and it decreases at the rate of $R\%$ per annum, then population after ' n ' years:

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

- 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 :

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

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

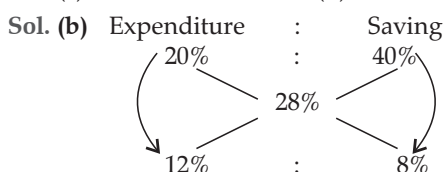
$$\text{Population } n \text{ years ago} = \frac{P}{\left(1 - \frac{R}{100}\right)^n}$$

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

- ④ **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
(c) 60 (d) 70



$$\therefore \text{Savings} = \frac{2}{5} \times 100 = 40\%$$

$$x = 40\%$$

- ④ **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

⇒ Population after 3 years

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

$$\text{Percentage increase} = \frac{113.85 - 100}{100} \times 100$$

$$= 13.85\%$$

- ④ **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%
(c) 75% (d) 90%

Sol. (c) $P : Q : R$

$$6 : 5$$

$$9 : 10$$

$$18 : 15 : 20$$

$$\Rightarrow \text{Required percentage} = \frac{15}{20} \times 100 = 75\%$$

- ④ **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) $100 \longrightarrow 113$

$$\downarrow \quad \downarrow$$

$$10000 \longrightarrow 12769$$

$$\text{Percentage increase} = \frac{12769 - 10000}{10000} \times 100$$

$$= 27.69\%$$

- ④ **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) $14\frac{11}{17}\%$

Sol. (b) Rita : Richa = 17 : 20

$$\text{So, required\%} = \frac{3}{17} \times 100 = 17\frac{11}{17}\%$$

- ④ **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

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

- ④ **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 .

1

Level

Beginner

1. 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
3. 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) $12\frac{1}{3}\%$
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]
(A) 20 (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%
8. 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
13. What percentage of ₹ 124 is ₹ 49.60? [SSC CPO 2018]
(A) 250 (B) 16 (C) 123 (D) 40
14. A saves 12% of her income. If she spends ₹ 2,16,128, then her total income is: [SSC CPO 2018]
(A) ₹ 2,42,063 (B) ₹ 2,45,600
(C) ₹ 2,48,000 (D) ₹ 2,43,560
15. If A's salary is 60% more than B's salary, then by what percentage is B's salary is less than that of A? [SSC CGL 2019]
(A) 47.7% (B) 33.3% (C) 37.5% (D) 45%
16. Radha saves 25% of her income. If her expenditure increases by 20% and her income increases by 29%, then her savings increase by: [SSC CGL 2021]
(A) 56% (B) 52% (C) 65% (D) 70%
17. The value of a motorcycle depreciates every year by 4%. What will be its value after 2 years, if its present value is ₹ 75,000? [SSC 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, 15% on travel, 10% on clothes and the remaining amount of ₹ 27,000 is saved. What is Ajay's income? [SBI 2014]
(A) ₹ 60,000 (B) ₹ 80,500
(C) ₹ 60,700 (D) ₹ 70,500
19. The salary of an employee increases every year in the month of July by 10%. If his salary in May 2000 was ₹ 15,000, then his salary in October 2001 was: [SSC Sub Inspector 2012]
(A) ₹ 16,500 (B) ₹ 18,000
(C) ₹ 18,150 (D) ₹ 19,965
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]
(A) 200 (B) 230 (C) 250 (D) 320
21. If 50% of $(P - Q) = 30\%$ of $(P + Q)$ and $Q = x\%$ of P , then the value of x is: [SSC Sub Inspector 2013]
(A) 30 (B) 25 (C) 20 (D) 50
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. A number when reduced by 10% gives 30. The number is: [SSC MT 2013]
(A) 35 (B) $33\frac{1}{2}$ (C) $33\frac{1}{3}$ (D) 40

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]
(A) 65 (B) 54 (C) 60 (D) 58
25. Mohan's income is 40% more than Shyam's income. Shyam's income is what per cent less than Mohan's income?
[SSC CHSL 2021]
(A) $28\frac{2}{7}\%$ (B) $28\frac{5}{7}\%$
(C) $28\frac{3}{7}\%$ (D) $28\frac{4}{7}\%$

2 Intermediate

Level

1. 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) $5\frac{5}{7}\%$ (C) 5% (D) 6%
2. 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 mistakenly multiplied by $\frac{7}{5}$ instead of 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%
8. The price of sugar is increased by 17%. A person wants to increase his expenditure by 5% only. By approximately what % should he decrease his consumption?
[SSC CGL 2018]
(A) 10.3% (B) 10.7% (C) 10.9% (D) 9.9%
9. The radius of a sphere is reduced by 40%. By what per cent will its volume decrease?
[SSC CGL 2019]
(A) 60% (B) 64%
(C) 72.5% (D) 78.4%
10. A is 20% less than B and C is 30% more than D. If D is 25% less than A, then, which of the following is true?
[SSC CGL 2019]
(A) $B = 0.39 C$ (B) $C = 0.78 B$
(C) $B = 0.78 C$ (D) $C = 0.39 B$
11. Ravi scores 72% marks in an examination. If these are 360 marks, then the maximum marks are:
[SSC CGL 2019]
(A) 450 (B) 400 (C) 500 (D) 350
12. If A is 40% less than B and C is 40% of the sum of A and B, then by what percentage is B greater than C?
[SSC CGL 2019]
(A) 60% (B) $56\frac{1}{4}\%$ (C) $40\frac{1}{8}\%$ (D) 36%
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 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 20% of $a = b$, then $b\%$ of 20 is equal to:
[SSC CPO 2018]
(A) 4% of a (B) 2% of a
(C) 16% of % (D) 8% of a
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 $66\frac{2}{3}\%$ 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

3 Expert Level

1. 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) $33\frac{1}{3}$
2. A student multiplies a number with $\frac{3}{4}$ instead of $\frac{4}{3}$. What is the error percentage?
[SSC CGL 2019]
(A) 59.67% (B) 43.75%
(C) 67.45% (D) 39.34%
3. A is 150% of B and B is 40% of C. If $A + B + C = 20$, then the value of $2B + 3C - 4A$ is:
[SSC CHSL 2021]
(A) 16 (B) 14 (C) 20 (D) 15
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 ?
[SSC CGL 2021]
(A) 30% (B) 34% (C) 26% (D) 20%
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?
[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?
[SSC CGL 2021]
(A) $\frac{1}{2}$ (B) $\frac{4}{3}$ (C) $\frac{3}{4}$ (D) $\frac{1}{4}$
7. 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?
[SSC CGL 2019]
(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]
(A) 1 (B) 6 (C) 7 (D) 3
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. If 40% of a number is less than its 60% by 30, then the 20% of that number is:
[SSC CGL 2019]
(A) 60 (B) 40 (C) 50 (D) 30
13. If $x\%$ of y is 150 and $y\%$ of z is 300, then the relation between x and z is:
[SSC CGL 2018]
(A) $z = x$ (B) $z = \frac{x}{3}$
(C) $z = \frac{x}{2}$ (D) $z = 2x$
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
(C) ₹ 10,600 (D) ₹ 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 2nd 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. Raghav spends 80% of his income. If his income increases by 12% and the savings decrease by 10%, then what will be the percentage increase in his expenditure?
[SSC CGL 2018]
(A) 20.5% (B) 16% (C) 17.5% (D) 22%

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.	(C)	20.	(C)
21.	(B)	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.	(B)
11.	(C)	12.	(B)	13.	(D)	14.	(A)	15.	(B)	16.	(A)	17.	(A)	18.	(C)	19.	(B)		

Level-3: Expert

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

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:

$$\begin{aligned}
 R &= S + 0.2S = 1.2S \\
 \text{Required\%} &= \left(\frac{R-S}{R} \right) \times 100 \\
 &= \left(1 - \frac{S}{R} \right) \times 100 \\
 &= \left(1 - \frac{1}{1.2} \right) \times 100 \\
 &= \frac{100}{6} = 16\frac{2}{3}\%
 \end{aligned}$$

4. Option (A) is correct.

Explanation:

$$\begin{aligned}
 \frac{125}{100} \times x &= 100 \\
 \Rightarrow x &= \frac{100 \times 100}{125} \Rightarrow 80
 \end{aligned}$$

5. Option (B) is correct.

Explanation:

$$\begin{aligned}
 \text{Let the number} &= x \\
 \frac{40}{100} \times \frac{4}{5} \times \frac{3}{4} \times x &= 48 \\
 \frac{6}{25}x &= 48 \\
 x &= \frac{48 \times 25}{6} = 200 \\
 \Rightarrow 1\% \text{ of } 200 &= 2
 \end{aligned}$$

6. 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.

$$\begin{aligned}\Rightarrow n(A \cup B) &= n(A) + n(B) - n(A \cap B) \\ &= 75\% \text{ of } x + 60\% \text{ of } x - (x - 25\% \text{ of } x) \\ &= \frac{3}{4}x + \frac{3}{5}x - \frac{3}{4}x = \frac{3}{5}x\end{aligned}$$

$$\begin{aligned}\text{So, } \frac{3}{5}x &= 240 \\ x &= 400\end{aligned}$$

7. Option (D) is correct.

Explanation:

$$\text{Total C.P.} = 200 \times 10 = ₹ 2,000$$

$$\text{Total S.P.} = 12 \times 195 = ₹ 2,340$$

$$\% \text{ profit} = \frac{2,340 - 2,000}{2,000} \times 100 = 17\%$$

8. Option (C) is correct.

Explanation: Increase in salary = ₹ 900. i.e.,

$$8,100 \rightarrow 9,000$$

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

9. Option (C) is correct.

Explanation: Let total number of students who appeared in an examination be x .

According to the question,

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

$$\Rightarrow x = 6,000$$

10. Option (A) is correct.

$$\text{Explanation: } \frac{18}{100} \times \frac{15}{100} \times \frac{25}{9} \times 3,800 = 285$$

11. Option (D) is correct.

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

12. Option (B) is correct.

Explanation:

$$5 \text{ litres} = 5,000 \text{ ml}$$

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

13. Option (D) is correct.

Explanation:

According to the question,

$$124 \times x\% = 49.60$$

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

14. Option (B) is correct.

Explanation:

$$12\% = \frac{3}{25} \rightarrow \text{Saving}$$

$$25 \rightarrow \text{Income}$$

$$\text{Expenditure} = 22 \text{ units} = 2,16,128$$

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

$$25 \text{ units} = 2,45,600$$

$$\text{So, total income} = ₹ 2,45,600$$

15. Option (C) is correct.

Explanation:

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

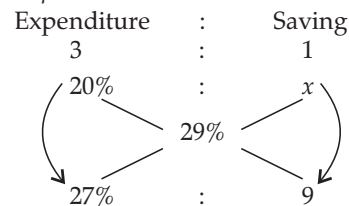
So, according to the question,

$$A : B = 160 : 100$$

$$\text{Required}\% = \frac{60}{160} \times 100 = 37.5\%$$

16. Option (A) is correct.

Explanation:



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

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:

$$\text{Saving percentage} = (100 - 55)\% = 45\%$$

If the income of Ajay be ₹ x , then,

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

$$\Rightarrow x = ₹ 60,000$$

19. Option (C) is correct.

Explanation: Salary in May, 2000 = ₹ 15,000

Salary in July, 2000 \Rightarrow 15,000 + 10% of 15,000

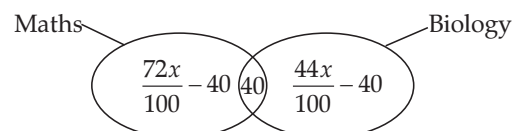
$$= ₹ 16,500$$

Salary in October 2001 = 16,500 + 10% of 16,500

$$= ₹ 18,150$$

20. Option (C) is correct.

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



$$\frac{72x}{100} - 40 + 40 + \frac{44x}{100} - 40 = x$$

$$\Rightarrow \frac{72x}{100} + \frac{44x}{100} - x = 40$$

$$\Rightarrow x = \frac{40 \times 100}{16} \Rightarrow x = 250$$

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

$$\begin{aligned}\frac{P-Q}{2} &= (P+Q) \times \frac{30}{100} \\ \Rightarrow 5(P-Q) &= (P+Q) \times 3 \\ \Rightarrow 5P-3P &= 5Q+3Q \\ \Rightarrow 2P &= 8Q \\ \Rightarrow P &= 4Q \\ \text{Also, } Q &= \frac{x}{100} \times P \\ \Rightarrow Q &= \frac{x}{100} \times 4Q \Rightarrow \frac{4x}{100} = 1 \\ \Rightarrow x &= 25\end{aligned}$$

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,

$$\begin{aligned}(57 - 43)\% \text{ of } x &= 42,000 \\ \Rightarrow 14\% \text{ of } x &= 42,000 \\ \Rightarrow x &= 3,00,000\end{aligned}$$

23. Option (C) is correct.*Explanation:* Let the number be x

$$\begin{aligned}\Rightarrow x - 10\% \text{ of } x &= 30 \\ \Rightarrow x - \frac{10}{100}x &= 30 \\ \Rightarrow \left(\frac{100-10}{100}\right)x &= 30 \\ \Rightarrow x &= \frac{30 \times 100}{90} = 33\frac{1}{3}\end{aligned}$$

Hence, the number is $33\frac{1}{3}$ **24. Option (B) is correct.***Explanation:* According to the question,Number of girls = $(100 - 60)\% = 40\%$

$$\Rightarrow 40\% = 36$$

$$\text{So, } 60\% = 54$$

Number of boys = 54

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

$$\text{Mohan : Shyam} = 7 : 5$$

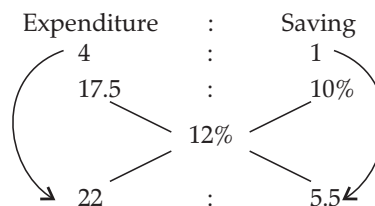
$$\text{Shyam's income is less by} = \frac{2}{7} \times 100\% = 28\frac{4}{7}\%$$

Level-2: INTERMEDIATE**1. Option (D) is correct.***Explanation:* Quantity of salt = 5% of 6 litres = 300 ml

Quantity of water = 6,000 ml - 300 ml = 5,700 ml

$$\begin{aligned}\text{Quantity of water left after evaporation} \\ &= (5,700 - 1000) \text{ ml} = 4,700 \text{ ml}\end{aligned}$$

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

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

10% decrease in savings.

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

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

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

$$\begin{aligned}P &= 100 - 124 \\ C &= 124 - 100 = 118\end{aligned}$$

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

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 $\frac{5}{4}$, as expenditure is constant.

According to question,

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

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

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

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

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 $(40,000 - x)$

$$\text{Savings of A} = (100 - 85)\% \text{ of } x = 0.15x$$

$$\begin{aligned}\text{Savings of B} &= (100 - 95)\% \text{ of } (40,000 - x) \\ &= 0.05(40,000 - x)\end{aligned}$$

$$0.15x = 0.05(40,000 - x)$$

$$\Rightarrow 0.15x + 0.05x = 40,000 \times 0.05$$

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

$$\Rightarrow x = ₹ 10,000$$

7. Option (A) is correct.*Explanation:*Let passing marks = p

$$p \times 1.05 = 273$$

$$p = 260$$

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

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

$$\begin{array}{ccc}
 100 & \xrightarrow{\quad} & 117 \\
 & \searrow & \swarrow \\
 & & 105
 \end{array}
 \begin{array}{l}
 \\
 -12 \\
 \end{array}$$

$$\% \text{ decrease} = \frac{12}{117} \times 100 = 10.3\%$$

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

$$\frac{R_1}{R_2} = \frac{60}{100} = \frac{3}{5}$$

$$\text{Volume} = V_1 : V_2 = 27 : 125$$

$$\text{Volume decrease} = \frac{98}{125} \times 100 = 78.4\%$$

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

$$\begin{array}{l}
 \text{Let} \quad B = 100 \\
 A : B : C : D = 80 : 100 : 78 : 60 \\
 C = 0.78 B
 \end{array}$$

11. Option (C) is correct.*Explanation:*

$$72\% \text{ of marks} = 360$$

$$100\% \text{ of marks} = \frac{360 \times 100}{72} = 500$$

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

$$\begin{array}{l}
 A : B : C \\
 60 : 100 : 64
 \end{array}$$

$$\text{Required}\% = \frac{36}{64} \times 100 = 56\frac{1}{4}\%$$

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

$$\text{Suppose} \quad B = 100, \text{ then } A = 128,$$

$$C = \frac{3}{4}(A + B) = \frac{3}{4} \times 228 = 171$$

$$\begin{array}{ccc}
 128 : 100 : 171 \\
 \quad \quad \quad \nearrow \\
 \quad \quad \quad +43
 \end{array}$$

$$\text{Required percentage} = \frac{43}{128} \times 100$$

$$= \frac{1,075}{32} = 33.59 \approx 33.6\%$$

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

$$\begin{array}{l}
 I = E : S \\
 +20.1\% \left(\begin{array}{l} 400 = 260 : 140 \\ 480.4 = 325 : 155.4 \end{array} \right) + 15.4
 \end{array}$$

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

15. Option (B) is correct.*Explanation:* According to the question,

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

$$\frac{x}{y} = \frac{3}{2}$$

$$\text{Required}\% = 3 - 2/2 \times 100 = 50\%$$

 $x \rightarrow 50\% \text{ more than } y$ **16. Option (A) is correct.***Explanation:* According to the question,

$$A : B = 124 : 100 = 31 : 25$$

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

17. Option (A) is correct.*Explanation:*Given, 20% of $a = b$ Then, $b\%$ of 20 = 20% of $b = 20\%$ of 20% of a

$$= \frac{1}{5} \times \frac{1}{5} \times a = \frac{1}{25} \times a = 4\% \text{ of } a$$

18. Option (C) is correct.*Explanation:* $A : B = 135 : 100$

$$\text{Required}\% = \frac{35}{135} \times 100 \approx 26\%$$

19. Option (B) is correct.*Explanation:* Let total property be x .

$$x \times \frac{2}{3} \times \frac{3}{10} = 12,500$$

$$\Rightarrow x = 6,25,000$$

$$x \times \frac{45}{100} = ₹ 2,81,250$$

Level-3: EXPERT**1. Option (A) is correct.***Explanation:*

$$\frac{(x+20)}{100} \times 250 = \frac{125}{100} \times \frac{x}{100} \times 220$$

$$x = 200$$

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

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

$$\begin{aligned}
 \Rightarrow \text{Required}\% &= \frac{30-25}{30} \times 100 \\
 &= \frac{5}{30} \times 100 = 16\frac{2}{3}\%
 \end{aligned}$$

2. Option (B) is correct.*Explanation:* Let number be 12.

According to the question,

$$12 \times \frac{3}{4} = 9 \quad (9+7=16)$$

$$12 \times \frac{4}{3} = 16$$

$$\% \text{ error} = \frac{7}{16} \times 100 = 43.75\%$$

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

$$\begin{aligned}
 A : B &= 150 : 100 = 3 : 2 \\
 B : C &= 40 : 100 = 2 : 5 \\
 A : B : C &= 3 : 2 : 5 \\
 &= 3a : 2a : 5a \\
 A + B + C &= 20 \\
 \Rightarrow 10a &= 20 \\
 \Rightarrow a &= 2 \\
 \Rightarrow 2B + 3C - 4A &= 2(2a) + 3(5a) - 4(3a) \\
 &= 7a = 14
 \end{aligned}$$

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

Income	Expenditure	Saving
200	170	30
↓ 26% Increase		↓ 60%
252		48

$$\text{As, } 252 - 48 = 204$$

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

5. Option (B) is correct.*Explanation:* Let price, consumption and expenditure are P, C and E, respectively.

$$P \times C = E$$

$$\text{Let, } 25 \times 4 = 100$$

$$\begin{aligned} \text{Then, after changes new expenditure} \\ = 32 \times 3.5 = 112 \end{aligned}$$

$$\begin{aligned} \text{So, percentage decrease} &= \frac{0.5}{4} \times 100 \\ &= 12.5\% \text{ (decrease)} \end{aligned}$$

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

$$\begin{array}{lcl}
 \text{Correct} & \rightarrow \frac{4}{3} \times 12 & \rightarrow 16 \\
 \text{Wrong} & \rightarrow \frac{3}{4} \times 12 & \rightarrow 9
 \end{array}$$

-7 (By option)

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

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

$$A - B = 8$$

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

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

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

$$\begin{aligned}
 \Rightarrow \frac{180}{60} &= \frac{(100 + x)\%}{(100 - x)\%} \\
 \Rightarrow x &= 50
 \end{aligned}$$

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

$$70\% \text{ of } 210 = 147$$

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

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

$$25\% \text{ more} = \frac{5}{4}$$

$$C = 35\% \text{ of } (A + B)$$

$$A : B : C$$

$$\begin{array}{ccc}
 500 & 400 & 315 \\
 \hline
 & -185 &
 \end{array}$$

$$\text{Required\%} = \frac{185}{500} \times 100 = 37\%$$

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

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

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

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

$$\Rightarrow x = 7y$$

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

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

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

11. Option (C) is correct.*Explanation:*

$$A : B : C = 148 : 100 : \frac{248 \times 40}{100}$$

$$= 148 : 100 : 99.2$$

$$\text{Required\%} = \frac{48.8}{99.2} \times 100 = 49.2\%$$

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

$$(60\% \text{ of } x) - (40\% \text{ of } x) = 30$$

$$\Rightarrow 20\% \text{ of } x = 30$$

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

$$x\% \text{ of } y = 150 \quad \dots(1)$$

$$y\% \text{ of } z = 300 \quad \dots(2)$$

$$(1) \div (2)$$

$$\frac{x}{z} = \frac{1}{2} \Rightarrow z = 2x$$

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

$$5\% \text{ of } A = 20\% \text{ of } B$$

$$\frac{A}{B} = \frac{4}{1}$$

$$\Rightarrow 5 \text{ units} = 43,000$$

$$\therefore \text{B's salary} = 8,600$$

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

$$\begin{array}{rcl} \text{I} & = & \text{E} \quad \text{S} \\ 100 & = & 80 \quad 20 \\ 130 & = & 100 \quad 30 \end{array}$$

Savings increased by 50%

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

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

$$\begin{array}{l} \text{Let price} = 625 \\ \text{end of Ist year} = 750 \\ \text{IInd year} = 900 \\ \text{IIIrd year} = 1,080 \\ \text{IVth year} = 1,296 \\ \text{Difference} = 216 = 259.20 \\ 40\% \text{ of } 900 = 360 = 432 \end{array}$$

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

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

$$\begin{array}{rcl} \text{I} & = & 5 \quad : \quad 7 \\ \text{E} & \rightarrow & 2 \quad : \quad 3 \\ \hline \text{S} & \rightarrow & 4,000 \quad : \quad 5,000 \\ & & 12,000 \quad : \quad 10,000 \end{array}$$

$$\begin{array}{l} 15 - 14 \text{ unit} = 12,000 - 10,000 \\ 1 \text{ unit} = 2,000 \\ 12 \text{ units} \rightarrow 24,000 \end{array}$$

18. Option (B) is correct.*Explanation:* According to the question,

$$A : B : C : D = 195 : 156 : 260 : 200$$

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

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

$$110 \left(\frac{100-x}{100} \right) = 50 \left(\frac{100+x}{100} \right)$$

$$x = \frac{75}{2}\%$$

$$x\% \text{ of } 650 = 243.75$$

$$(x - 10)\% \text{ of } 780 = 214.50$$

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

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

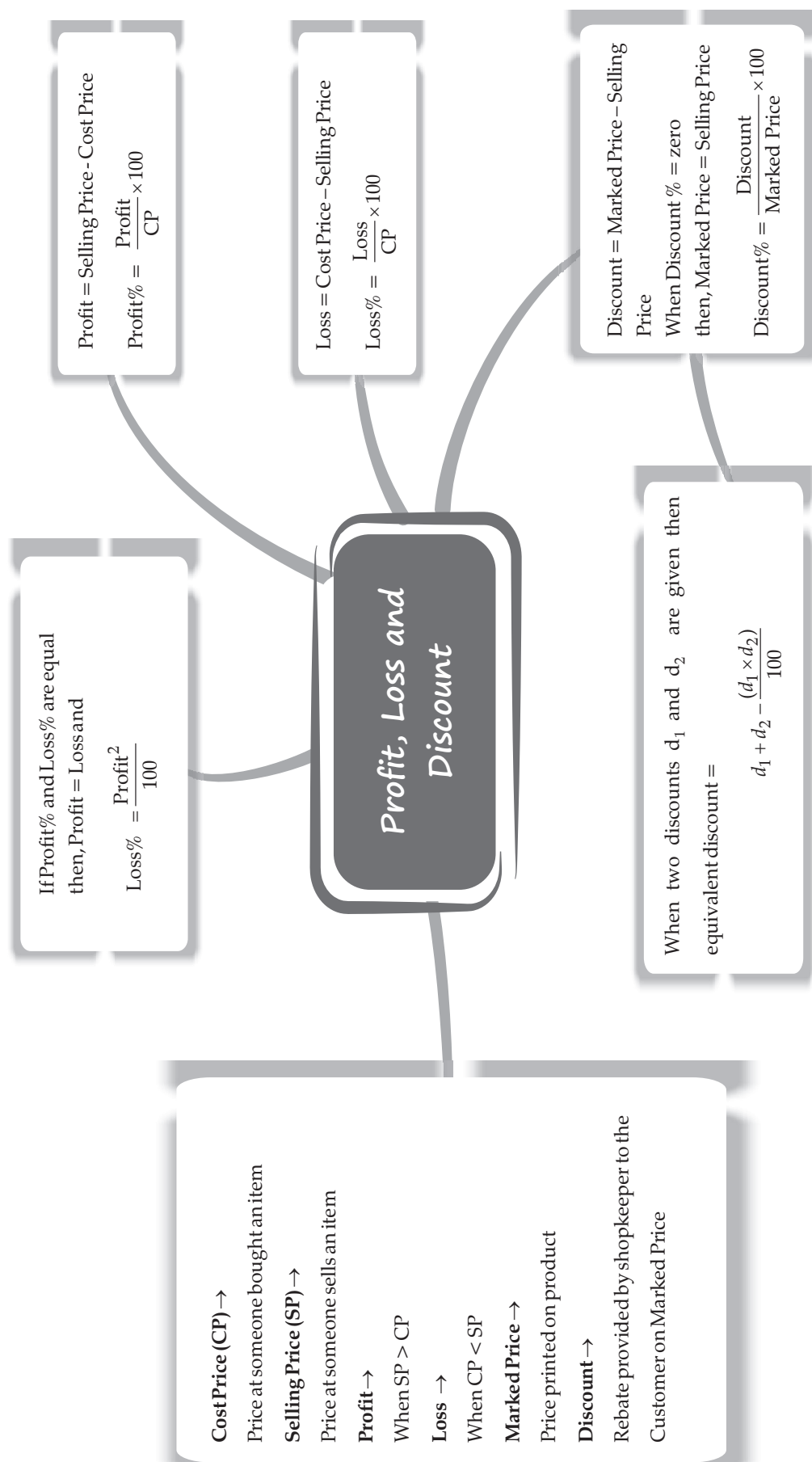
$$\begin{array}{rcl} \text{I} & : & \text{S} = \text{E} \\ 500 : 100 = 400 & & \\ 560 : 90 = 470 & & \end{array} \Bigg] + 70$$

$$\left(\text{Expenditure} = 80\% = \frac{4}{5} \right)$$

$$\text{I} : \text{S} = 5 : 1$$

$$\% \text{ I} = \frac{70}{400} \times 100 = 17.5\%$$





Chapter

2

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 dealt 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.

IMPORTANT FORMULA

⇒ Profit = Selling Price (SP) – Cost Price (CP)

⇒ Loss = Cost Price (CP) – Selling Price (SP)

⇒ Profit% = $\frac{\text{Profit}}{\text{Cost price}} \times 100$

⇒ Loss% = $\frac{\text{Loss}}{\text{Cost price}} \times 100$

⇒ Discount = Marked price – Selling price

⇒ Discount% = $\frac{\text{Discount}}{\text{Marked price}} \times 100$

When two discounts d_1 and d_2 are given, then

equivalent discount = $d_1 + d_2 - \frac{(d_1 \times d_2)}{100}$

- 🔗 **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 = $\frac{\text{CP}(100 + \text{Profit}\%)}{100}$

$$= \frac{500(100 + 10)}{100}$$

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

- 🔗 **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, $\frac{\text{CP}}{\text{SP}} = \frac{5}{4}$
 Assuming, CP = 5x
 and SP = 4x
 Here, CP > SP, so in this case, loss is occurred.
 Using, loss% = $\frac{(\text{CP} - \text{SP})}{\text{CP}} \times 100$

$$= \frac{(5x - 4x)}{5x} \times 100$$

$$= 20\%$$

- 🔗 **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

Sol. (c) Using, $SP = CP + \text{profit\% of CP}$
 $SP = 700 + 10\% \text{ of } 700$
 $= 700 + 70 = ₹ 770$

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

Sol. (a) $SP = ₹ 550$

Profit% = 10%

Let, $CP = x$

$$\Rightarrow x + 10\% \text{ of } x = 550$$

$$\Rightarrow x + \frac{x}{10} = 550$$

$$\Rightarrow 11x = 5,500$$

$$\Rightarrow x = ₹ 500$$

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

So, new selling price = 120% of cost price = $\frac{120}{100} \times 500$
 $= ₹ 600$

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 = ₹ x

According to the question,

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

$$x = 1000$$

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
 (c) ₹ 1000 (d) ₹ 300

Sol. (a) We know that, $CP = 100\%$

When sold for 10% profit

$$SP = 110\%$$

When sold for 5% loss

$$SP = 95\%$$

According to the question,

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

$$15\% = 75$$

$$100\% = (75/15)100 = ₹ 500$$

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.

- (a) 1% loss (b) No loss, no profit
 (c) 1% profit (d) 2% loss

Sol. (a) Assuming, $CP = 100\%$

Marked price = 110%

$$SP = 110\% - [10\% \text{ of } 110\%]$$

$$= 99\%$$

$$\text{Hence, loss} = 100\% - 99\% \quad [CP - SP]$$

$$= 1\% \text{ loss}$$

1

Level

Beginner

- If the ratio of cost price and selling price of an article is 10:11, the per centage 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 selling price. His profit per cent is: [SSC CGL 2012]
 (A) 20 (B) 25 (C) $16\frac{2}{3}$ (D) $33\frac{1}{3}$
- If the cost price of 15 books is equal to the selling price of 20 books, then the loss per cent is: [SSC CGL 2011]
 (A) 16 (B) 20 (C) 24 (D) 25
- If an article is sold at 200% profit, then the ratio of its cost price to selling price will be: [SSC CGL 2010]
 (A) 1 : 2 (B) 2 : 1 (C) 1 : 3 (D) 3 : 1
- Successive discounts of 10%, 20% and 30% is equivalent to single discount of: [SSC CGL 2010]
 (A) 60% (B) 49.6% (C) 40.5% (D) 36%
- What single discount is equivalent to two successive discount of 20% and 15%? [SSC 2011]
 (A) 35% (B) 32% (C) 34% (D) 30%
- If the selling price of 10 articles is equal to the cost 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]
 (A) 140% (B) 200% (C) 220% (D) 250%
- 20% loss on selling price is what per cent loss on the cost price? [SSC CGL 2011]
 (A) 25% (B) 15%
 (C) $16\frac{2}{3}\%$ (D) $16\frac{1}{3}\%$
- If the cost price of 15 articles is equal to the selling price of 12 articles, then find gain %: [SSC CGL 2011]
 (A) 20 (B) 25 (C) 18 (D) 21
- 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]
 (A) ₹ 19,800 (B) ₹ 20,700
 (C) ₹ 23,000 (D) ₹ 25,000

12. The profit% of a bookseller if he sells a book at marked price after enjoying a commission 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 (D) ₹ 400
14. A sells an article to B at a profit of 20% and B sells it to C at a profit of 25%. If C pays ₹ 1,200, then the cost price of the article originally (in ₹) is: [SSC CGL 2012]
(A) ₹ 700 (B) ₹ 600 (C) ₹ 1000 (D) ₹ 800
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]
(A) ₹ 150 (B) ₹ 200 (C) ₹ 400 (D) ₹ 800
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) ₹ 24,250
(C) ₹ 22,500 (D) ₹ 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
18. An article is sold for ₹ 300 at a profit of 20%. Had it been sold ₹ 235, the loss per centage would have been: [SSC CGL 2013]
(A) 5 (B) 6 (C) 16 (D) 3
19. The marked price of a table is ₹ 12,000. If it was sold for ₹ 10,500 after allowing a certain discount, then the rate of discount is: [SSC CGL 2013]
(A) 12.5% (B) 15% (C) 17.5% (D) 10%
20. On the eve of Gandhi Jayanti, Gandhi Ashram declared a 25% discount on silk. If the selling price of a silk saree is ₹ 525, then what is its marked price? [SSC CGL 2013]
(A) ₹ 700 (B) ₹ 725
(C) ₹ 750 (D) ₹ 775
21. A shopkeeper marks his goods 20% above his cost price and gives 15% discount on the marked price. His gain per cent is: [SSC CGL 2014]
(A) 5% (B) 4% (C) 2% (D) 1%
22. If a shopkeeper purchases cashew nut at ₹ 250/kg and sells it at ₹ 10 per 50 grams, then he will have: [SSC Sub. Inspector 2015]
(A) 25% profit (B) 20% profit
(C) 20% loss (D) 25% loss
23. By selling an article for ₹ 450, I lose 20%. For what amount, should I sell it to gain 20%? [SSC CHSL 2015]
(A) ₹ 490 (B) ₹ 470
(C) ₹ 562.50 (D) ₹ 675
24. A fruit seller buys oranges at the rate of ₹ 10/dozen and sells at the rate of ₹ 12/dozen. His gain per cent is: [SSC CHSL 2015]
(A) 15% (B) 20% (C) $8\frac{1}{3}\%$ (D) 12%
25. 10% discount and then 20% discount in succession is equivalent to the total discount of: [SSC CGL 2016]
(A) 15% (B) 30% (C) 24% (D) 28%

2 Level

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
2. A shopkeeper earns a profit of 12% on selling a book at 10% discount on the printed price. The ratio of the cost price and printed price of the books: [SSC CGL 2011]
(A) 45 : 56 (B) 45 : 51
(C) 47 : 56 (D) 47 : 51
3. By selling a bicycle for ₹ 2,850, a shopkeeper gains 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
4. While selling a watch, a shopkeeper gives a discount 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]
(A) ₹ 1,250 (B) ₹ 1,400
(C) ₹ 1,500 (D) ₹ 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 $8\frac{1}{3}\%$
6. 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]

- (A) 2.5% (B) $18\frac{2}{9}\%$
(C) $16\frac{2}{3}\%$ (D) 20%
7. If a commission of 10% is given on the marked price of a work, the publisher gains 20% profit. If the commission is increased by 15%, the gain per cent is:
[SSC CGL 2012]
(A) 15% (B) $16\frac{2}{3}\%$
(C) $13\frac{1}{3}\%$ (D) $15\frac{1}{6}\%$
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%?
[SSC CGL 2012]
(A) 30% (B) 20% (C) 27% (D) 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]
(A) ₹ 350 (B) ₹ 450
(C) ₹ 405 (D) ₹ 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 is:
[MTS 2014]
(A) ₹ 160 (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 (D) 10% loss
12. Rita purchased a car with a marked price of ₹ 2,10,000 at a discount of 5%. If the sales tax charged is 10%, find the amount she has to pay. [SSC MTS 2014]
(A) Rs. 2,19,500 (B) Rs. 2,19,000
(C) Rs. 2,19,450 (D) Rs. 2,20,000
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
(C) ₹ 180 (D) ₹ 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%
15. A shopkeeper allows 10% discount on goods when 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]
(A) 60% (B) 30% (C) 50% (D) 40%
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. By selling a fan for ₹ 1,900, a man has a loss of 5%. Then, at what price (in Rs) should he sell the fan to gain 20% profit?
[SSC SI 2017]
(A) ₹ 2000 (B) ₹ 2400
(C) ₹ 2600 (D) ₹ 2800
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 per centage 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

Level-2: Intermediate

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

Level-3: Expert

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

Solutions with Detailed Explanation

Level-1: BEGINNER

1. Option (B) is correct.

Explanation: Cost Price/Selling Price = 10/11

Let Cost Price = ₹ 10x

and Selling Price = ₹ 11x

$$\begin{aligned}\therefore \text{Profit\%} &= \left(\frac{\text{SP} - \text{CP}}{\text{CP}} \right) \times 100 \\ &= \frac{(11x - 10x)}{10x} \times 100 = 10\%\end{aligned}$$

2. Option (D) is correct.

Explanation:

Assuming SP = ₹ 100

Then profit will be ₹ 25

So, CP = 100 - 25 = ₹ 75

Using; CP = SP - Profit

$$\begin{aligned}\text{Hence, profit \% on CP} &= \frac{\text{Profit}}{\text{CP}} \times 100 \\ &= \frac{25}{75} \times 100 = 33\frac{1}{3}\%\end{aligned}$$

3. Option (D) is correct.

Explanation: According to question,

$$15 \text{ CP} = 20 \text{ SP}$$

$$\frac{\text{CP}}{\text{SP}} = \frac{20}{15} = \frac{4}{3}$$

Let CP = ₹ 4x

and SP = ₹ 3x

$$\begin{aligned}\therefore \text{Loss per centage} &= \frac{(4x - 3x)}{4x} \times 100 \\ &= \frac{1}{4} \times 100 = 25\%\end{aligned}$$

4. Option (C) is correct.

Explanation: If CP was 100, then 200% profit will be 200.

$$\text{SP} = 200 + 100 = 300$$

Hence, CP : SP = 100 : 300 = 1 : 3

5. Option (B) is correct.

Explanation: Successive discount [10%, 20%, 30%]

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

6. Option (B) is correct.

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

[Here, a and b are two discounts]

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

7. Option (A) is correct.

Explanation: According to question,

$$10 \text{ SP} = 11 \text{ CP}$$

$$\frac{\text{SP}}{\text{CP}} = \frac{11}{10}$$

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

8. Option (D) is correct.

Explanation:

Assuming, SP = ₹ 100

$$40\% \text{ of SP} = ₹ 40$$

So, CP = ₹ 40

$$\text{Hence, required\%} = \frac{100}{40} \times 100 = 250\%$$

9. Option (C) is correct.

Explanation: If selling price was ₹ 100.

then 20% loss = ₹ 20

$$\text{CP} = ₹ 120$$

$$\text{Hence, loss\% on CP} = \frac{20}{120} \times 100 = 16\frac{2}{3}\%$$

10. Option (A) is correct.

Explanation: According to question,

$$15 \text{ CP} = 12 \text{ SP}$$

$$\frac{\text{CP}}{\text{SP}} = \frac{12}{15}$$

Let the Cost Price = $12x$

and Selling Price = $15x$

$$\text{Hence, Gain\%} = \frac{(15x - 12x)}{12x} \times 100 = 20\%$$

11. Option (C) is correct.

Explanation: According to question,

$$105\% = 21,000$$

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

$$[\text{CP} = 100\% = 20,000]$$

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

12. Option (D) is correct.

Explanation: Assuming price of book = ₹ 100

$$25\% \text{ of } 100 = 25 \text{ [Commission amount]}$$

$$\text{Actual rate} = 100 - 25 = ₹ 75$$

$$\text{Profit} = 100 - 75 = ₹ 25$$

$$\text{Hence, profit\%} = \frac{25}{75} \times 100 = 33.33\%$$

13. Option (D) is correct.

Explanation: According to question,

Assuming, CP to A = ₹ x

$$x \times \frac{110}{100} \times \frac{105}{100} = 462$$

$$\Rightarrow x = 400$$

Hence, cost to A = ₹ 400

14. Option (D) is correct.

Explanation: According to question,

Assuming original C.P. of article = ₹ x

$$x \times \frac{120}{100} \times \frac{125}{100} = 1,200$$

$$x = \frac{1,200 \times 100 \times 100}{120 \times 125}$$

$$\text{Hence, } x = 800$$

15. Option (B) is correct.

Explanation:

Assuming CP = 100%

According to question,

$$130\% = 90\% + 80$$

$$40\% = 80$$

$$1\% = 2$$

$$\text{Hence, } 100\% = 200$$

So, the CP is Rs. 200

16. Option (C) is correct.

Explanation:

Assuming CP = ₹ x

According to question,

$$110\% \text{ of } x = 27,500 \times \left(\frac{100 - 10}{100} \right)$$

$$\text{Hence, } x = 27,500 \times \frac{9}{10} \times \frac{10}{11} = 22,500$$

17. Option (B) is correct.

Explanation:

Assuming CP = 100%

According to question,

$$80\% = 110\% - 12$$

$$30\% = 12$$

$$\text{Hence, } 100\% = \frac{12}{30} \times 100 = 40$$

So, the CP of article = Rs. 40

18. Option (B) is correct.

Explanation:

Actual price = 300 [Selling price]

Profit = 20%

120% of CP = 300

$$\text{CP} = (300/120)100 = ₹ 250$$

According to question,

New selling price = Rs. 235

So, loss per centage = $[(250 - 235)/250]100 = 6\%$

Hence, loss% = 6%

19. Option (A) is correct.

Explanation: Assuming discount = $d\%$

According to question,

$$\frac{d}{100} \times 12,000 = 12,000 - 10,500$$

$$\frac{d}{100} \times 12,000 = 1,500$$

$$\text{Hence, } d = 12.5\%$$

20. Option (A) is correct.

Explanation:

$$\text{SP} = ₹ 525$$

Assuming marked price = x

SP after 25% discount = $x - 0.25x = 0.75x$

According to question,

$$525 = 0.75x$$

$$\text{Hence, } x = ₹ 700$$

21. Option (C) is correct.

Explanation:

Let CP = ₹ 100

Then, MP = ₹ 120

Discount = 15% of MP

$$= \frac{15 \times 120}{100} = ₹ 18$$

Selling Price = MP - Discount

$$= 120 - 18 = ₹ 102$$

$$\text{Hence, gain\%} = \frac{(102 - 100)}{100} \times 100\% = 2\%$$

22. Option (C) is correct.

Explanation: SP = ₹ 10/50 grams

$$\text{SP of 1 gm} = ₹ \frac{10}{50}$$

$$\text{SP of 1000 gm} = \frac{10}{50} \times 1000 = \text{Rs. } 200$$

$$\text{So, loss\%} = \frac{(250 - 200)}{250} \times 100 = 20\%$$

23. Option (D) is correct.

Explanation: According to question,

$$\frac{450}{100 - 20} = \frac{SP_2}{100 + 20}$$

$$SP_2 = 450 \times \frac{120}{80} = \text{Rs. } 675$$

24. Option (B) is correct.

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

Selling price of 1 dozen oranges = Rs. 12

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

25. Option (D) is correct.

Explanation: Using, successive discount formula

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

Level-2: INTERMEDIATE**1. Option (C) is correct.**

Explanation:

Marked price = ₹ 50 (Given)

$$\text{So, SP} = \frac{50 \times 80}{100} = ₹ 40$$

$$\text{Hence, CP} = \frac{40 \times 100}{125} = ₹ 32$$

2. Option (A) is correct.

Explanation:

$$\begin{aligned} \frac{MP}{CP} &= \frac{(100 + P\%)}{(100 - D\%)} \\ &= \frac{100 + 12}{100 - 10} = \frac{112}{90} = \frac{56}{45} \end{aligned}$$

$$\text{Hence, CP : MP} = 45 : 56$$

3. Option (B) is correct.

Explanation: According to the question,

$$CP = \frac{100}{114} \times 2,850 = ₹ 2,500$$

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

4. Option (C) is correct.

Explanation:

$$\text{Discount 1} = 5\%$$

$$\text{Discount 2} = 6\%$$

Assuming marked price = ₹ P

$$d_2 - d_1 = (6\% - 5\%) = 1\%$$

$$1\% \text{ of } P = 15$$

$$\text{Hence, } 100\% \text{ of } P = ₹ 1,500$$

5. Option (D) is correct.

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

$$\text{CP of both} = 10 + 14 = ₹ 24$$

$$\text{SP of both} = 13 \times 2 = ₹ 26$$

$$\begin{aligned} \text{Hence, profit\%} &= \frac{(26 - 24)}{24} \times 100 \\ &= 8\frac{1}{3}\% \end{aligned}$$

6. Option (C) is correct.

Explanation:

$$\text{SP of 1st} = ₹ 4,000$$

$$\text{Gain\%} = 25\%$$

$$\text{CP of 1st} = \frac{100}{125} \times 4,000 = ₹ 3,200$$

$$\text{So, 2nd article's CP} = 8,000 - 3,200 = ₹ 4800$$

$$\text{2nd article's SP} = ₹ 4,000$$

Hence, loss per centage for 2nd article

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

7. Option (C) is correct.

Explanation:

$$\text{Assuming MP} = ₹ 100$$

$$\text{SP [after 10\% commission]} = ₹ 90$$

$$\text{If CP} = x$$

$$\text{Gain\%} = 20\%$$

$$\text{So, } \frac{120x}{100} = 90$$

$$\Rightarrow x = 75$$

Now,

If 15% commission was given

$$\text{SP} = ₹ 85$$

$$\text{Gain} = 85 - 75 = 10$$

$$\text{Hence, Gain\%} = \frac{10 \times 100}{75} = \frac{40}{3} = 13\frac{1}{3}\%$$

8. Option (A) is correct.

Explanation: Assuming CP = ₹ 100

Let marked or written price = ₹ x

According to question,

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

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

i.e., 30% above CP

9. Option (D) is correct.

Explanation: Assuming original price = ₹ P

According to question,

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

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

10. Option (C) is correct.

Explanation:

$$\text{Assuming CP} = ₹ 100$$

$$\text{Profit} = 10\%$$

$$\text{New CP} = ₹ 96 \text{ [4\% less]}$$

$$\text{If, gain} = 18\frac{3}{4}\%$$

$$\text{SP} = 118\frac{3}{4}\% \text{ of } ₹ 96 = ₹ 114$$

According to question,

$$\text{Difference (in SP)} = 114 - 110 = ₹ 4$$

$$\text{CP} = ₹ 100$$

So, if difference in SP = ₹ 6

$$\text{then, CP} = \frac{100}{4} \times 6 = ₹ 150$$

11. Option (A) is correct.

Explanation: Given that, the selling price of each watch = Rs. 99

$$\text{For 10\% loss, CP} = (99/90)100 = ₹ 110$$

$$\text{For 10\% profit, CP} = (99/110)100 = ₹ 90$$

$$\text{Total CP} = (110 + 90) = ₹ 200$$

$$\text{SP} = 99 + 99 = ₹ 198$$

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

12. Option (C) is correct.

Explanation:

$$\text{MRP} = ₹ 2,10,000$$

$$\text{Discount} = 5\%$$

$$\text{Sale price} = 2,10,000 \times \frac{95}{100}$$

$$= ₹ 1,99,500$$

$$\text{Tax} = 10\%$$

Hence, sale price after tax

$$= \frac{1,99,500 \times 110}{100} = ₹ 2,19,450$$

13. Option (B) is correct.

$$\text{Explanation: CP} = 1,800 - 200 = ₹ 1,600$$

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

Hence, if no discount given

$$\text{Profit} = 2,000 - 1,600 = ₹ 400$$

14. Option (A) is correct.

Explanation:

$$\text{Profit} = 1000 - 900 = 100$$

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

15. Option (C) is correct.

Explanation: Assuming marked price = ₹ x

$$\Rightarrow \text{SP} = \frac{90x}{100} = ₹ \frac{9x}{10}$$

$$\Rightarrow \text{CP} = \frac{80 \times 9x}{100 \times 10} = ₹ \frac{36}{50}x$$

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

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

16. Option (B) is correct.

Explanation: According to question, [x = MRP of T.V.]

$$\frac{x \times 80}{100} - \frac{x \times 70}{100} = 800$$

$$\frac{10x}{100} = 800$$

$$\text{Hence, } x = \frac{800 \times 100}{10} = ₹ 8,000$$

17. Option (A) is correct.

Explanation:

$$\text{Assuming CP} = ₹ x$$

$$\Rightarrow \text{Marked price} = ₹ 1.2x$$

According to question,

$$1.2x = 12x - 2,160$$

$$10.8x = 2,160$$

$$x = 2,160 / 10.8 = 200$$

Hence, CP of blackboard = ₹ 200

18. Option (C) is correct.

Explanation: SP (after 20% discount)

$$= 150 \times \frac{80}{100} = ₹ 120$$

$$\text{So, } x \times \frac{120}{100} = 108$$

$$\Rightarrow x = ₹ 90$$

$$\text{Hence, required discount} = (100 - 90)\% = 10\%$$

19. Option (C) is correct.

Explanation:

$$\text{Assuming CP} = ₹ 100$$

$$\Rightarrow \text{SP} = ₹ 120$$

Assuming marked price = ₹ x

$$\Rightarrow 80\% \text{ of } x = 120$$

$$\Rightarrow x = \frac{120}{0.8} = 150$$

$$\text{Hence, required\%} = \frac{150 - 100}{100} \times 100 = 50\%$$

20. Option (D) is correct.

Explanation:

$$\text{Loss\%} = \frac{(\text{CP} - \text{SP})}{\text{CP}} \times 100$$

$$\text{SP} = \frac{3\text{CP}}{4}$$

$$\text{CP of 1 mango} = \frac{1}{15}$$

$$\text{So, SP of 1 mango} = \frac{1}{20}$$

Hence, he sold 20 mangoes for a rupee.

21. Option (B) is correct.

Explanation:

$$\text{Assuming CP} = ₹ x$$

$$\text{Loss} = 5\% \text{ of } x = \frac{x}{20}$$

$$\text{SP} = \text{CP} (1 - \text{loss}/100)$$

$$\frac{19x}{20} = 1,900$$

$$x = 2,000$$

If 20% profit, then

$$SP = CP + 20\% \text{ of } CP$$

$$\text{Now, New SP} = 2,000 + 400 = ₹ 2,400$$

22. Option (D) is correct.

Explanation: For 40% and 30%

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

For 45% and 20%

$$\text{Single discount} = \left(45 + 20 - \frac{45 \times 20}{100} \right) = 56\%$$

Assuming marked price = ₹ P

According to question,

$$P \times (58 - 56)\% = 12$$

$$\Rightarrow \frac{P \times 2}{100} = 12$$

$$\text{Hence, } P = \frac{1,200}{2} = ₹ 600$$

23. Option (D) is correct.

Explanation: CP = ₹ 1,500

$$25\% \text{ of } 1500 = 375$$

$$\text{So, } SP = 1,500 + 375 = ₹ 1,875$$

$$\begin{aligned} \text{Profit} &= 1,875 - 1,500 - 75 [75 = \text{tax}] \\ &= 300 \end{aligned}$$

$$\text{Hence, required profit\%} = 300 \times \frac{100}{1500} = 20\%$$

24. Option (C) is correct.

Explanation:



$$10\% - (-5\%) = 15\%$$

$$15\% \rightarrow 56.25$$

$$1\% \rightarrow 3.75$$

$$\text{Hence, } 100\% = 375$$

$$\text{So, cost price of watch} = ₹ 375$$

Level-3: EXPERT

1. Option (A) is correct.

Explanation:

$$\text{Successive discount} = 20 + 10 - \frac{(20 \times 10)}{100} = 28\%$$

$$\text{Difference in discount} = (30 - 28)\% = 2\%$$

Given

$$(30\% - 28\%) = 2\%$$

$$\text{So, } 2\% = 72$$

$$\Rightarrow 1\% = 36$$

$$\text{Hence, } 100\% = ₹ 3,600$$

2. Option (D) is correct.

Explanation:

$$\text{Assuming price} = ₹ 100x$$

$$\text{Successive increment} = 110x + 110x \text{ of } 20\% = ₹ 132x$$

According to question,

$$\Rightarrow 132x = 33$$

$$x = \frac{33}{132} = \frac{1}{4}$$

$$\text{Hence, original price} = 100 \times \frac{1}{4} = ₹ 25$$

3. Option (B) is correct.

Explanation:

Assuming CP of first = ₹ P

$$\text{CP of second} = ₹ (19,500 - P)$$

According to the question,

$$\frac{80}{100}P = (19,500 - P) \times \frac{115}{100}$$

$$\Rightarrow P = \frac{4,48,500}{39} = ₹ 11,500$$

$$\Rightarrow \text{CP of second horse} = 19,500 - 11,500 = ₹ 8,000$$

4. Option (B) is correct.

Explanation: Assuming original price = ₹ x/kg

$$\text{Quantity of sugar} = \frac{270}{x}$$

$$\text{New price} = x - 10\% \text{ of } x$$

$$= x - \frac{10}{100}x = \frac{9}{10}x$$

$$\text{New qty.} = \frac{270}{\frac{9}{10}x}$$

According to question,

$$\frac{270}{\frac{9}{10}x} - \frac{270}{x} = 1$$

$$\Rightarrow 270 \left[\frac{10 - 9}{9x} \right] = 1$$

$$\text{Hence, } x = 30$$

5. Option (B) is correct.

Explanation:

$$25\% \uparrow \Rightarrow 125$$

$$x\% \downarrow \Rightarrow 100$$

$$\text{Hence, } x = \frac{25}{125} \times 100 = 20\%$$

6. Option (B) is correct.

Explanation: Assuming original price = ₹ x/kg

$$\text{New price} = ₹ \frac{4x}{5} / \text{kg}$$

According to the question,

$$\frac{600}{\frac{4x}{5}} - \frac{600}{x} = 5$$

$$\Rightarrow 20x = 600$$

$$\text{Hence, } x = 30$$

7. Option (B) is correct.

Explanation: Assuming consumption = 100 kg

New consumption = x kg

According to the question,

$$100 \times 6 = x \times 7.5$$

$$x = 80 \text{ kg}$$

Hence, reduction in consumption

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

8. Option (D) is correct.

Explanation:

Marked price = ₹ 500

Discount = 40%

SP = 500 - 40% of 500

$$= ₹ 300$$

...(1)

36% and 4% successive discount

$$\text{SP after 36\% discount} = 500 - \frac{36}{100} \times 500 = ₹ 320$$

$$\text{SP after 4\% discount} = 320 - \frac{4}{100} \times 320$$

$$= ₹ 307.20$$

...(2)

From (2) and (1), we get

$$307.20 - 300 = ₹ 7.20$$

9. Option (C) is correct.

Explanation: Cost price of each egg = ₹ $\frac{5}{3}$

Selling price of each egg = ₹ $\frac{12}{5}$

$$\text{So, profit on each egg} = \frac{12}{5} - \frac{5}{3} = ₹ \frac{11}{15}$$

Given that total profit = ₹ 143

Let number of eggs he bought = x

$$\text{So, } \frac{11}{15} \times x = 143$$

$$x = 195$$

Hence, he bought 195 eggs.

10. Option (B) is correct.

Explanation: Assuming CP of 1st cycle = ₹ C

CP of other = ₹ $(1,500 - C)$

According to the question,

$$C + \frac{20}{100}C = (1,500 - C) - \frac{20}{100}(1,500 - C)$$

$$2C = 1,200$$

Hence, $C = ₹ 600$

and CP of other cycle = $1,500 - 600 = ₹ 900$

11. Option (D) is correct.

Explanation:

$$\text{1st article } \quad \text{CP} = \frac{100 \times 375}{125} = ₹ 300$$

$$\text{IInd article } \quad \text{CP} = \frac{100 \times 375}{75} = ₹ 500$$

$$\text{Total CP} = 500 + 300 = ₹ 800$$

$$\text{Total SP} = 375 + 375 = ₹ 750$$

$$\text{Hence, } \text{loss\%} = \frac{800 - 750}{800} \times 100$$

$$= 6.25\% \text{ i.e., } 6\frac{1}{4}\%$$

12. Option (B) is correct.

$$\text{Explanation: } \text{CP} = 18 \times \frac{7}{10} + 13 \times \frac{3}{10}$$

$$= \frac{165}{10} = ₹ 16.5$$

$$\text{SP} = ₹ 18.15$$

[Given]

$$\text{Hence, } \text{Gain\%} = \frac{1.65}{16.5} \times 100 = 10\%$$

13. Option (B) is correct.

Explanation: For maximum profit

CP must be minimum i.e., 150

SP must be maximum = 350

$$\text{Profit} = \text{SP} - \text{CP}$$

$$= 350 - 150 = ₹ 200/\text{book}$$

Hence, profit on 15 books = $200 \times 15 = ₹ 3,000$

14. Option (D) is correct.

Explanation: MP = ₹ 1,600

$$\text{After 1st discount (10\%)} = 1,600 \times \frac{90}{100} = ₹ 1,440$$

$$\text{Final SP} = ₹ 1,224$$

[Given]

$$\text{So, } \frac{x}{100} \times 1,440 = 1,440 - 1,224$$

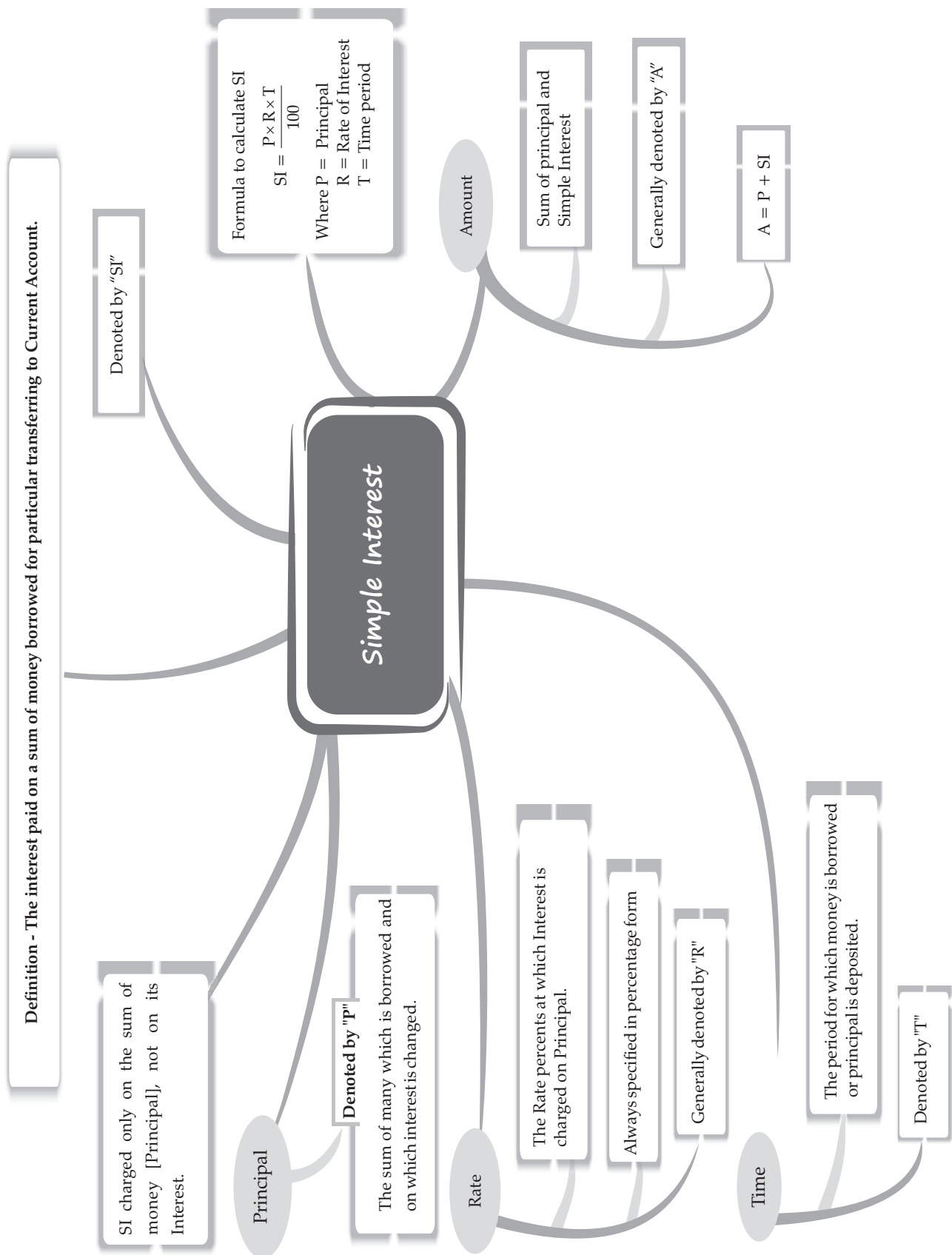
$$\text{Hence, } x = 15\%$$

15. Option (A) is correct.

Explanation: Required % reduction

$$= \frac{0.25}{1.25} \times 100 = 20\%$$





CHAPTER

3

Simple Interest



LEARNING OBJECTIVES:

- ❖ Interest is applied while taking or giving certain amount of money.
- ❖ Method of calculating simple interest.
- ❖ Method to know principal amount, time and rate per cent.
- ❖ Different types of question asked in competitive exams.
- ❖ Real life application related to borrowing or lending money.

➤ **Interest:** When a person or organisation borrows some money from another person or organisation (bank, other financial institutes), then the borrower pays some extra amount of money at the time of repayment. That extra amount of money during repayment is called interest.

➤ **Principal (P):** Generally denoted by "P". It is the amount of money borrowed for a certain time.

➤ **Amount:** The sum of interest and principal is known as amount and denoted by "A".

$$A = I + P \quad [\text{where } I \text{ is the interest}]$$

➤ **Rate of Interest:** Denoted by "R". It is the rate at which interest is charged on principal and always specified in percentage form.

➤ **Time (T):** The period for which money is borrowed.

➤ **Simple Interest (SI):** Interest is calculated on the principal amount for any length of time. In simple interest, the interest is always calculated on the original principal.

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

[formula used to calculate simple interest]

🔗 **Example 1:** What would be the simple interest obtained on an amount of ₹ 5,760 at the rate of 6 p.c.p.a. after 3 years?

Sol. Here, Time = 3 years
Rate of Interest = 6% p.a. (per annum)
Principal (P) = ₹ 5,760

$$\begin{aligned} \text{Using: } SI &= \frac{PRT}{100} \\ &= \frac{5,760 \times 6 \times 3}{100} = 1,036.80 \end{aligned}$$

Hence, SI = 1,036.80

SOME IMPORTANT FORMULAE AND TRICKS

$$A = P + SI$$

[where A is amount and P is principal]

We can calculate the amount directly by using [If SI is not given]

$$A = P \left[1 + \frac{RT}{100} \right]$$

➤ When an amount becomes n times of itself in y years at rate of interest $r\%$ per annum, then

$$r \times y = (n - 1) \times 100$$

🔗 **Example 2:** The rate at which a sum becomes four times of itself in 15 years, the SI will be:

Sol. Using $SI = (P \times R \times T) / 100$
 $3P = (P \times R \times 15) / 100$
 $R = 20\% \text{ per annum}$

➤ If rate of interest (R) becomes $R_2\%$ from $R_1\%$ and ₹ y is earned more in T years, then

$$P = \frac{y \times 100}{(R_2 - R_1) \times T}$$

[where P = Principal]

🔗 **Example 3:** If annual rate of simple interest increases from 10% to $12\frac{1}{2}\%$, a man's yearly income increases by ₹ 1,250. His principal (in ₹) is:

Sol. Using $P = \frac{\times 100}{(R_2 - R_1) \times T}$
 $y = ₹ 1,250$

$$R_2 - R_1 = 12\frac{1}{2}\% - 10\% = \frac{5}{2}\%$$