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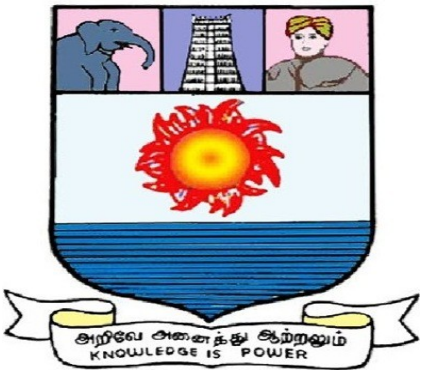

QUANTITATIVE APTITUDE

Subject Code: JNBA61

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Prepared By

Dr. A. Jafar Sathic

Guest lecturer

Department of Business Administration

Government Arts and Science College

Ottapidaram – 628401

SYLLABUS

Unit I

Numerical Reasoning: Problems related to Number series, Analogy of numbers, Classification of numbers, Letter series, Seating arrangements, Directions, blood relations and puzzle test.

Unit II

Combinatorics: Counting techniques, Permutations, Combinations and Probability

Unit III

Syllogisms and data sufficiency

Unit IV

Application of Base system: Clocks (Base24), Calendars (Base7), Cutting of Cubes and cuboids

Unit V

Puzzle Solving &Time Management using various problems solving tools and techniques

Reference books:

- Barron‟sby Sharon Welner Green and Ira K Wolf (Galgotia Publications pvt.Ltd.)
- Quantitative Aptitude by U Mohan Rao Scitech publications
- Quantitative Aptitude by Arun Sharma Mc Graw-Hill publications
- Quantitative Aptitude by Abhijit Guha
- Quantitative Aptitude by Pearson publications

Web sources:

- https://www.m4maths.com
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- https://www.123test.com/numerical-reasoning-test/
- https://www.bankexamstoday.com/p/data-interpretation-questions-sets.html
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UNIT I

NUMERICAL REASONING

1.1 Numerical Reasoning

Numerical reasoning involves processing numerical patterns logically and easily. People with strong numerical reasoning excel at more than addition, multiplication, and division. They easily process, analyze and interpret numerical charts, trends, and relationships.

Numerical reasoning tests measure your ability to interpret, analyze, and draw logical conclusions from numerical data, such as graphs, tables, and financial reports. Commonly used in recruitment for finance and technical roles, these assessments evaluate proficiency in basic arithmetic, percentages, ratios, and data interpretation under tight time constraints.

1.1.1 Key Aspects of Numerical Reasoning

- Data Interpretation: Analyzing information from tables, charts, and graphs to make decisions.
- Fundamental Math: Applying arithmetic, percentages, ratios, and currency conversions.
- Logical Analysis: Identifying patterns in number series and solving word problems.
- Contextual Application: Solving business-related metrics or financial problems.

1.1.2 Numerical Reasoning Test

A numerical reasoning test is a type of psychometric assessment frequently used in the recruitment process and in educational settings. Its primary purpose is to measure an individual's ability to handle numbers and solve problems using numerical data. The main goal is to assess a candidate's numerical analytical skills and their ability to interpret, analyze, and draw conclusions from sets of data.

Numerical reasoning tests evaluate arithmetic skills, data interpretation, logical analysis, and the ability to work under time constraints. They measure how well a person can understand and use numerical or statistical data. These tests typically present data in various formats, such as graphs, tables, charts, or simple text. Questions are based on the data provided and often involve basic arithmetic, percentages, ratios, or statistical interpretation.

The complexity of these tests can vary greatly depending on the level of the position or course for which they are being used. Higher-level positions may require more complex data analysis and higher-level mathematical understanding. These tests are widely used in the hiring process for roles in finance, consulting, professional services, and other fields where numeracy is a key part of the job. They are also used in academic assessments and for admission to certain educational programs.

1.1.3 Uses of Numerical Reasoning

Numerical reasoning is used to interpret data, solve problems, and make logical decisions using numbers, graphs, and tables. It is critical for evaluating financial, marketing, and operational data, enabling tasks like forecasting, budgeting, and performance analysis, and is widely used in hiring to assess analytical skills.

- **Professional Recruitment:** Employers use these tests to measure a candidate's ability to interpret, analyze, and make deductions from numerical data under timed conditions, reducing hiring bias and identifying top talent.
- **Financial Analysis:** Used to assess investment risks, review financial statements, calculate return on investment (ROI), manage budgets, and perform audits.
- **Data Interpretation & Reporting:** Involves interpreting graphs, tables, and charts to identify trends, patterns, and insights in business data.

- **Operational Decision-Making:** Helps in interpreting data to make fast, evidence-based decisions, such as analyzing marketing campaign performance or managing supply chain logistics.
- **Daily Life Tasks:** Used for calculating percentages, ratios, and currency conversions, reconciling bank accounts, and assessing value for money.

1.1.4 How do prepare for a Numerical Reasoning Test?

To prepare for a numerical reasoning test, start by strengthening your foundational math skills, focusing on areas like arithmetic, fractions, percentages, and basic algebra. Regular practice with sample questions and full-length timed tests will help you get familiar with the test format and improve your speed and accuracy. Pay special attention to interpreting data from graphs and tables, as these are common components of such tests. Reviewing your practice tests to understand and learn from your mistakes is crucial, and if needed, don't hesitate to seek additional help or resources to clarify challenging concepts.

1.2 Number Series

The arrangement of numbers in a certain order, and in which some numbers are placed wrongly in the series and some numbers are missing is called a number series. Based on calculating the addition and subtraction of the numbers, candidates have to observe and find the accurate number to the series of numbers.

1.2.1 Types of Questions on Number Series

Here are some of the series patterns which are discussed below:

- ***Based on subtraction and addition***

In the series 4, 9, 14, 19, 24, 29 we can see that it is an increasing series and the rate of increase is 9-4 = 5.

In the series 13, 11, 9, 7, 5 we can see that it is a decreasing series and the rate of decrease is 13-11 = 2.

- ***Based on division and multiplication***

In the series 4, 8, 16, 32, 64, we can see that it is an increasing series and the series is increasing by the multiple of 2.

In the series 100, 50, 25, 5, 1 we can see that it is a decreasing series and the series is decreasing as the terms are divided by 5.

- ***Based on square and cube***

In the series 8, 27, 125, 343, 1331, 2197, we can see that it is an increasing series. The series is the cube of the consecutive prime numbers from 2 to 13.

1.2.3 Steps to Solve Number Series

Here we are providing some steps on how to solve number series question that forms an important part of the reasoning section of the banking syllabus:

Step 1: Screening: Candidates should first read the question carefully. Sometimes reading the question carefully can be enough for the candidate to solve the question.

Example 1: 1, 3, 7, 13, 21, 21, 31, ?

In this series, the terms are increasing by +2, +4, +6, +8, +10. So, the next term will be increased by 12. Hence, the next term is 31 + 12 = 43.

Example 2: 2, 4, 8, 16, 32, 64, ?

In this series, the terms are increasing by the multiples of 2. Therefore, the next term will be 64 * 2 = 128.

Step 2: Check the pattern Decreasing or Increasing or Alternating.

Sometimes candidates fail to decipher the pattern of the number series. During bank exam preparation, candidates should try to find out the trend of the series by looking at the series pattern. They can find it by checking the series whether it is decreasing or increasing or it is following an alternate pattern.

Example:

5, 10, 13, 26, 29, 58

Clearly, we can see that it is an increasing pattern.

729, 512, 343, 216, 125

Here, we can see that the series is of decreasing pattern.

4, -8, 16, -32, 64, -128

This series is neither increasing nor decreasing. So clearly, it is following an alternating pattern.

Step 3: Find the rate of increase or decrease if the series is of increasing or decreasing pattern.

During bank exam preparation, candidates should read the question carefully and find whether the nature of the series is increasing or decreasing. Moreover, on the basis of that, they should find the rate at which the terms are increasing or decreasing.

Step 4: Check if the series is alternating

For alternating series, candidates need to check whether the series has two different operations, which are being alternately performed, or there is a mix of two series.

Example:

In the series 4, 9 6, 18, 9, 27, 13, 36. This series is a mix of two series 9, 18, 27, 36 and 4, 6, 9, 13.

In the series 200, 600, 1200, 1600, 3200, 3600, 7200 two types of operations are going, one is the addition of 400 and the second is multiplication by 2.

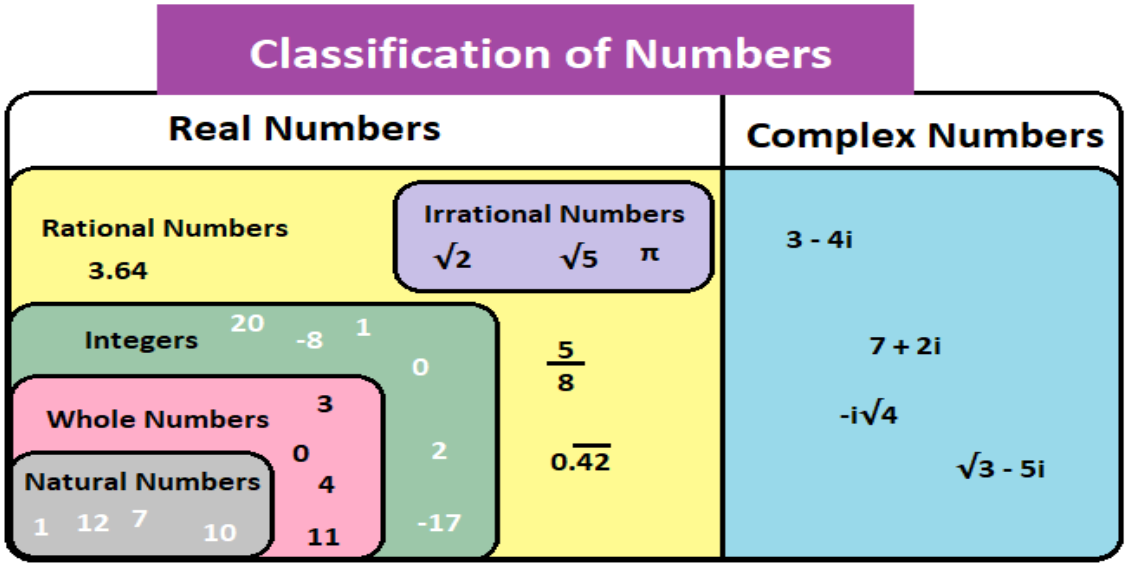
1.3 Number Analogy

Number Analogy-In this type of Analogy, numbers are given in a pair or group on one side. We have to find the relationship between them and then find the number or group of numbers which will replace the question mark in the other pair on the other side. In numerical or number analogy reasoning, pair of numbers is given in a certain similarity between them. Another number is also given with the same similarities.

In Number analogy section deals with two types of questions:

- Choosing a similarly related pair as the given number pair on the basis of the relation between the numbers in each pair.
- Choosing a number similar to a group of numbers on the basis of certain common properties that they possess.

1.4 Classification of Numbers



The numbers can be classified into sets known as the number system. The different types of numbers in mathematics are:

- **Natural Numbers:**

Natural numbers are known as counting numbers that contain the positive integers from 1 to infinity. The set of natural numbers is denoted as "N" and it includes N = {1, 2, 3, 4, 5, …….}

- **Whole Numbers:**

Whole numbers are known as non-negative integers and it does not include any fractional or decimal part. It is denoted as "W" and the set of whole numbers includes W = {0,1, 2, 3, 4, 5, …….}

- **Integers:**

Integers are the set of all whole numbers but it includes a negative set of natural numbers also. "Z" represents integers and the set of integers are Z = { -3, -2, -1, 0, 1, 2, 3}

- **Real Numbers:**

All the positive and negative integers, fractional and decimal numbers without imaginary numbers are called real numbers. It is represented by the symbol "R".

- **Rational Numbers:**

Any number that can be written as a ratio of one number over another number is written as rational numbers. This means that any number that can be written in the form of p/q. The symbol "Q" represents the rational number.

- **Irrational Numbers:**

The number that cannot be expressed as the ratio of one over another is known as irrational numbers and it is represented by the symbol "P".

- **Complex Numbers:**

The number that can be written in the form of a+bi where "a and b" are the real number and "i" is an imaginary number is known as complex numbers "C".

- **Imaginary Numbers:**

The imaginary numbers are the complex numbers that can be written in the form of the product of a real number and the imaginary unit "i"

Apart from the above, there exist other numbers namely even and odd numbers, prime numbers and composite numbers. These can be defined as given below:

- **Even Numbers:**

The numbers which are exactly divisible by 2, are called even numbers. These can be positive or negative integers such as -42, -36, -12, 2, 4, 8 and so on.

- **Odd Numbers:**

The numbers which are not exactly divisible by 2, are called odd numbers. These can be both positive and negative integers such as -3, -15, 7, 9, 17, 25 and so on.

- **Prime Numbers:**

Prime numbers are the numbers that have two factors only. (i.e.,) 1 and the number itself. In other words, the number which is divided by 1 and the number itself is called prime numbers. For example, 2, 3, 5, 7, 11, etc.

- **Composite Numbers:**

A composite number is a number that has more than two factors. For example, 4 is a composite number, as the number 4 is divisible by 1, 2, and 4. Other examples of composite numbers are 6, 8, 9, 10, and so on.

- **Special Numbers**

❖ ***Cardinal Numbers:*** Cardinal number defines how many of something are there in a list, such as one, five, ten, etc.

❖ ***Ordinal Numbers:*** Ordinal numbers explain the position of something in a list, such as first, second, third, fourth, and so on.

❖ ***Nominal Numbers:*** Nominal number is used only as a name. It does not denote an actual value or the position of something.

❖ ***Pi (π):*** Pi is a special number, which is approximately equal to 3.14159. Pi (π) is defined as the ratio of the circumference of the circle divided by the diameter of the circle.

❖ (i.e.,) Circumference/ Diameter = π = 3.14159.

❖ ***Euler's Number (e):*** Euler's number is one of the important numbers in Maths, and it is approximately equal to 2.7182818. It is an irrational number and it is the base of the natural logarithm.

❖ ***Golden Ratio (φ):*** A golden ratio is a special number and it is approximately equal to 1.618. It is an irrational number and the digits do not follow any pattern.

1.5 Letter Series

A letter series is a sequence of letters that follows a specific logical pattern or rule. These

sequences are designed to test a person's ability to recognize relationships between letters, predict the next element, or identify missing letters in the series. A letter series is a sequence of letters that follows a specific logical rule or pattern.

The challenge is to decipher the underlying rule and determine the missing letter(s) or the next letter(s) in the sequence. These letter sequences follow particular patterns to challenge candidates to figure out the hidden logic behind them and describe a possible future event following the next letters.

Alphabets	A	B	C	D	E	F	G	H	I	J	K	L	M
Positional value	1	2	3	4	5	6	7	8	9	10	11	12	13
Positional value	26	25	24	23	22	21	20	19	18	17	16	15	14
Alphabets	Z	Y	X	W	V	U	T	S	R	Q	P	O	N

The logical Series patterns can differ, including any order, number-based positions in the alphabet, sequences, or changes based on letter positions.

1.5.1 Types of Letter Series Patterns

a) Alphabetical Order Patterns

Simple Forward/Backward Series:

Example:

A, B, C, D, ? (Next: E)

Z, Y, X, W, ? (Next: V)

Skip Pattern (Fixed Intervals):

Example:

A, D, G, J, ? (Skip 2 letters: A→B,C→D)

B, E, H, K, ? (Next: N)

b) Position-Based Patterns

Letter Position in Alphabet (A=1, B=2, etc.):

Example:

D (4), H (8), L (12), P (16), ? (Next: T=20)

Mathematical Operations on Positions:

Example:

C (3), F (6), I (9), L (12), ? (Next: O=15)

c) Reverse Alphabet Patterns

Reverse Position (Z=1, Y=2, ..., A=26):

Example:

V (5), R (9), N (14), ? (Next: J=19)

d) Repetition and Alternation Patterns

Example:

A, B, A, C, A, D, ? (Next: A)

X, Y, Z, X, Y, Z, ? (Next: X)

1.6 Seating Arrangement

Seating arrangement is the logical arrangement of people or objects. This concept involves arrangement of people in many possible ways. Seating Arrangement is a common category of Logical Reasoning that is asked in competitive exams.

In these types of questions, you will have to arrange a group of persons satisfying certain conditions. Questions on this topic can be asked in any sequence such as linear or circular arrangements. By applying logical analysis, we can perform logical arrangement to answer the questions or decode.

1.6.1 Rules for Seating Arrangement Questions

Seating Arrangement Questions can be a linear arrangement or circular arrangement. In circular seating arrangement, we arrange people around a circle while in linear seating arrangement, we arrange people in a line. Some detail regarding the objects/person and how they are seated is given, one should arrange either in a Linear or circular as mentioned. Here, we will discuss the

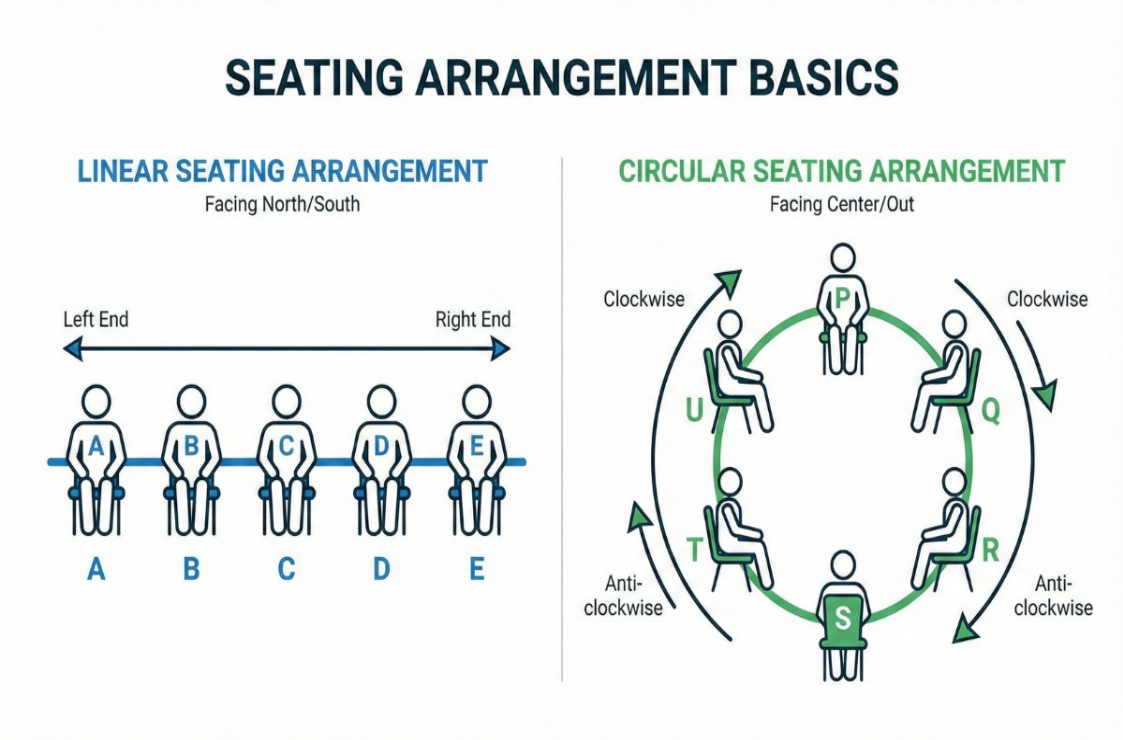
rules:

- Identifying the right and left in a given seating arrangement
- If it is not mentioned in the question, we cannot assume the left or immediate left.
- Always start the arrangement with complete fixed details.
- In the case of a circular arrangement, if nothing is mention regarding the direction they are facing then by default, assume they are facing the center.

1.6.2 Types of Seating Arrangement Questions

The Seating arrangement questions are the most common in reasoning sections of entrance exams. There are different types of problems with the concept of seating arrangement as follows.

- Linear Arrangement
- Square/Rectangular Arrangement
- Circular Arrangement
- Triangular arrangement
- Hexagonal arrangement
- Pentagon arrangement.
- Combination of the above.



Following are some questions on seating arrangement as follows.

Example 1:

B, L, M, N, P, and Q are in a row. P and Q are in the center, B and L are at the ends. M is sitting to the left of B. Who is to the right of L?

Solution:

The seating arrangements can be as follows:

L, N, P, Q, M, B

or

L, N, Q, P, M, B

Therefore, N is to the right of L.

Example 2:

Five boys are sitting to be photographed. S is to the left of R and to the right of B. M is to the right of R. E is between R and M.

a) Who is sitting immediate right to E?

   Answer: M

b) Who is second from the right?

   Answer: E

Solution :

The seating arrangement is as follows:

B, S, R, E, M

Example 3:

Five girls are standing in a line. One of the two girls at extreme end is P and the other is B. A is to the right of S. C is to the immediate left of B. What is the position of A from the left?

Answer: A is third from left

Solution :

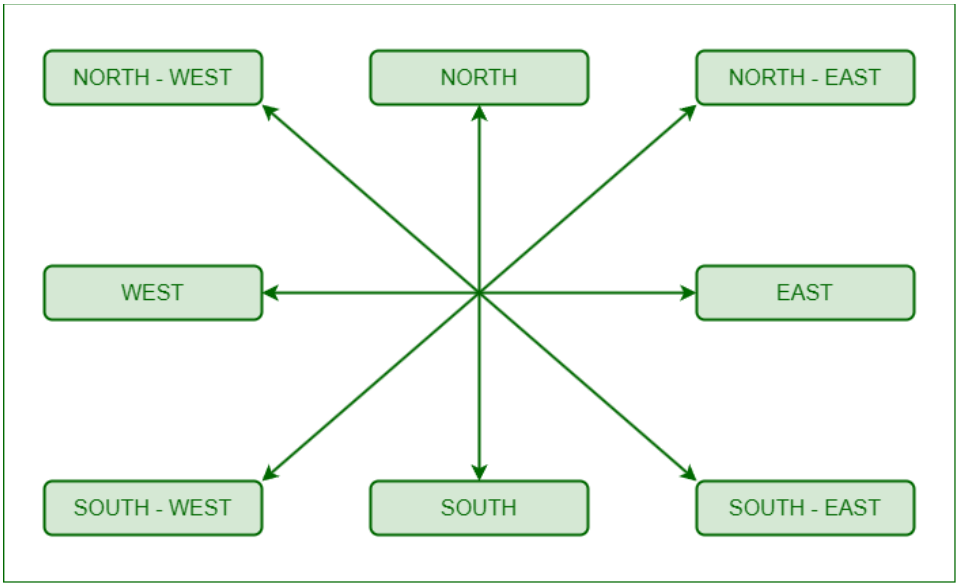
The seating arrangement is as follows.

P, S, A, C, B

1.7 Directions

Direction is part of the reasoning in which you identify the direction of a person or an object.

Direction can be defined as the direction or path that something is going or is intended to move in, as well as the axis that something is facing or pointing along. The four major directions are north, east, west, and south. There are also sub-main directions that are northeast, southwest, southeast, and northwest. The image below will help you understand this better.



1.7.1 Points to be remembered before solving Questions on Direction

The angle between North and East, East and South, South, and West, and West and North is 90°. The angle between North and northeast, northeast and east, east and southeast, southeast and south, south and southwest, southwest and west, west and northwest, and northwest and north is 45°.

The clockwise direction is north-east-south-west.

The anticlockwise direction is north-west-southeast.

Right means 90° clockwise, and left means 90° anticlockwise.

x° Right= x° Clockwise direction, x° Left= x° Anticlockwise direction.

1.7.2 Some Important Tip Regarding Direction

- Right of North = east
- Right of east = south
- Right of south = west
- Right of west = north

- Left of north = west
- Less of east = north
- Left of south = east
- Left of west = south.
- Right of northeast = southeast
- Right of southeast = southwest
- Right of southwest = northwest
- Right of northwest = northeast
- Left of northeast = northwest
- Left of southeast = northeast
- Left of southwest = southeast
- Left of northwest = southwest

1.7.3 Steps to be followed to solve Questions on Direction

- Always use the 2-D plane to draw a diagram.
- First, make a diagram using the given data.
- Always mark the starting and ending points.
- You should always be careful about taking turns, whether it is right or left.
- Mark the distance along with the path.
- And then you can answer your question easily.

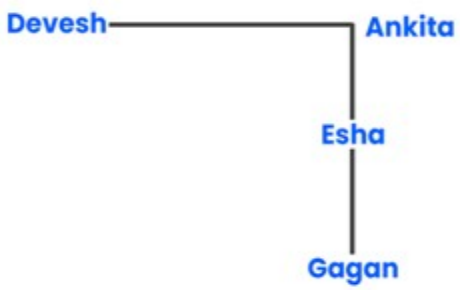
Let us discuss three types of Condition Based on Direction and Distance:

a) Basic Direction based question:

Q1. Ankita is in the east of Devesh and in the north of Esha. If Gagan is in the south of Esha, then Ankita is in which direction with respect to Gagan?

Solution:

Let us understand it with the help of diagrams.



Let us start with Esha, and then from there, we can draw others' positions as well.

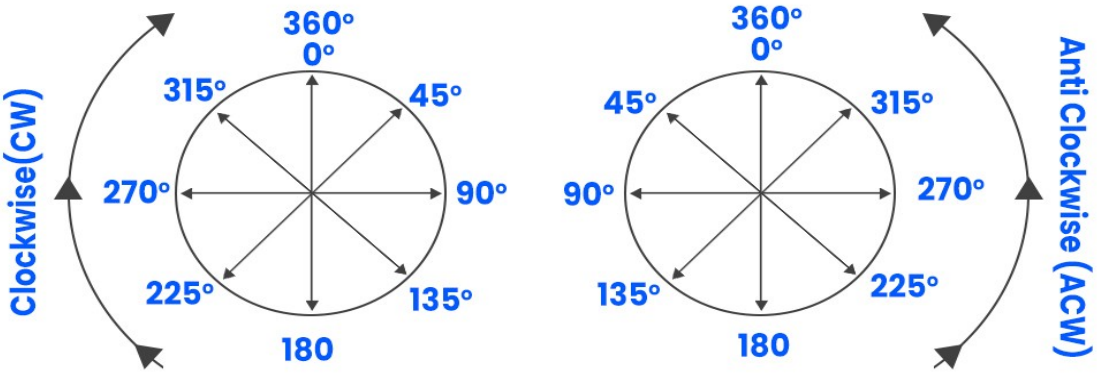
Hence, Ankita is towards the North of Gagan.

b) Degree-based questions:

Q2. If a person goes to his left side, he will go towards the anti-clockwise direction.

If a person goes to his right side, he will go towards the clockwise direction.

In the case of moving towards the left or right side, we assume that the movement is at an angle of 90 degrees.



Solution:

In easy words, we can say that:

Left turn = Anticlockwise turn

Right turn = Clockwise turn.

c) Coded Direction based question:

In such types of questions, the directions are given in a certain coded language.

Q3. Direction: Study the following information carefully and answer the questions given below.

In a coded language:

A@B (11) means A is 11m in the north of B

A*B (26) means A is 11m in the south of B

A&B (18) means A is 18m in the east of B

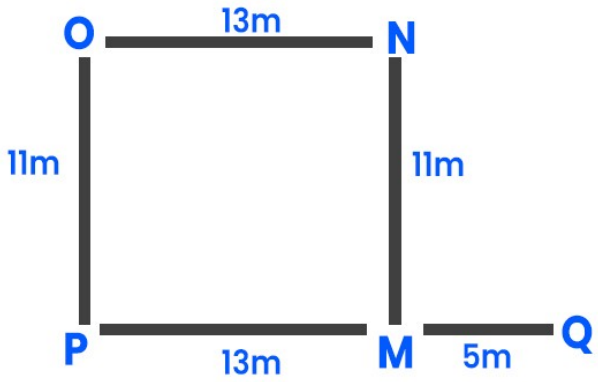
A~B (21) means A is 13m in the west of B

N@M (11), O~N (13), P*O (11), Q&P (18); Then, M is in which direction with respect to Q?

1) North
2) West
3) North-west
4) East
5) South-east

Answer: 2

Solution:



M is in the west direction with respect to Q.

Note: To find the Shortest Distance between any two points:

Use the formula of Pythagoras' theorem i.e., H^2 = √(P^2+B^2)

1.8 Blood Relation

Blood relation reasoning involves reaching the conclusion by applying the rules of relationships within a family structure, often through direct or coded questions, and mastering it requires

understanding familial connections and practicing logical deductions.

A blood relation test, also known as a "Blood Relation Problem," is a type of puzzle that tests a person's ability to understand and reason about the relationships between different members of a family.

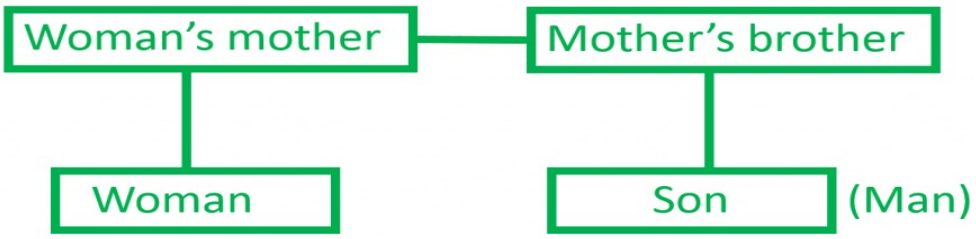
Let's dive into the concepts of blood relation reasoning.

1.8.1 Understanding Blood Relation Concepts

In reasoning, Blood relation is one of the most asked questions in competitive exams. To understand the blood relation concepts, we must have a full grasp of the relationships and connections within a family, which is given as follows:

- **Parental Relations:** Father (F), Mother (M)
- **Siblings:** Brother (B), Sister (S)
- **Grandparents:** Grandfather (GF), Grandmother (GM)
- **Marital Relations:** Husband (H), Wife (W)
- **Children:** Son (S), Daughter (D)

While solving reasoning question on Blood Relation , Visualizing relationships through family trees is a common method to understand the questions better.



1.8.2 Common Types of Blood Relation Questions

- ***Pointing or Introducing***

In these questions, individuals are introduced or described using their relationships to others. The goal is to identify the relationship between the individuals mentioned.

Example: A woman introduces a man as her "father's brother's son." How is the man related to the woman's father?

- ***Family Tree***

These questions provide a diagram of a family tree, and you're asked to determine relationships based on the given information.

Example: In a family tree, A is the father of B, B is the sister of C, and C is the mother of D. What is the relationship between A and D?

- ***Coded Relations***

In these questions, relationships are represented by codes, and you're given a set of rules or equations to decipher the codes.

Example: In a coded blood relation system, M represents Mother, F represents Father, S represents Son, and D represents Daughter. Translate the code MFS: FMSD.

- ***Mixed Blood Relations***

These questions involve a combination of the above types, often mixing pointing, family tree, and coded relations.

Example: A man points to a woman in a photograph and says, "Her mother's brother is my mother's father's only son." How is the girl's mother related to the man?

- ***Puzzle-Based Blood Relation***

These questions present a puzzle or scenario involving blood relations and require you to solve the puzzle using logical reasoning.

Example: In a family of six, there are three generations. The grandfather has two sons and one

daughter. Each son has two children, and the daughter has one child. How many grandchildren does the grandfather have?

- ***Single-Person Blood Relation***

These questions focus on determining the relationship between a single individual and another person based on the given information.

Example: A woman says, "My brother's son's sister is my niece." What is the relationship between the woman and her niece?

1.8.3 Tips for Blood Relation Reasoning Questions

The following are the tips and tricks for solving Questions on Blood relations.

- ***Considering "Me" as the Introducing Person***

This is a crucial tip, especially for questions where individuals are introduced relative to the speaker. By assuming the role of the speaker, you can easily determine the relationships between the mentioned individuals.

- ***Checking All Options Carefully in Coded Relations***

In coded blood relation problems, it's essential to consider all options, including gender possibilities. Eliminate options that contradict the given information to narrow down the correct answer.

- ***Avoiding Gender Assumptions***

Unless explicitly stated, never assume a person's gender based on their name. Stick to the provided information to avoid erroneous conclusions.

- ***Interpreting "Only Son" or "Only Daughter"***

"Only son" or "only daughter" doesn't necessarily mean an individual has no other siblings. They could have one or more siblings of the opposite gender.

- ***Identifying the Two Persons of Interest***

Determine the two individuals whose relationship needs to be established. Then, analyze the relationships between other family members to identify the connection between the two.

- ***Correlating Given Relations with Personal Relations***

Connect the relationships mentioned in the question with personal relationships you're familiar with. This enhances understanding and simplifies the problem-solving process.

- ***Utilizing Pictorial Representation***

Visualizing relationships through diagrams or family trees is an effective strategy. It helps

organize the information and facilitates a systematic approach to solving the problem. Remember, consistent practice and exposure to diverse blood relation problems will significantly improve your problem-solving skills.

1.8.4 Different Blood Relation Terms

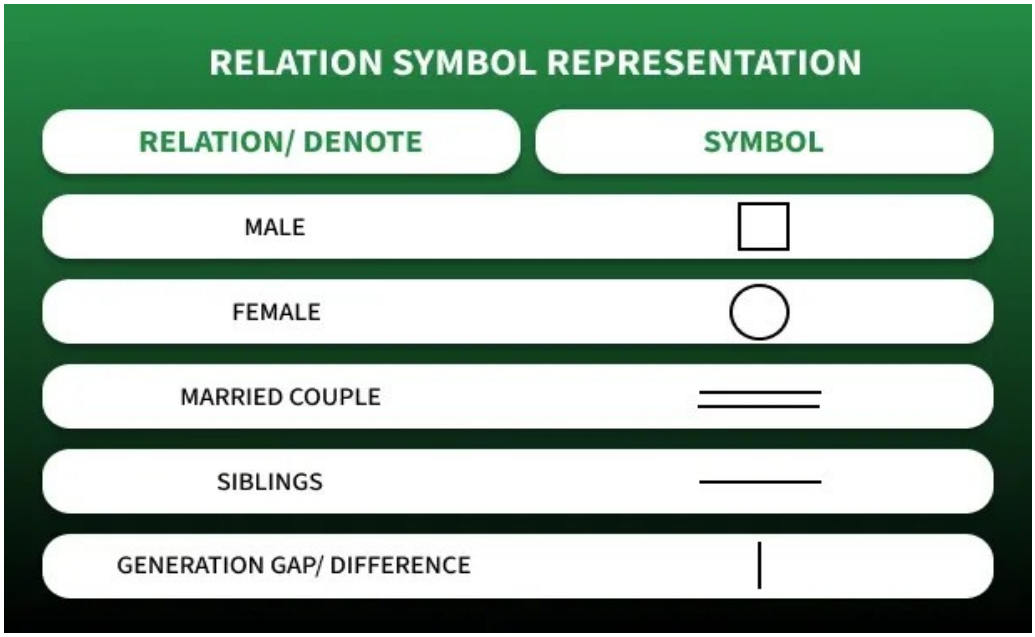
The following are the different terms used in blood relations reasoning question:

Relationship	**Terms Used**
Father's son/Mother's son	Brother
Father's daughter/Mother's daughter	Sister
Mother's brother (younger/elder)	Maternal Uncle
Father's brother (younger/elder)	Paternal Uncle
Father's sister (younger/elder)	Paternal Aunt
Mother's sister (younger/elder)	Maternal Aunt
Son's wife	Daughter-in-law
Daughter's husband	Son-in-law
Sister's husband	Brother-in-law
Brother's wife	Sister-in-law
Husband's brother/Wife's brother	Brother-in-law
Husband's sister/Wife's sister	Sister-in-law
Husband's father/Wife's father	Father-in-law
Husband's mother/Wife's mother	Mother-in-law
Brother's son/Sister's son	Nephew
Brother's daughter/Sister's daughter	Niece
Uncle's daughter/Aunt's daughter	Cousin
Uncle's son/Aunt's son	Cousin
Father's father	Paternal Grandfather
Mother's father	Maternal Grandfather
Father's mother	Paternal Grandmother
Mother's mother	Maternal Grandmother
Father of grandfather /father of grandmother	Great grandfather

Mother of grandfather/Mother of grandmother	Great grandmother

1.8.5 Relation Symbols Representation

You can also used different symbols for convenience, while solving blood relation reasoning Problems.



Example 1:

Introducing Sanghoti to guests, Dinabandhu said, "Her father is the only son of my father".How is Sanghoti related to Dinabandhu?

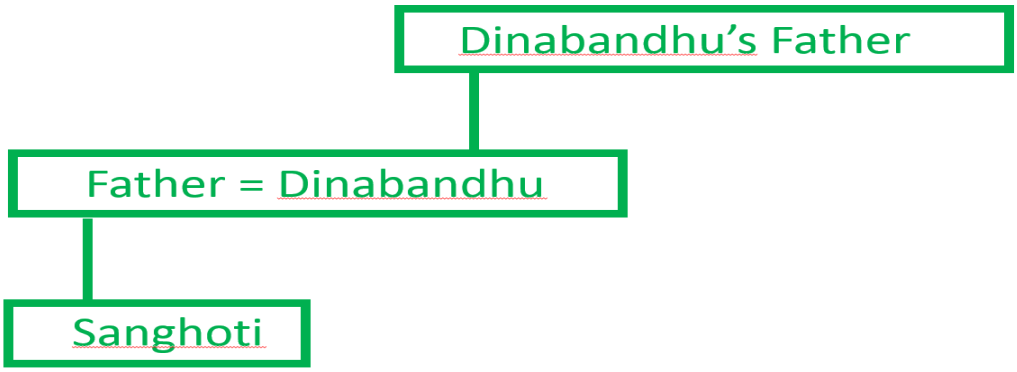
(a) Daughter

(b) Mother

(c) Sister

(d) Niece

Solution:



Hence, Sanghoti is Dinabandhu's daughter.

Answer: (a) Daughter.

Example 2:

A woman introduces a man as the son of the brother of her mother. How is a man related to the woman?

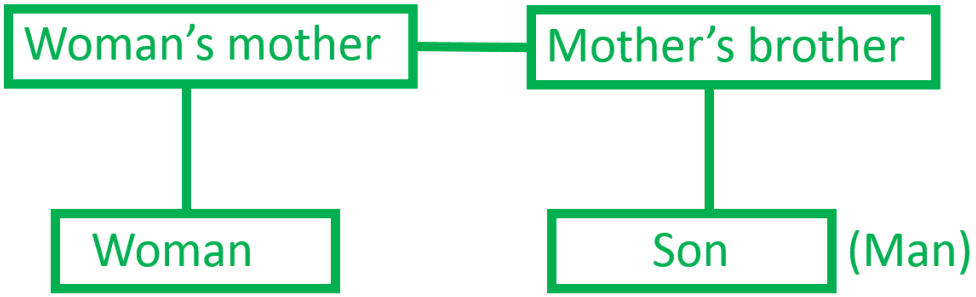
(a) Nephew

(b) Son

(c) Cousin

(d) Uncle

Solution:



Hence, man is woman's Cousin.

Answer: (c) Cousin.

1.9 Puzzle Tests

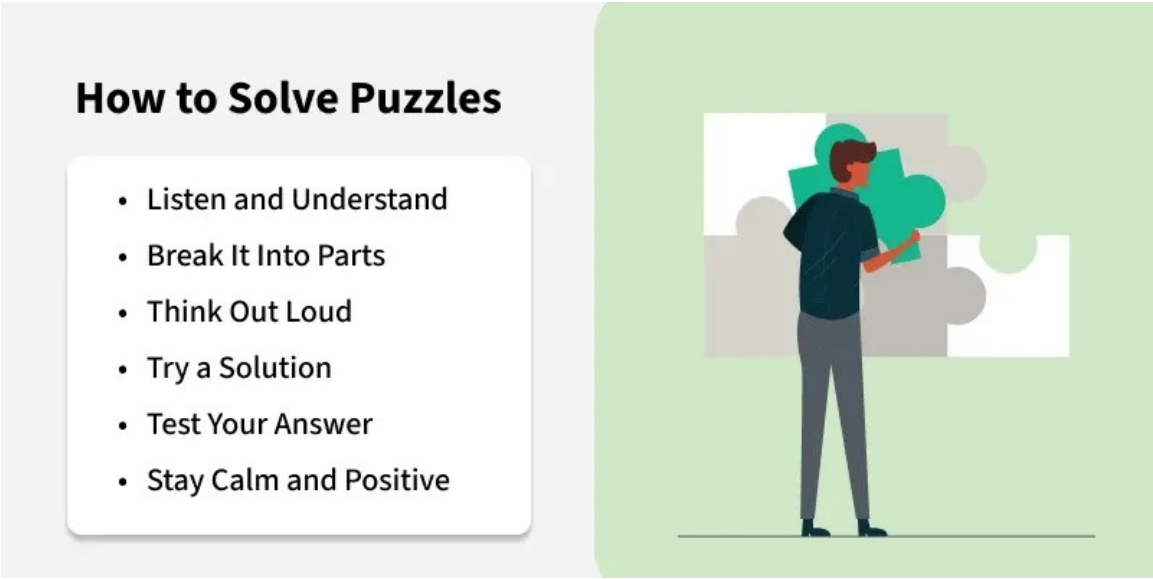
Puzzle tests in quantitative aptitude assess analytical, logical, and mathematical skills by requiring the deduction of, or arrangement of information based on, specific constraints.

Common types include, but are not limited to, linear/circular arrangements, blood relations, scheduling, and number-based puzzles, often involving topics like percentages, ratios, and equations.

1.9.1 Types of Quantitative Puzzles

- **Arrangement Puzzles:** Linear, circular, or matrix-based arrangements of people or objects.
- **Number/Sequence Puzzles:** Identifying patterns, such as finding the missing number, or using average-based logic.
- **Equation-Based Puzzles:** Solving word problems that require setting up and solving linear equations with multiple variables.
- **Spatial/Shape Puzzles:** Problems involving geometric shapes, such as cutting a cake or arranging dominos.
- **Data-Driven Logic:** Puzzles requiring deduction based on given clues (e.g., Blood Relations).

1.9.2 Puzzles solving



1.9.3 Reasoning Puzzle Questions

The concept of reasoning puzzles is based entirely on logical analysis of the data given in the puzzle. Candidates only need to consider the information mentioned in the question and

accordingly answer them.

Directions (Q1 – Q5): Read the data given below carefully and answer the following questions:

Eight friends Vandana, Aparna, Devika, Arunima, Charu, Nandita, Sagarika and Fatima went shopping. Each of them bought shoes from 8 different brands – Puma, Reebok, Adidas, Bata, Nike, Woodland, Lee Cooper and Fila but not necessarily in the same order.

- The colour of each pair of shoes was different – black, white, brown, pink, green, grey, blue and purple but not necessarily in the same order
- Devika did not buy the purple colour shoes but shopped from Woodland
- Vandana and Charu did not buy brown shoes
- Vandana doesn't like Puma
- Fatima doesn't like Fila but bought a pink pair of shoes
- Aparna's favourite colour is blue and she bought the shoes of her favourite colour
- Nandita shopped at Bata
- Arunima likes Adidas and bought her grey colour shoes from there
- The one who shopped at Reebok has brown shoes and the one who bought Green shoes shopped at Puma
- The one who likes Nike bought black shoes

Q 1. Which of the given sets is incorrect?

a) Vandana – Nike – Black
b) Devika – Woodland – White
c) Nandita – Bata – Purple
d) Charu – Bata – Green
e) Arunima – Adidas – Grey

Answer:(d) Charu-Bata-Green

Q 2. Which brand shoes did Devika buy?

a) Woodland
b) Fila
c) Nike
d) Reebok

e) Lee Cooper

Answer:(a)Woodland

Q 3. If Fatima bought shoes from Lee Cooper. What was the colour of the shoes she bought?

a) Brown
b) Pink
c) Purple
d) Black
e) Grey

Answer:(b) Pink

Q 4. Which of the below-given pairs of shoe brands and their colour is correct?

a) Reebok – Black
b) Puma – Green
c) Nike – Pink
d) Woodland – Green
e) Lee Cooper – Blue

Answer: (b)Puma-Green

Q 5. Which colour shoes did Arunima buy?

a) Black
b) Purple
c) White
d) Blue
e) Grey

Answer: (5) Grey

Solution (Q1-Q5):

Vandana	Nike	Black
Aparna	Fila	Blue
Devika	Woodland	White
Arunima	Adidas	Grey

Charu	Puma	Green
Nandita	Bata	Purple
Sagarika	Reebok	Brown
Fatima	Lee Cooper	Pink

Check Your Progress

I) Number Series: Directions (Q1 – Q3): For the given number series, find what will come in place of the question mark (?)

Q 1) **2 10 50 ? 1250 6250**

a) 125
b) 450
c) 100
d) 250
e) 150

Answer: (d) 250

Solution:

2×5 = 10
10×5 = 50
50×5 = 250
250×5 = 1250
1250×5 = 6250

Q 2) **5. 5 7.5 ? 37.5 112.5**

a) 10.5
b) 12
c) 15
d) 15.5
e) 17

Answer: (c) 15

Solution:

$5 \times 1 = 5$

$5 \times 1.5 = 7.5$

$7.5 \times 2 = 15$

$15 \times 2.5 = 37.5$

$37.5 \times 3 = 112.5$

Q 3) **15 19 28 ? 69 105**

a) 44

b) 46

c) 45

d) 47

e) 48

Answer: (a) 44

Solution:

$15 + 22 = 19$

$19 + 32 = 28$

$28 + 42 = 44$

$44 + 52 = 69$

$69 + 62 = 105$

II) Letter Series: (Q1 – Q3): For the given letter series, find what will come in place of the underline (_____).

Q1) **SCD, TEF, UGH, ___, WKL**

a) CMN

b) UJI

c) VIJ

d) IJT

Answer: (c) VIJ

Explanation:

In this letter series, each letter is shifted one position forward in the English alphabet. Starting with "SCD," we have:

S + 1 = T

C + 1 = D

D + 1 = E

Continuing this pattern:

U + 1 = V

G + 1 = H

So, the missing term is "VIJ."

Q2) **B2CD, ____, BCD4, B5CD, BC6D**

a) B2C2D

b) BC3D

c) B2C3D

d) BCD7

Answer: (c) BC3D

Explanation:

In this letter and number series, the pattern is as follows:

The letter "B" appears at the beginning of each term.

The number represents a sequential count starting from 2 and increasing by 1 with each term.

The letters "C" and "D" appear in each term.

So, the missing term would be "BC3D" as it continues the pattern.

Q3) **DFH, HJL, LNP, ___, TVX**

a) DTV

b) NRT

c) PRT

d) RQS

Answer: (c) PRT

Explanation:

In this letter series, each letter is shifted two positions forward in the English alphabet, and the next letter is added. Starting with "DFH," we have:

D + 2 = F
F + 2 = H
H + 2 = J
Continuing this pattern:
P + 2 = R
R + 2 = T
So, the missing term is "PRT."

III) Seating Arrangement Reasoning: (Q1 – Q3)

Q1). There are 8 people sitting around a circular table. A is sitting to the immediate left of B, who is third to the left of C. D is sitting between C and E, and F is sitting to the immediate right of E. Who is sitting to the immediate left of D?

a) B

b) C

c) E
d) F

Answer: b) C

Explanation:

Circular arrangement will be: B, _, _, C, D, E, F, A, B (from right of B). The two positions are not mentioned in question but it does not matter as it only asked about the immediate left of D.

Q2) There are six persons sitting in a row facing North. A is sitting towards immediate left of B and immediate right of C. C is sitting to immediate right of F. D is immediate right of E who is to the left of F, then which two people are sitting in the center?

a) D and B
b) A and B
c) F and C
d) E and D

Answer: c) F and C

Explanation:

The seating arrangement is: E, D, F, C, A, B.
F and C are sitting in the center.

Q3. In a row of 5 persons, A is sitting third to the right of B and fourth to the right of C. D is sitting immediate left of A and immediate right of E. Who is sitting at the extreme left end?

a) A
b) B
c) C
d) D

Answer: c) C

Explanation:

The seating arrangement is: C, B, E, D, A.
C is sitting at the extreme left end.

IV) Blood Relation: (Q1 – Q3)

Q1) A woman introduces a man as the son of the brother of her mother. How is the man related to the woman?

(a) Brother
(b) Uncle
(c) Nephew
(d) Cousin

Answer: (d) Cousin

Explanation:

Woman's mother's brother is her maternal uncle.

The man is the son of her maternal uncle => Cousin .

Q2) If A is the brother of B, C is the sister of B, and B is the father of D, how is D related to A?

(a) Nephew/Niece

(b) Niece

(c) Nephew

(d) Cousin

Answer: (a) Nephew/Niece

Explanation:

A is the brother of B => A and B are siblings.

C is the sister of B => A,B,C are siblings.

B is the father of D => D is nephew / niece for both A and B

Q3) If A is the mother of B, B is the son of C, and C is the brother of D, how is D related to A?

(a) Brother-in-law

(b) Uncle

(c) Nephew

(d) Cousin

Answer: (a) Brother-in-law

Explanation:

A is the mother of B => A is a female.

B is the son of C => C is a parent (Mother/Father) of B.

C is the brother of D => C is a male and C is B's Father => D is B's Uncle/Aunt and A's Brother-in-law/Sister-in-law

Self-Assessment Questions

Small Questions – LOCF Mapping Table

S.No	Small Question	CO	Bloom's Level	PO
1	Describe the uses of Numerical Reasoning?	CO1	Understanding	PO1
2	List the Steps to Solve Number Series	CO2	Remembering	PO1
3	Mention the Common Types of Blood Relation Questions.	CO2	Remembering	PO2
4	brief the Seating Arrangement Questions	CO3	Understanding	PO3
5	How do you prepare for a Numerical reasoning Test?	CO4	Applying	PO4

Big Questions – LOCF Mapping Table

S.No	Big Question	CO	Bloom's Level	PO
1	Explain different types of Questions on Number Series	CO1	Understanding	PO1
2	Describe the Classification of Numbers	CO2	Understanding	PO1
3	Analyze the Different Blood Relation Terms.	CO2	Analyzing	PO2
4	What are the Points to be remembered before solving Questions on Direction?	CO3	Remembering	PO3
5	Explain various types of Letter Series Patterns.	CO4	Understanding	PO4

UNIT II

COMBINATORICS

2.1 Combinatorics

2.2 Multiplication Principle

2.3 Addition Principle

2.4 Permutations

2.5 Combination

2.1 Combinatorics

Combinatorics is a branch of mathematics that focuses on studying the selection, arrangement, and operation of countable discrete structures. This is essential in computer science because it can be used to solve problems regarding statistics and probability. Moreover, combinatorics also plays a big role in the optimization of various applications. Combination and Permutation are two terms that are often used to solve problems in combinatorics.

2.1.1 Meaning and Definition

Combinatorics is a branch of mathematics focused on counting, arranging, and analyzing finite sets. It deals with the study of combinations, permutations, and the structures that arise from these arrangements.

Combinatorics is the mathematics of counting and arranging. Of course, most people know how to count, but combinatorics applies mathematical operations to count quantities that are much too

large to be counted the conventional way. Combinatorics is especially useful in computer science.

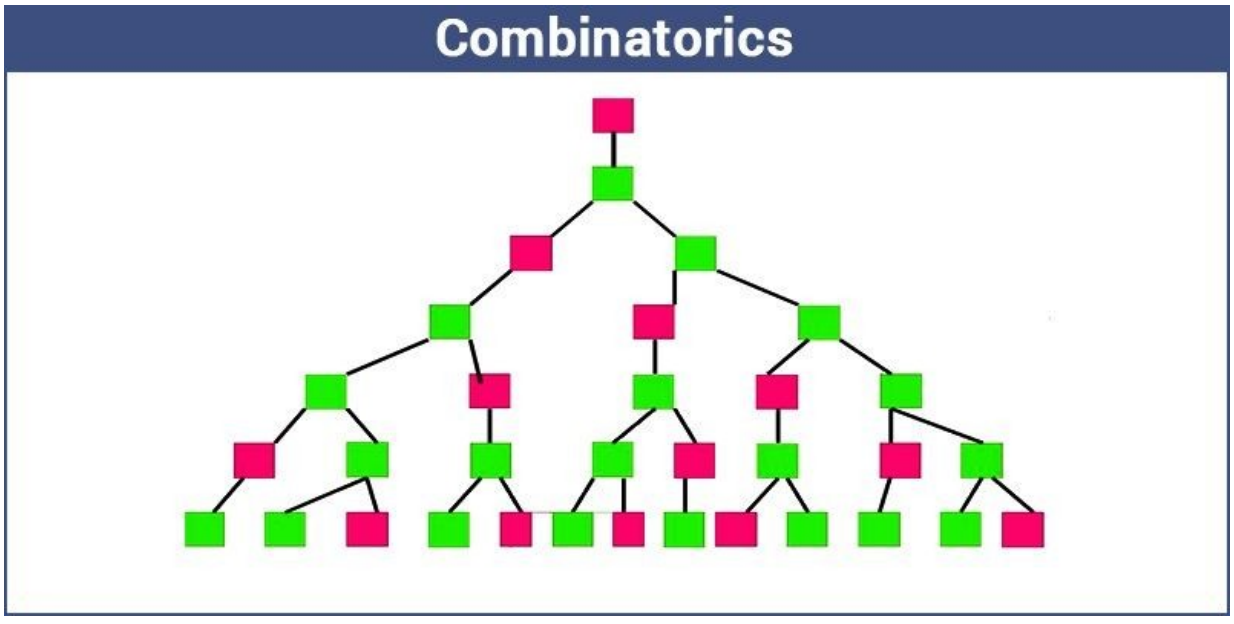
Combinatorics can help us count the number of orders in which something can happen. It is an area of mathematics primarily concerned with counting, both as a means and as an end to obtaining results, and certain properties of finite structures.

2.1.2 Applications of Combinatorics

Combinatorics is applied in most of the areas such as:

- Communication networks, cryptography and network security
- Computational molecular biology
- Computer architecture
- Scientific discovery
- Languages
- Pattern analysis
- Simulation
- Databases and data mining
- Homeland security
- Operations research

2.1.3 Features of combinatorics



Some of the important features of the combinatorics are as follows:

- Counting the structures of the provided kind and size.
- To decide when particular criteria can be fulfilled and analyzing elements of the criteria, such as combinatorial designs.
- To identify “greatest”, “smallest” or “optimal” elements, known as external combinatorics.

Combinatorial structures that rise in an algebraic concept, or applying algebraic techniques to combinatorial problems, known as algebraic combinatorics.

2.1.4 Uses of Combinatorics

Combinatorics has numerous applications across various fields. Here are some key areas where combinatorics is used:

- ***Probability Theory:*** Combinatorics helps in calculating probabilities by counting the number of favorable outcomes over the total possible outcomes.
- ***Graph Theory:*** Used to study graphs, which are structures made up of nodes connected by edges.
- ***Design and Analysis of Experiments:*** Combinatorial designs help in planning experiments to ensure that the data collected is statistically valid and can be analyzed effectively.
- ***Algorithms and Data Structures:*** Combinatorial algorithms are used in sorting, searching, and optimization problems.

2.1.5 Combinatorics -Counting Techniques

In combinatorics, counting techniques help solve problems involving arrangements and selections. Some key techniques include:

- ***Multiplication Principle:*** If one event can occur in "m" ways and another in "n" ways, then both can occur in m × n ways.
- ***Addition Principle*****:** If events are mutually exclusive, count each separately and add.
- ***Permutations:*** Arrangements where order matters (n! / (n-r)!).
- ***Combinations:*** Selections where order doesn't matter (nCr = n! / (r!(n-r)!)).

2.2 Multiplication Principle

If one event can occur in "m" ways and another in "n" ways, then both can occur in m × n ways. If there are n ways to perform task A and m ways to perform task B, and these tasks are independent (i.e., performing one does not affect the other), then there are n×m ways to perform both tasks.

Example: If you have 3 shirts and 4 pants, there are 3×4 = 12 ways to choose a shirt and a pant.

Common Examples:

- **Menu Combinations:** A lunch special with 5 sandwiches, 7 sides, and 4 drinks offers $5×7×4=140$ possible combinations.
- **Outfits:** If you have 3 shirts and 4 pairs of pants, you can create $3×4=12$ different outfits.
- **Passwords/Codes:** A 3-letter, 2-digit password (using 26 letters and 10 digits) has $26×26×26×10×10=1,757,600$ possibilities.
- **Travel Routes:** Choosing from 15 hotels, 6 rental cars, and 8 flights results in $15×6×8=720$ total vacation combinations.
- **Coin Tosses:** Tossing three coins simultaneously results in $2×2×2=8$ possible outcomes (heads or tails for each).
- **Device Options:** A tablet with 2 screen sizes, 3 storage capacities, and 2 cover colors has $2×3×2=12$ total options.

Example Question

You're ordering a pizza with 3 crust options (thin, thick, or garlic) and 2 topping options (cheese or veggie). How many different pizza combinations can you make?

Solution:

Using the multiplication principle:

- Crust options: 3
- Topping options: 2

Total combinations = 3 × 2 = 6

You can make 6 different pizzas:

i. Thin crust with cheese
ii. Thin crust with veggie
iii. Thick crust with cheese

iv. Thick crust with veggie

v. Garlic crust with cheese

vi. Garlic crust with veggie

2.3 Addition Principle

If events are mutually exclusive, count each separately and add. If there are n ways to perform task A and m ways to perform task B, and these tasks cannot be done simultaneously, then there are n + m ways to choose one of these tasks.

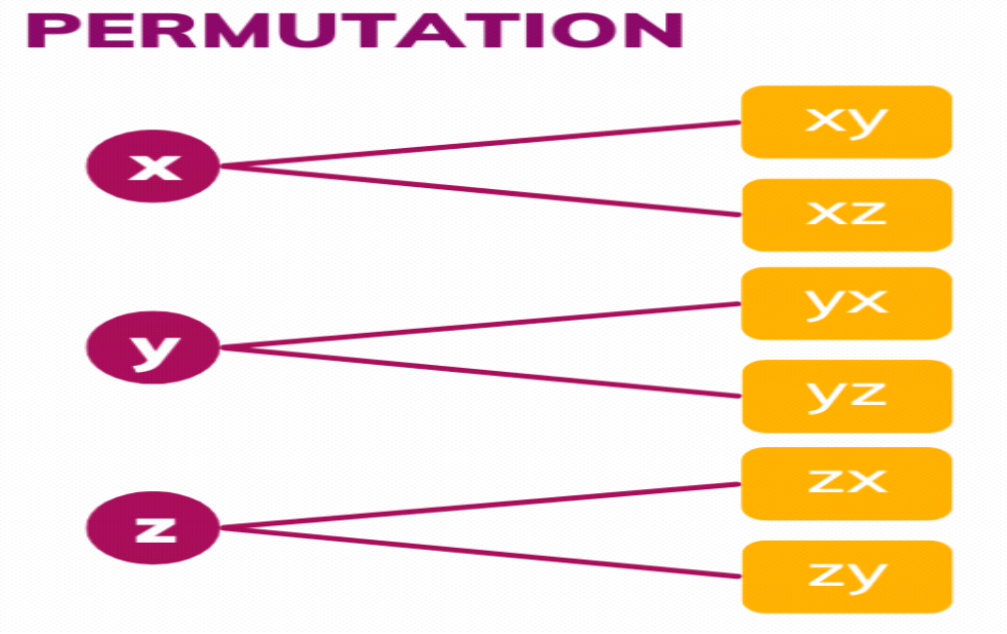
Example: If you have 3 shirts and 4 pants, there are 3+4 = 7 ways to choose either a shirt or a pant.

Common Examples:

- **Menu Choices:** If a lunch menu has 10 pizza options and 7 soup options, there are 10+7=17 total ways to choose a single item.
- **Transportation:** A student can travel to school by bus (3 routes) or by train (2 routes), resulting in 3+2=5 total travel options.
- **Clothing Selection:** If you have 5 shirts and 3 pairs of pants, and you must choose just one item to wear, you have 5+3=8 choices.
- **Classroom Setup:** A class consists of 18 freshmen and 7 sophomores. The total number of students is 18+7=25
- **Product Selection:** A bakery sells 20 different cupcakes, 10 donuts, and 15 muffins. Selecting one treat gives 20+10+15=45 total options.

2.4 Permutations

In Mathematics, a Permutation is defined as a mathematical concept that determines the number of possible arrangements for a specific set of elements.

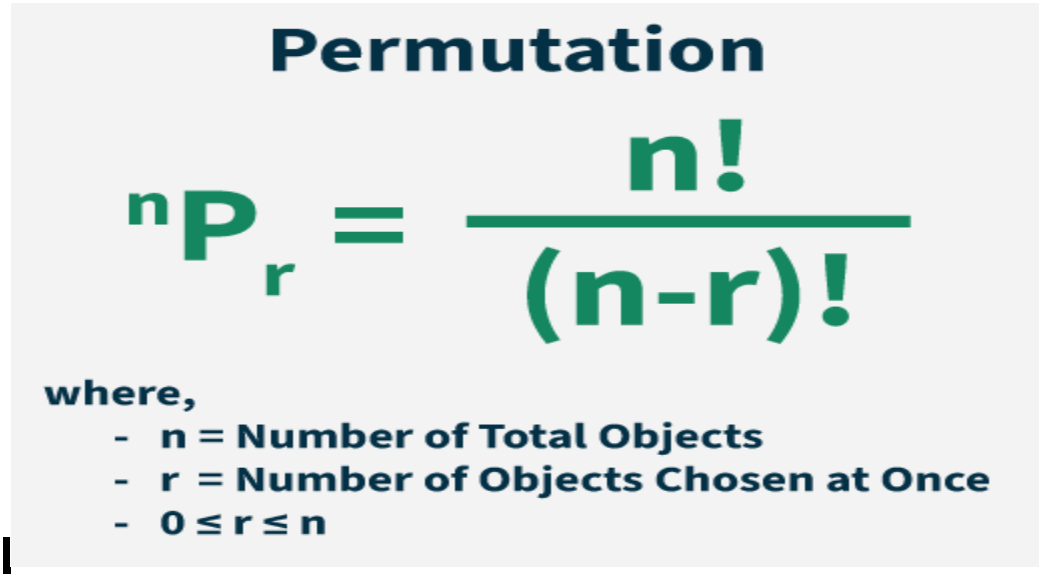


Permutation: xy, yx, yz, zy, zx, and xz

2.4.1 Permutation Formula

The permutation formula is used to calculate the number of ways to arrange a subset of objects from a larger set where the order of selection matters.

The formula for Permutation is given as follows,



Derivation of Permutation Formula

To derive the formula for permutation, we can use the first principle of counting

If an event can occur in m different ways, and another event can occur in n different ways, then the total number of occurrences of the events is m × n.

By the definition of permutation and the principle of counting, we know

$^nP_r = n \times (n - 1) \ldots (n - r + 1)$

This product is exactly:

$P(n, r) = n! / (n-r)!$

Note that there are n ways to pick an item for the first position, (n - 1) ways to pick the second and so on.

2.4.2 Properties of Permutations

Some of the common properties of permutations are listed as follows:

- $^nP_n = n\ (n-1)\ (n-2) \ldots 1 = n!$
- $^nP_0 = n! / n! = 1$
- $^nP_1 = n$
- $^nP_{(n-1)} = n!/1 = n!$
- $^nP_r / {}^nP_{r-1} = n - r + 1$
- $^nP_r = n \times {}^{n-1}P_{r-1} = n \times (n-1) \times {}^{n-2}P_{r-2} = n \times (n-1) \times (n-2) \times {}^{n-3}P_{r-3} =$ and so on.
- $^{n-1}P_r + r \times {}^{n-1}P_r\text{-}1 = {}^nP_r$

2.4.3 Solved Examples of Permutation

Let's consider some problems based on the derived formula to better understand its use.

Example 1: Find $^6P_3$

As per the formula,

$^nP_r = n! / (n - r)!$

$^6P_3 = 6! / (6-3)!$

$= 6 \times 5 \times 4 = 120$

Example 2: Find n if $^nP_2 = 12$

$^nP_r = n! / (n - r)!$

$\Rightarrow {}^nP_2 = n! / (n - 2)!$

$\Rightarrow {}^nP_2 = n \times (n - 1) \times (n - 2)! / (n - 2)!$

$\Rightarrow {}^nP_2 = n \times (n - 1)$

$\Rightarrow {}^nP_2 = n^2 - n$

$\therefore n^2 - n = 12$

Solving the equation,

$n^2 - n - 12 = 0$

$\Rightarrow n(n - 4) + 3(n - 4) = 0$

$\Rightarrow (n + 3)(n - 4) = 0$

$\therefore n = -3 \text{ or } n = 4$

$\because n \geq 0$

Thus, n = 4

2.4.4 Types of Permutation

Permutation can be classified in three different categories:

- Permutation of n different objects (when repetition is not allowed)
- Repetition, where repetition is allowed
- Permutation when the objects are not distinct (Permutation of multi sets)

Let us understand all the cases of permutation in details.

- ***Permutation of n different objects (without repetition)***

If n is a positive integer and r is a whole number, such that r < n, then P(n, r) represents the number of all possible arrangements or permutations of n distinct objects taken r at a time. In the case of permutation without repetition, the number of available choices will be reduced each time. It can also be represented as: ${}^nP_r$.

P(n, r) = n(n-1)(n-2)(n-3)……..up to r factors

P(n, r) = n(n-1)(n-2)(n-3)……..(n – r +1)

$$\Rightarrow P(n,r) = \frac{n!}{(n-r)!}$$

Here, "${}^nP_r$" represents the "n" objects to be selected from "r" objects without repetition, in which the order matters.

Example 1:

How many 3 letter words with or without meaning can be formed out of the letters of the word SWING when repetition of letters is not allowed?

Solution:

Here n = 5, as the word SWING has 5 letters. Since we have to frame 3 letter words with or without meaning and without repetition, therefore total permutations possible are:

$$\Rightarrow P(n,r) = \frac{5!}{(5-3)!} = \frac{5\times4\times3\times2\times1}{2\times1} = 60$$

Example 2:

How many 3-digit numbers divisible by 3 can be formed using the , digits 2, 4, 6, and 8 without repetition?

For a number to be divisible by 3, the sum of it digits must be divisible by 3

From the given set, various arrangements like 444 can be formed but since repetition isn't allowed we won't be considering them.

We are left with just 2 cases i.e. 2, 4, 6 and 4, 6, 8

Number of arrangements are 3! in each case

Hence the total numbers of permutations are: 3! + 3! = 12.

- ***Permutation when repetition is allowed***

We can easily calculate the permutation with repetition. The permutation with repetition of objects can be written using the exponent form.

When the number of object is **"n,"** and we have **"r"** to be the selection of object, then;

Choosing an object can be in n different ways (each time).

Thus, the permutation of objects when repetition is allowed will be equal to,

$n \times n \times n \times \ldots\ldots$(r times) $= n^r$

This is the permutation formula to compute the number of permutations feasible for the choice of "r" items from the "n" objects when repetition is allowed.

Example1:

How many 3 letter words with or without meaning can be formed out of the letters of the word ***SMOKE*** when repetition of words is allowed?

Solution:

The number of objects, in this case, is 5, as the word SMOKE has 5 alphabets, and r = 3, as 3-letter word has to be chosen.

Thus, the permutation will be:

Permutation (when repetition is allowed) = $5^3 = 125$

Example2:

How many 3-digit numbers greater than 500 can be formed using 3, 4, 5, and 7?

Since a three-digit number greater than 500 will have either 5 or 7 at its hundredth place, we have ***2 choices*** *for this place.*

*There is no restriction on the repetition of the digits hence, for the remaining 2 digits****;*** *we have* ***4 choices for*** *each*

So the total permutations are,

$2 \times 4 \times 4 = 32$

- ***Permutation of multi-sets***

Permutation of n different objects when P_1 objects among '**n**' objects are similar, P_2 objects of the second kind are similar, P_3 objects of the third kind are similar …… and so on, P_k objects of the kth kind are similar and the remaining of all are of a different kind,

Thus it forms a multiset, where the permutation is given as:

$$\frac{n!}{P_1!\, P_2!\, P_3 \ldots\ldots P_n!}$$

Example:

Find the number of ways of selecting 6 balls from 4 red, 6 blue, and 5 white given that the selection must have 2 balls of each color.

Solution:

We need to select 2 balls each of color red, blue and white as per the given condition.

Number of ways of selecting 2 red balls is ${}^4C_2$

Number of ways of selecting 2 blue balls is ${}^6C_2$

Number of ways of selecting 2 white balls is ${}^5C_2$

Hence, the total ways of selection are ${}^4C_2 \times {}^6C_2 \times {}^5C_2 = 900$

2.4.5 Difference between Permutation and Combination

The major difference between the permutation and combination are given below:

Permutation	Combination
Permutation means the selection of objects, where the order of selection matters	The combination means the selection of objects, in which the order of selection does not matter.
In other words, it is the arrangement of r objects taken out of n objects.	In other words, it is the selection of r objects taken out of n objects irrespective of the object arrangement.
The formula for permutation is $^nP_r = n! /(n-r)!$	The formula for combination is $^nC_r = n!/[r!(n-r)!]$

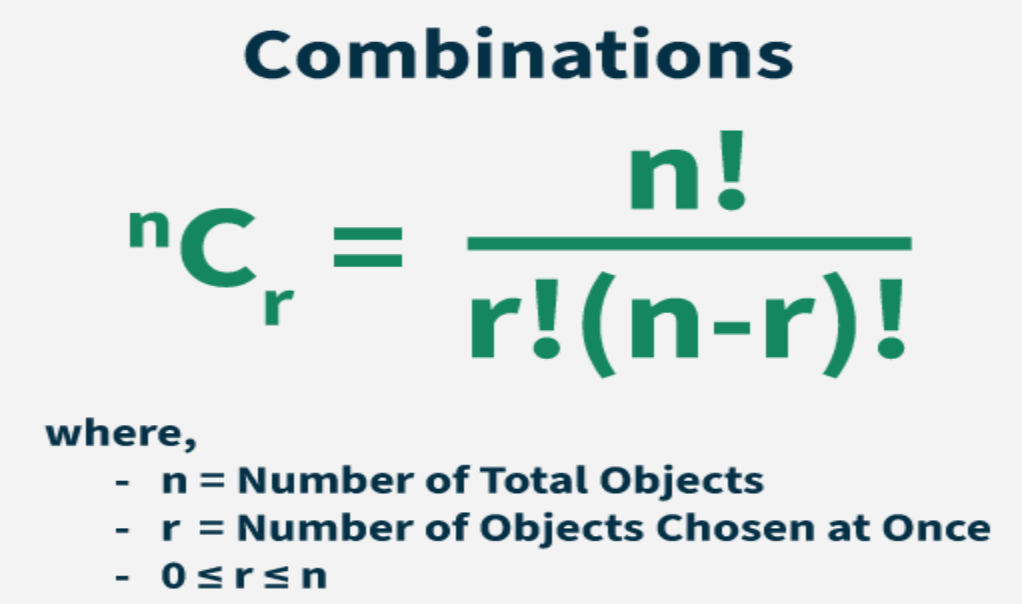
2.5 Combination

A combination is a mathematical technique that determines the number of possible arrangements in a collection of items where the order of the selection does not matter.

Combination: xy, yz, and zx

2.5.1 Combinations Formula

The number of combinations when 'r' elements are selected out of a complete set of 'n' elements is denoted by **nCr** and is given by formula:



Example 1:

Let n = 4 (E, F, G, H) and r = 2 (consisting of all the combinations of size 2).

$^nC_r = {}^4C_2$

$\Rightarrow {}^4C_2 = 4!/((4-2)! \times 2!)$

$\Rightarrow {}^4C_2 = (4 \times 3 \times 2 \times 1)/(2 \times 1 \times 2 \times 1) = 6$

The six combinations are EF, EG, EH, FG, FH, and GH.

Example 2:

In how many ways 6 boys can be arranged in a queue such that

a) Two particular boys of them are always together

b) Two particular boys of them are never together

Solution:

a) *If two boys are always together, then they will be treated as one entity. Hence we can be arranged 5 boys in 5! ways. Also, two boys can arrange themselves in 2 different ways.*

Therefore required arrangement = 5! × 2 = 120 × 2 = 240 ways.

b) *Total number of permutations among 6 numbers is given by = 6! = 720.*

In 240 cases 2 boys are always together.

Thus, for two boys who are never together no of ways will be = 720 – 240 = 480 ways.

Example 3:

In the function, if every person shakes hands with every other in the party and there exists a total of 28 handshakes at the party, find the number of persons who were present in the function.

Solution:

Suppose there are n persons present at a party and every person shakes hands with every other person.

Then, total number of handshakes = nC2 = n(n - 1)/2

$\Rightarrow n(n - 1)/2 = 28$

$\Rightarrow n(n - 1) = 28 \times 2$

$\Rightarrow n(n - 1) = 56$

$\Rightarrow n = 8$

2.5.2 Probability of Combinations

Combination probability, also known as the probability of combinations, involves the process of determining the possibility of specific subset from a large set regardless to the order in which the subsets are chosen. Combination probability has wide range of application in games, statistics, gambling, genetics, etc. Probability of Combinations can be easily understood with the help of the examples given below:

Example 1:

How many ways are possible to distribute 7 different candies to 3 people where each gets only 1 candy?

Solution:

For the first people, we can choose any of the candy among the 7 candies available. Similarly, for the 2nd person we are left with 6 choices and for the 3rd, we will be having 5 choices. So, the number of ways of distributing candies = 7 × 6 × 5 = 210 ways

Example 2:

In how many ways can the letters of the word 'POWER' be arranged?

Solution:

Letters of the word 'POWER' can be arranged in 5! ways i.e. 5 × 4 × 3 × 2 × 1 ways

= 120 ways.

Example 3:

How many six-digit numbers can be formed with digits 2,3,5, 6, 7, and 9 and with distinct digits?

Solution:

Number of distinct ways of forming 6-digit numbers with different digits is

6! = 6 × 5 × 4 × 3 × 2 × 1 ways

= 720 ways.

Example 4:

The principle would like to assemble a committee of 6 students from the 11 member student council. How many different committees can be chosen?

Solution:

We will use the formula, where, ${}^{n}C_{r} = n!/(n-r)!r!$

Now, after putting thee values we get, ${}^{11}C_{6} = 11!/(11-6)!\cdot 6!$

= 11! / 5!·6! = 11×10×9×8×7 / 5×4×3×2×1 =66×7 = 462

∴ 462 committees can be chosen.

Check Your Progress

Multiplication principle: (Q1 – Q2)

Q1: A cafe offers 2 types of coffee (latte, cappuccino) and 3 flavors of syrup (vanilla, hazelnut, caramel). How many different coffee combinations can be made?

A) 2
B) 3
C) 5
D) 6

Answer: D) 6

Solution

Using the multiplication principle: 2 coffee types × 3 syrup flavors = 6 combinations

Q2) A shop has 4 types of shirts and 3 types of pants. How many different shirt-pant combinations can be made?

A) 3
B) 4
C) 7
D) 12

Answer: D) 12

Solution

Using the multiplication principle: 4 shirts × 3 pants = 12 combinations

Addition principle: (Q1 – Q2)

Q1) In a library, 12 books are fiction, and 8 books are non-fiction. How many books is either fiction or non-fiction (assuming no book is both)?

A) 4
B) 12
C) 20
D) 96

Answer) 20

Solution: *(12 + 8 = 20)*

Q2) A cafe has 5 types of tea and 3 types of coffee. How many beverage options are either tea or coffee (assuming no overlap)?

A) 2
B) 5
C) 8
D) 15
Answer: C) 8

Solution : *(5 + 3 = 8)*

Permutation: (Q1 – Q3)

Q1) the number of ways in which 8 students can be seated in a line is

a) 5040
b) 50400
c) 40230
d) 40320

Answer: (d) 40320

Explanation:

For the 1st position, there are 8 possible choices. For the 2nd position, there are 7 possible choices. For the 3rd position, there are 7 possible choices, etc. And for the eighth position, there is only one possible choice. Hence, this can be written as 8!
(i.e.) 8! = 8×7×6×5×4×3×2×1=40,320
Hence, the number of ways in which 8 students can be seated in a line is 40320.

Q2) The number of ways 4 boys and 3 girls can be seated in a row so that they are alternate is

a) 12
b) 104
c) 144
d) 256

Answer: (c) 144

Explanation:

Given that, there are 4 boys and 3 girls.
The only pattern 4 boys and 3 girls are arranged in an alternate way is BGBGBGB.
Therefore, the total number of ways is 4!×3! = 144.

Q3) There are 10 true-false questions in an examination. These questions can be answered in:

a) 20 ways
b) 100 ways
c) 512 ways
d) 1024 ways

Answer: (d) 1024 ways

Explanation:
Given that there are 10 questions.
Each question can be answered in two ways. (i.e. either true or false).
Hence, the number of ways these questions can be answered is 2^{10}, which is equal to 1024.

Combination Probability: (Q1 – Q4)

Q1) In a team, 3 boys and 4 girls are there. Among them 4 members need to be selected for one round of a game. Find the probability of selecting an equal number of boys and girls?
Solution:

Probability of selecting an equal number of boys and girls = $(4C_2 \times 3C_2)/7C_4$
$(4C_2 \times 3C_2)/7C_4 = 18/35$
Hence probability of selecting equal number of boys and girls is 18/35

Q2) What is the number of possible combinations to choose 6 numbers from a set of 49 numbers?
Solution:

$^{49}C_6 = 49!/6!\ (49-6)!$
$^{49}C_6 = 49!/(6! \times 43!)$ possible ways.

Q3) What is the number of ways need to form a group of 3 people from a group of 10?
Solution:

$^{10}C_3 = 10!/3!(10-3)!$
$^{10}C_3 = 10\times9\times8/3\times2\times1$
$^{10}C_3 = 120$
∴There are 120 different ways to do this.

Q4) How many ways can 8 students be chosen from a class of 21?
Solution:

$^{21}C_8 = 21!/8!\times(21-8)!$
$^{21}C_8 = (21\times20\times19\times18\times17\times16\times15\times14)/(8\times7\times6\times5\times4\times3\times2\times1)$
$^{21}C_8 = 203{,}490$
∴ There are 203,490 ways to chose from a class of 21.

Self-Assessment Questions

Small Questions – LOCF Mapping Table

S.No	Small Question	CO	Bloom's Level	PO
1	Define combinatorics.	CO1	Remembering	PO1
2	List the applications of combinatorics	CO2	Remembering	PO1
3	Describe multiplication principle with suitable example.	CO2	Understanding	PO2
4	Explain the properties of permutation.	CO3	Understanding	PO3
5	Brief note on combinations formula.	CO4	Understanding	PO4

Big Questions – LOCF Mapping Table

S.No	Big Question	CO	Bloom's Level	PO
1	Give the features of combinatorics.	CO1	Remembering	PO1
2	Draw the common examples of addition principle	CO2	creating	PO1
3	Enumerate the different types of permutation.	CO2	Remembering	PO2
4	Explain the difference between permutation and combination.	CO3	Understanding	PO3
5	Discuss in detail about probability of combinations.	CO4	analyzing	PO4

UNIT III

SYLLOGISMS AND DATA SUFFICIENCY

3.1 Syllogisms

The word syllogism is derived from the Greek word "syllogismos" which means "conclusion, inference". Syllogisms are a logical argument of statements using deductive reasoning to arrive at a conclusion. A syllogism is a form of deductive reasoning where a valid, logical conclusion is drawn from two assumed true premises (a major and a minor premise). Originating from Aristotle, this three-part argument structure (e.g., All men are mortal; Socrates is a man; therefore, Socrates is mortal) is crucial for logical analysis.

3.1.1 Key Components

- **Major Premise**: A general statement (e.g., All A are B).
- **Minor Premise**: A specific statement relating to the major premise (e.g., C is A).
- **Conclusion:** The logical deduction from the two premises (e.g., Therefore, C is B).

Example:

- *Major Premise:* All mammals are animals.
- *Minor Premise 2:* All whales are mammals.
- *Conclusion:* Therefore, all whales are animals.

3.1.2 Key aspects of syllogism

The main aspects of syllogism include:

Structure: Comprises a Major Premise (general rule), Minor Premise (specific instance), and Conclusion.

Validity vs. Truth: A syllogism can be valid (logically sound) even if the premises are false, but it is only true if the premises are true.

Components: Uses terms like "All," "No," "Some," or "Some are not" to define relationships between categories

Solving Methods: Commonly solved using Venn Diagrams to visualize connections or by analytical rules (e.g., All + All = All).

3.1.3 Types of **syllogism**

- **Categorical:** All birds have feathers. A robin is a bird. Therefore, a robin has feathers.
- **Conditional (Hypothetical):** If it rains, the ground gets wet. It is raining. Therefore, the ground is wet.
- **Disjunctive (Either/Or):** Either the light is on, or it is off. The light is not on. Therefore, the light is off.

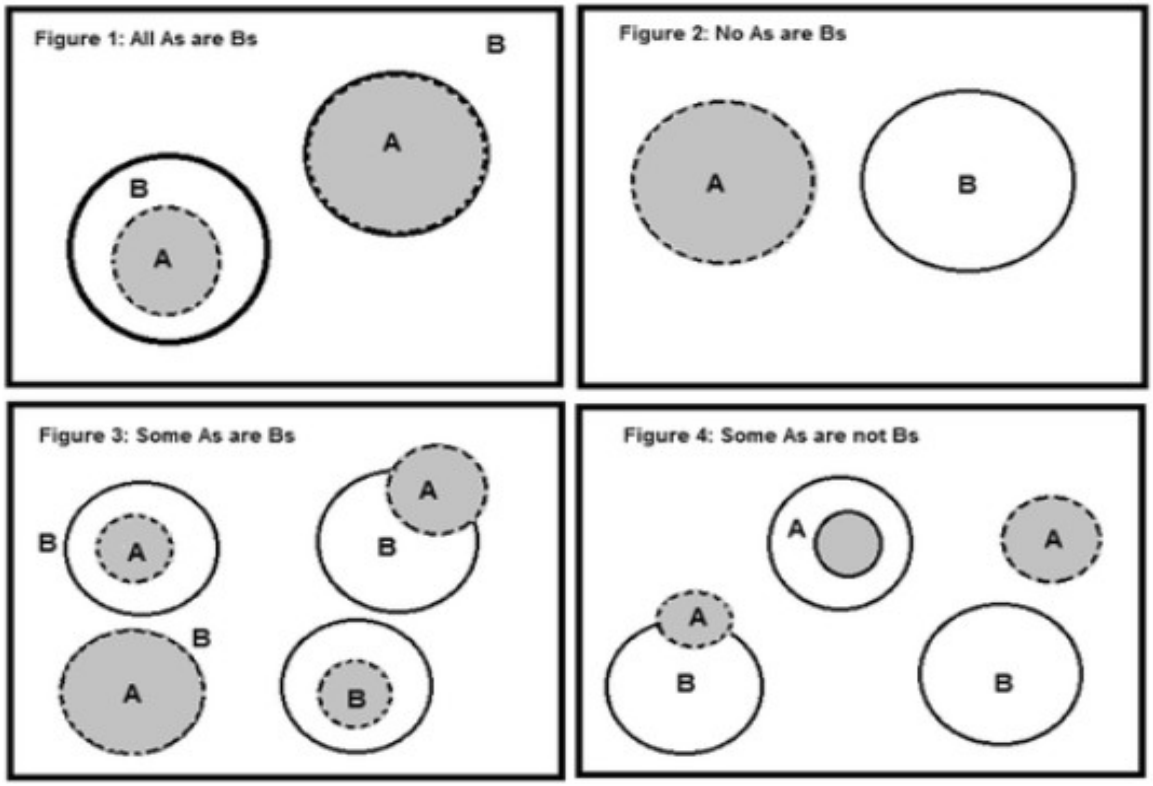
3.2 Syllogism Tricks

Syllogism questions are a part of the reasoning. This question contains a few statements followed by two conclusions. A few of the options are later given, out of which the correct option is needed to be chosen.

The syllogism questions are either attempted with logic or with Venn diagrams. Mostly a Venn diagram approach is more successive for such questions. The reason is it gives a more clear perspective about the answer and is mostly true.

All the cases that can be made into a syllogism question are listed below.
There are 4 cases,

- All A's are B's.
- No A's are B's.
- Some A's are B's.
- Some A's are not B's.



As per the given statements, any one of the 4 cases will fit in, for which we will draw Venn diagrams. And similarly, for other sentences, we will again draw Venn diagrams and try to combine those diagrams. These will result in multiple Venn diagrams.

If the conclusion is true as per all the Venn diagrams then the conclusion is true, and if the conclusion is false in any one of the Venn diagrams then the conclusion is false. Thus, we can summarise these as if the statement is true in all diagrams, it is true. If it is not true for even a single statement, it is false.

3.2.1 Multiple choices of Syllogism

A statement and conclusion question generally has two conclusions, and out of these two conclusions. A few of the available options can be:

- Only Conclusion I is true/ false.
- Only Conclusion II is true/ false.
- Only Conclusion I follow.
- Only Conclusion II follows.
- Conclusion I follow, but II does not.

- Conclusion II follows, but I do not.
- Any one of the conclusions can be true.
- Either conclusion I or conclusion II follows.
- Both the conclusions are true/ false.
- None of the conclusions follows.
- None follows.

These are the few options that may be available as your solution.

3.3 Approaches of syllogism

3.1.6 Different approaches of syllogism

There have two approaches namely logical approach and venn diagram approach are using to solve syllogism.

- ***Logical Approach to solve Syllogism***

The logical approach is the basic approach to solving questions related to syllogism. Let's try a question with this approach to understand it better.

Statements: All tigers are Cats.

Some cats are wild.

Conclusion I: All cats are wild.

Conclusion II: Tigers are wild.

As per the statements, all tigers are cats. Therefore, every single tiger is a cat. In the second statement, it is stated that some cats are Wild. Therefore, some cats may be wild, but if it includes tigers or not is not mentioned. Thus, we can see that none of the sentences is true.

- ***Venn diagram to solve Syllogism***

Statements: All tigers are Cats.

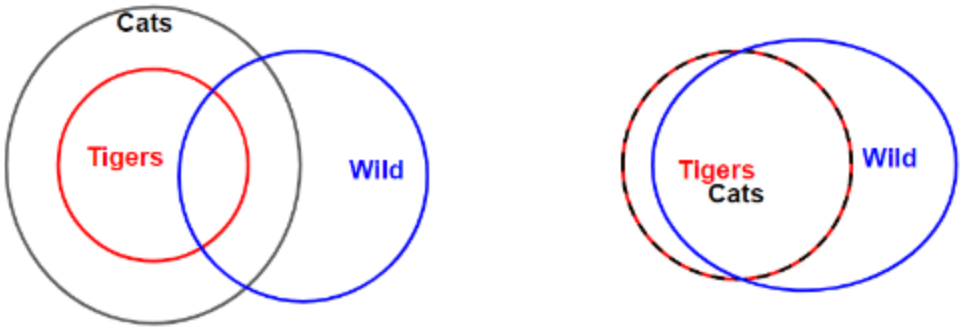
Some cats are wild.

Conclusion I: All cats are wild.

Conclusion II: Tigers are wild.

The question can be solved with the help of a Venn diagram, but in a Venn diagram approach, multiple diagrams are needed to be drawn to check whether a particular conclusion can be applied or not. A few of the diagrams that can help to answer this question are shown below, although we need multiple diagrams to answer the question.

The statement can be written in following manner



The main idea of the Venn diagram approach is that to state that a conclusion is true, you need to make all the diagrams and verify whether the Conclusion is correct or not. But to prove a conclusion is false, you just need a single diagram which does not follow the statement.

Hence, out of multiple Venn diagrams, only the mentioned above two are enough to conclude that "Conclusion I: All cats are wild" And "Conclusion II: All Tigers are wild" are false.

Example 1:

All buses are trains.

Only a few bikes are trains.

Some bikes are not cars.

Conclusions: I. All buses being cars is a possibility.

Conclusions: II. No bus is a bike.

(a) If only the conclusion I follow.

(b) If only conclusion II follows.

(c) If either conclusion I or II follows.

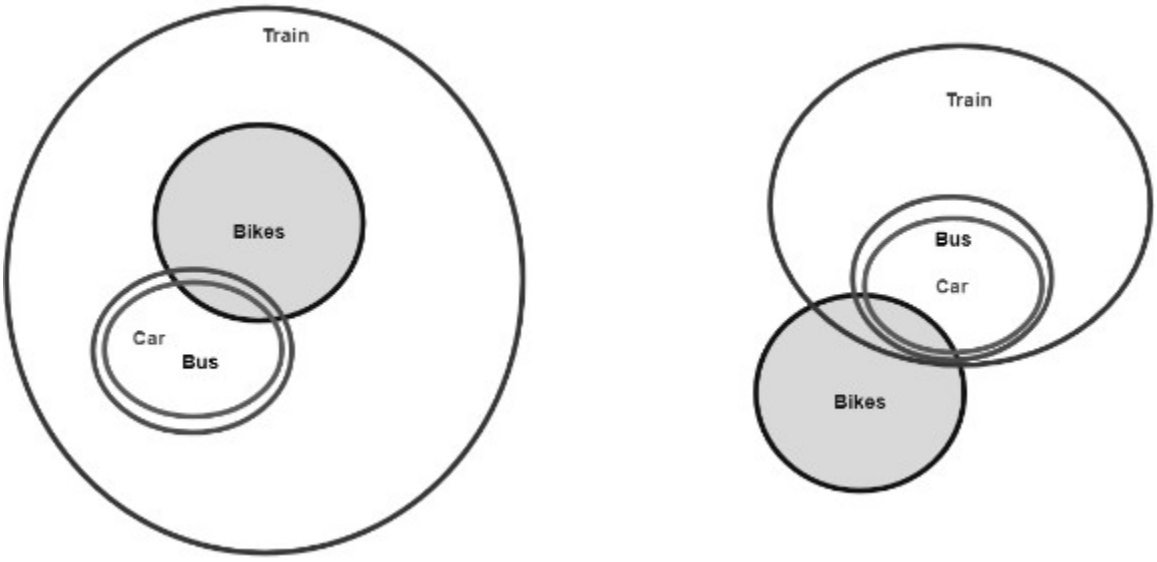
(d) If neither conclusion I nor II follows.

(e) If both conclusions I and II follow.

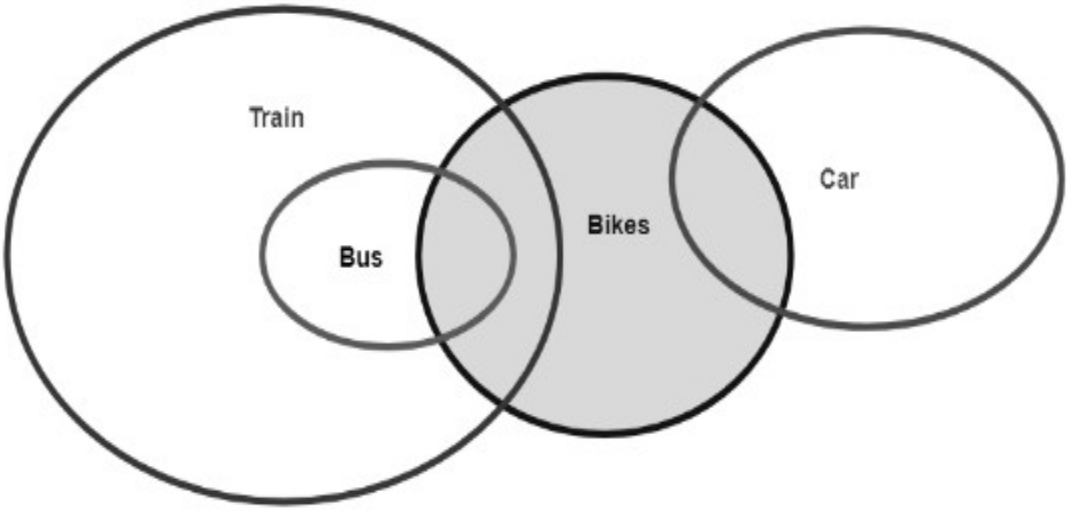
If we draw the Venn diagram of the given statement and then merge the diagrams, we will get multiple diagrams out of which the final diagrams given below can be used to conclude which of the conclusions are true.

In Conclusion, I say that All buses being cars is a possibility. As we need to find the chances of All the buses being cars, if there is even a single case, the Conclusion will be true. Hence, the

Conclusion is correct. There are possibilities that all buses can be cars, as shown in the below case.



For Conclusion II, No bus is a bike, as we can see that in the above case, Some buses are bikes. Therefore, this conclusion will be false.



Hence, the correct answer is option A, If only the conclusion I follow.

3.4 Data Sufficiency

Data sufficiency in logical reasoning refers to the ability to determine whether the data provided is adequate to answer a given question. It involves analyzing information and deciding if it is enough to reach a conclusion.

3.4.1 Concepts of data sufficiency

- **Unique Solution:** A statement is only sufficient if it provides one unique answer, not multiple possibilities.
- **Process:** Evaluate Statement I alone, then Statement II alone, and only combine them if neither is sufficient individually.
- **No Assumptions:** Use only the information given; do not assume facts outside the prompt.
- **Types:** Often found in quantitative aptitude (math) and logical reasoning (verbal) sections.
- **Standard Options:**

  (A) Only I is sufficient.

  (B) Only II is sufficient.

  (C) Both together are sufficient.

  (D) Either I or II is sufficient.

  (E) Neither, even together, is sufficient.

3.5 Types and Benefits Data Sufficiency

3.5.1 Types of Data Sufficiency

As of now we know what consists of the questions related to the Data Sufficiency reasoning section. Let us see the various types of Data Sufficiency one by one from below.

- **Blood Relation** : In this type of data sufficiency, relation between 2 people will be asked and candidates need to find the statement(s) in which data is sufficient to find the relation or the correct answer.
- **Order & Ranking** : In this type of data sufficiency, data on order of people or their ranking will be provided and candidates will need to find statement(s) in which data is sufficient to find the correct answer.
- **Direction & Distance** : In this type of data sufficiency, data on direction of people or points and the distance traveled by a person or distance between the points will be given and candidates will need to find the statement(s) in which data is sufficient to find the direction or distance between the points.

- **Coding Decoding** :In this type of data sufficiency, words or letters will be coded and candidates will need to find the statement(s) in which data is sufficient to find the logic applied to decide the code.
- **Seating Arrangement**: In this type of data sufficiency, data on arrangement of people will be provided and candidates will need to find the statement(s) in which data is sufficient to find the correct answer. Seating Arrangements are of two types such as Linear Arrangement and Circular Arrangement. In Linear Arrangement, people will be arranged or seated in one or multiple rows. In Circular Arrangement, people will be arranged or seated around a circular table.
- **Floor Puzzle** : In this type of data sufficiency, data on people living on different floors of either same or different buildings will be given and candidates will need to find the statement(s) in which data is sufficient to find the correct answer.
- **Scheduling** : In this type of data sufficiency, data based on months, years or date will be given and candidates need to decide whether the data provided in the statements is sufficient or not.

3.5.2 Benefits of Data Sufficiency

Data sufficiency questions in aptitude tests measure a candidate's ability to analyze, reason, and determine the minimum information necessary to solve a problem. Key benefits include enhancing logical thinking, improving decision-making speed, reducing unnecessary calculations, and testing critical thinking without requiring full computation.

- **Analytical Skill Development:** They force a focus on what information is necessary rather than just computing a number, fostering higher-level analytical thinking.
- **Time Management & Efficiency:** By identifying sufficient information without solving the entire problem, candidates can save time on exams, making it a critical skill for tests like the GMAT, CAT, and IBPS.
- **Real-World Application:** Data sufficiency mirrors professional scenarios where decisions must be made with incomplete or limited information.
- **Strengthens Logical Reasoning:** They test a wide range of topics—from arithmetic to, blood relations—by forcing a logical, rather than just computational, approach.

- **Improved Accuracy:** It helps in developing a structured, step-by-step approach to evaluating multiple statements to find the correct answer.

3.6 Strategies and Tips for Solving Data Sufficiency

3.6.1 Strategies for Solving Data Sufficiency Questions

Let us study some of the recommended strategies for data sufficiency problems:

- ***Reading Questions***

Carefully read the question stem before analyzing the statements. Identify what is being asked and the type of information needed to answer the question accurately. Look for keywords that indicate the type of data required, such as "total," "odd/even," or "sufficient."

- ***Utilizing Prior Knowledge***

Leverage your understanding of basic math concepts to simplify complex problems. Break down intricate scenarios into simpler components to evaluate sufficiency effectively. Apply known formulas and rules to assess the sufficiency of individual statements.

- ***Analyzing Statements***

Evaluate each statement independently, determining if it provides adequate information to solve the problem. Avoid combining statements prematurely, as they may be sufficient on their own but insufficient when combined. Check for consistency between statements to ensure accuracy.

3.2.5 Tips for Solving Data Sufficiency Questions

Let us also study some of the tips for solving data-sufficiency questions:

- ***Avoid Mistakes***

Avoid assuming additional information beyond what is given when tackling data-sufficiency questions. Focus solely on the provided statements without introducing external data. Misinterpreting the data can lead to incorrect answers.

- ***Interpret Statements***

To interpret statements accurately, break down the information into smaller parts and analyze each component separately. Identify key details that impact the solution. Look for relationships or patterns within the statements to determine their significance.

- ***Answer Confidently***

Confidence in answering data-sufficiency questions comes from understanding the question's requirements clearly. Ensure you comprehend what is being asked before analyzing the

statements. Eliminate options systematically based on whether they provide sufficient data or not.

3.6.2 Different types of Data Sufficiency Problems

Let us study two important types of data sufficiency:

- ***Quantitative Data Sufficiency***

Quantitative data sufficiency involves math-based questions where test-takers must determine if the provided data is adequate to solve a mathematical problem. These questions often require analyzing numerical data.

- ***Qualitative Data Sufficiency***

Qualitative data sufficiency focuses on non-numeric information, such as verbal reasoning or logical reasoning. Test-takers must assess whether the given details are enough to answer a non-mathematical question.

Check Your Progress

Syllogism: (Q1 – Q5): Direction: In each of the following questions two or three statements are given and these are followed by two conclusions. You have to take the given statements to be true even if they seem to be at variance from commonly known facts. Read the conclusion and then decide which of the given conclusion logically follows the statements:

Option A- If only (1) conclusion follows

Option B- If only (2) conclusion follows

Option C- If either (1) or (2) conclusion follows

Option D- If neither (1) nor (2) conclusion follows

Option E- If both (1) and (2) conclusion follows

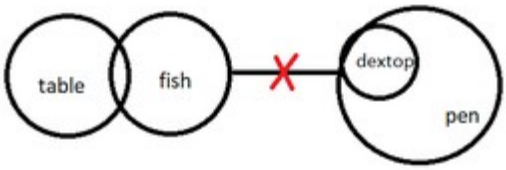
Q1. Statement: Only a few table are fish. No fish is desktop. All desktop is pen.

Conclusion:

1. Some table is not desktop.
2. All table being fish is a possibility.

Answer: Option- A

Some part of table is fish and all fish is not desktop. So conclusion 1 follows.

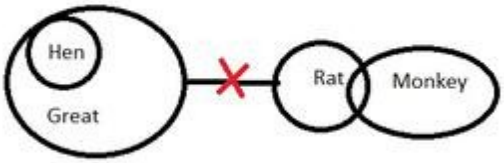


Q2 Statement: All hens are great. Only a few monkeys are rats. No rat is great

Conclusion:

1. Only a few monkey is hen.
2. All monkey are great.

Answer: Option- D

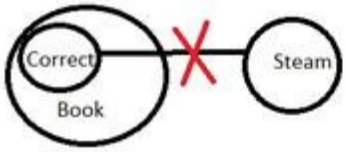


Q3 Statement: Only books are correct. No correct is steam.

Conclusion:

1. Some books can be steam
2. All books can be steam.

Answer: Option- A

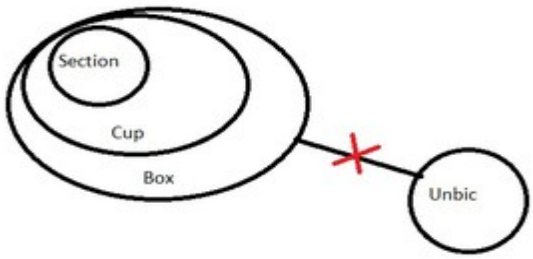


Q4 Statement: All section are cup. All cup are box. No box is unbic.

Conclusion:

1. No section is unbic.
2. Some box are section.

Answer: Option- E

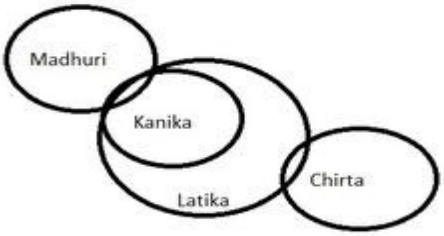


Q5 Statement: Some Madhuri is Kanika. All Kanika is Latika. Only a few Lallita is Chitra.

Conclusion:

1. All Kanika can be Chitra.
2. Some Madhuri is Latika.

Answer: Option- E



Data Sufficiency: (Q1 – Q5)

Q1) Five persons – Rina, Meenu, Dev, Rewa and Jaya, each have a different weight. Who among these persons is the heaviest?

Statement I: Only two persons are heavier than Meenu, who is heavier than Jaya and Rewa.

Statement II: Dev, who is not the lightest, is heavier than Meenu and Rewa, but not Rina.

a) Statement I provides enough information to answer the question on its own, while Statement II does not.

b) Statement II provides enough information to answer the question, whereas Statement I does not.

c) Either Statement I or Statement II alone provides enough information to answer the question.

d)When statements I and II are considered together, they are insufficient to provide a clear answer to the question.

e) Both Statement I and Statement II are required to provide a sufficient answer to the question.

Answer: e) Both Statement I and Statement II are required to provide a sufficient answer to the question at hand.

Q2) Four persons – Arav, Abul, Azal and Azim, are sitting in a straight line facing south. Who is/are sitting adjacent to Arav?

Statement I: Arav does not sit next to Azim, who does not sit on the extreme right.

Statement II: No one sits to the right of Arav and on the left of Abul, while only one person sits between Azal and Abul.

a) To answer the question, both Statements I and II must be considered together.

b) Statements I and II, when combined, do not provide enough information to answer the question.

c) Statement I or Statement II alone is enough to provide an answer to the question.

d) Statement II by itself is enough to provide an answer, whereas Statement I alone does not offer sufficient information to do so.

e) Statement I provides enough information to answer the question, whereas the data in Statement II is insufficient on its own.

Answer: d) Statement II by itself is enough to provide an answer, whereas statement I alone does not offer sufficient information to do so.

Q3) In a straight line of twenty-five persons facing north, how many persons are sitting between Dan and Hana?

Statement I: Ana sits at the extreme left end of the line. Only six persons sit between Ana and Hana. Only ten persons sit between Hana and Pal. Only four persons sit between Pal and Dan.

Statement II: Maya sits exactly in the middle of the line. Only three persons sit between Rama and Maya. Only six persons sit between Rama and Dan. Rama sits on the left of Dan. Hana sits fourth to the left of Maya.

a) Statement I provides enough data to answer the question, but Statement II does not offer sufficient information for a solution.

b) Statement II provides enough data to answer the question, whereas Statement I does not offer adequate information for a solution to be determined.

c) Sufficient data to answer the question can be found in either statement I alone or statement II alone.

d) When considering both statements I and II, the data provided is insufficient to provide an answer to the question at hand.

e)Both statements I and II are required to answer the question.

Answer: b) Statement II provides enough data to answer the question, whereas Statement I does not offer adequate information for a solution to be determined.

Q4) How is Mona related to Shilpa?

Statement I: Mona is the mother of Jay. Babu is married to Allan. Shilpa is the daughter of Babu. Allan is the brother of Jay.

Statement II: Mona is married to Vicky. Vicky is the father of Jay. Jay is married to Kalu. Jay is the uncle of Shilpa.

a) Statement I provides enough information to answer the question, whereas the data in Statement II is insufficient for a conclusive answer.

b) Statement II on its own is enough to provide the answer, whereas the information in Statement I alone does not suffice to address the question.

c) Statement I or Statement II alone is enough to answer the question.

d) When considering the question, the combination of statements I and II does not provide enough information for a conclusive answer.

e) To answer the question, both statements I and II are needed.

Answer: c) Statement I or Statement II alone is enough to answer the question.

Q5) Six persons – Ray, Sumi, Amit, Bilal, Dan, and Jon are sitting in a row facing north. Who among these persons sits on the immediate left of Amit?

Statement I: Amit sits between Ray and Dan, who sits on the extreme right.

Statement II: Amit is third to the right of Jon and second to the left of Bilal.

a) Statement I provides enough information to answer the question, whereas the data in Statement II is insufficient for a conclusive answer.

b) Statement II on its own is enough to provide the answer, whereas the information in Statement I alone does not suffice to address the question.

c) Statement I or Statement II alone is enough to answer the question.

d) When considering the question, the combination of statements I and II does not provide enough information for a conclusive answer.

e) To answer the question, both statements I and II are needed.

Answer: b) Statement II on its own is enough to provide the answer, whereas the information in Statement I alone does not suffice to address the question.

Self-Assessment Questions

Small Questions – LOCF Mapping Table

S.No	Small Question	CO	Bloom's Level	PO
1	What are the types of syllogism?	CO1	Remembering	PO1
2	What are the benefits of syllogism?	CO2	Remembering	PO1
3	Explain the concepts of data sufficiency.	CO2	Understanding	PO2
4	List the types of data sufficiency.	CO3	Remembering	PO3
5	What are tips for solving data sufficiency questions?	CO4	Remembering	PO4

Big Questions – LOCF Mapping Table

S.No	Big Question	CO	Bloom's Level	PO
1	Explain the key aspects of syllogism.	CO1	Understanding	PO1
2	Formulate the multiple choices of syllogism.	CO2	Creating	PO1
3	Discuss the different approaches of syllogism.	CO2	Creating	PO2
4	Explain different types of data sufficiency problems.	CO3	Evaluating	PO3
5	Spell out the strategies for solving data sufficiency questions.	CO4	Remembering	PO4

UNIT IV

APPLICATIONS OF BASE SYSTEM

4.1 Clocks

4.2 Clocks (base 24)

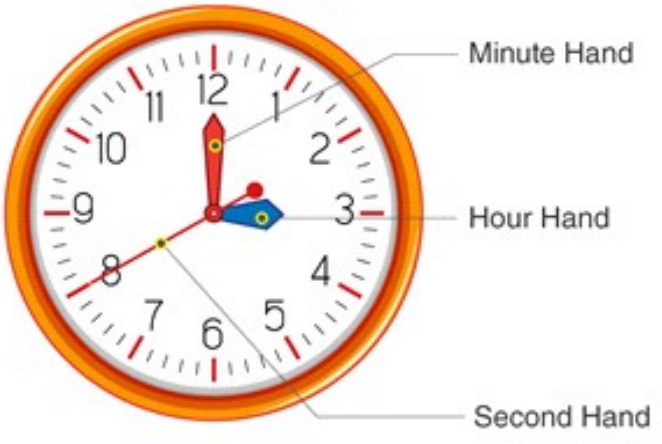
4.3 Calendar

4.4 Calendars (Base 7)

4.5 Cubes and Cuboids

4.1 Clocks

A Clock is a circular device provided with three hands viz. an hour hand, minute and second hand. The study of the clock is known as “horology”. A basic structure of a clock has 3 hands.



4.1.1 Introduction to clock

A clock is a circle with 360 degrees on it. It’s separated into 12 equal pieces with numbers ranging from 1 to 12. 360/12 = 30° for each section. One hour is when the minute hand completes a full round, i.e., covers 360°.

The hour and the minute hand are the two hands. Both hands move around the round dial. The hour hand is smaller compared to the minute hand and moves more slowly. The hour hand displays the time in hours, while the minute hand displays the time in minutes. We’ll look for

some of the A clock is a circle with 360 degrees on it. It's separated into 12 equal pieces with numbers ranging from 1 to 12. 360/12 = 30° for each section. One hour is when the minute hand completes a full round, i.e., covers 360°.

The hour and the minute hand are the two hands. Both hands move around the round dial. The hour hand is smaller compared to the minute hand and moves more slowly. The hour hand displays the time in hours, while the minute hand displays the time in minutes. We'll look for some of the most basic clock formats are follow:

4.1.2 Most basic clock formats

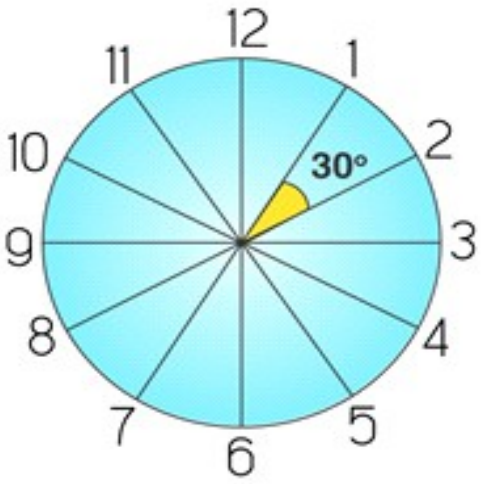
- **Dial:** The dial of a clock is circular. The dial's periphery is numbered 1 through 12 to indicate the hours in a 12-hour cycle. A dial's diameter is divided into 60 equal minute spaces or 12 equal hour spaces.
- **Minute Spaces:** The face or dial of a watch is circular divided into 60 equal pieces, known as minute spaces.
- **Hour Hand and Minute Hand:** Clocks contain two hands, the smaller of which is known as the hour hand or shorthand, and the larger of which is known as the minute hand.
- **Second hand:** On the circular dial, the second hand represents seconds. It rotates at a rate of one per minute.
- **Overlap:** Once every hour, both hands will coincide.
- **Straight Line:** When the hands are parallel or opposed to each other, they form a straight line.

4.1.3 Structure of a Clock

A clock is composed of 360 degrees and divided into 12 equal divisions. The angle between the consecutive divisions is obtained by dividing the total angle of clock 360° by the number of divisions.

- ***Twelve equal divisions of a clock***

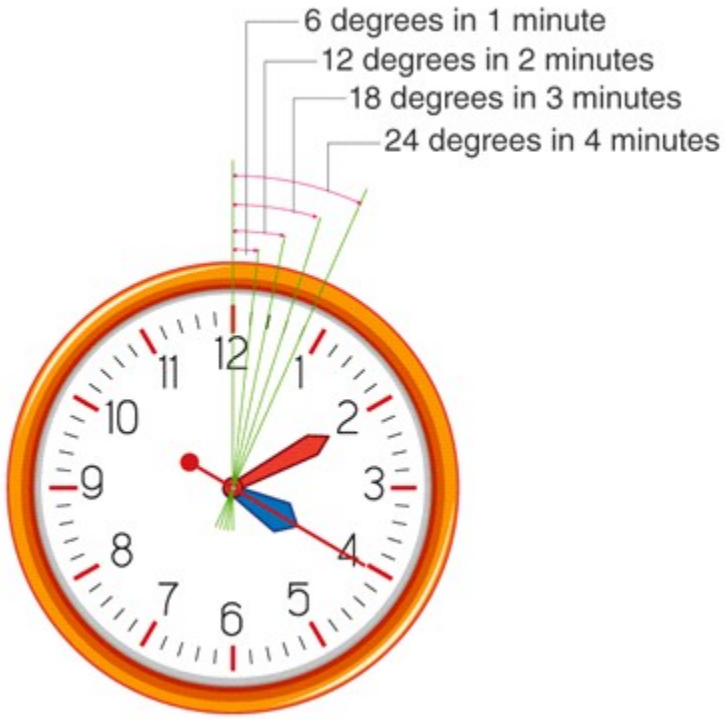
The angle between any two consecutive divisions = (360°)/12= 30°



- ***Angle divisions of a clock***

A close observation of a clock reveals that an angular space between any two consecutive divisions has further five more divisions. The area between the two divisions corresponds to a value of 5 minutes. Hence, dividing the 30° by five will result in the angular value of a minute.

Angular value of a minute = (30°)/5= 6°



- ***Important points***

  (i). In every 60 minutes, the minute hand gains 55 minutes on the hour on the hour hand.

  (ii) In every hour, both the hands coincide once.

  (iii) When the two hands are at right angles, they are 15 minute spaces apart.

  (iv) When the hands are in opposite directions, they are 30 minute spaces apart.

4.2 Clocks (base 24)

A 24-hour clock is a timekeeping system where the day runs from midnight to midnight, divided into 24 hours (00:00 to 23:59). It eliminates A.M./P.M. confusion by numbering hours 1 to 24, with 13:00 representing 1:00 p.m.. Commonly used in transportation, military, and international contexts, it starts at 00:00 (midnight) and often ends at 24:00.

4.2.1 Key Aspects of the 24-Hour System

- **Time Structure**: Uses four digits (HH:MM), where the first two digits represent the hour and the last two represent minutes.
- **No A.M./P.M.:** Times are continuous from 00:00 to 23:59.
- **Conversion (PM):** For times from 13:00 to 23:59, subtract 12 to get the P.M. time (e.g., 15:00 is 3:00 p.m.).

- **Midnight:** The day starts at 00:00 and ends at 24:00.
- **Usage:** Used for transport schedules, aviation, and military to prevent ambiguity.

Examples:

- 00:05: 12:05 a.m. (midnight)
- 08:00: 8:00 a.m.
- 12:00: 12:00 p.m. (noon)
- 13:00: 1:00 p.m.
- 23:00: 11:00 p.m.
- 24:00: 12:00 a.m. (midnight at end of day)

4.2.2 Formulas for clock calculations

- 60-minute space = 360° = 1 hour
- 1 minute = 6 degrees = 1 minute
- 6° x 5 = 30° = 5 minutes in a 5-minute space
- 15-minute gaps apart at a right angle or perpendicular
- 22 times in 24 hours for a straight angle (1 day)
- In 12 hours, the angle indicated by the hour hand equals 360°.
- In 60 minutes, the angle drawn by the minute hand equals 360°.
- Hour hand speed = 0.5 DPM (degree per minute)
- 30-minute interval apart at a straight angle or straight line (180°).
- Minute hand speed = 6 DPM
- At N o'clock, the angle of the hour hand from vertical is 30N.
- 44 times in 24 hours = right angle or perpendicular (1 day)

4.2.3 Important points and shortcuts of clocks calculations

- Every hour, the hands of both hands coincide once.
- They are 15-minute gaps apart when the two hands are at right angles.
- When the hands are parallel or opposite, they are in the same straight line.
- When the hands face each other, they are 30 minutes apart.
- In 60 minutes, the angle drawn by the minute hand equals 360°.
- In 12 hours, the angle indicated by the hour hand equals 360°.

- When a clock shows 8.15 and when the correct time is 8, it is 15 minutes early.
- On the other hand, if it says 7.45 when the true time is 8, it's considered 15 minutes late.

4.2.4 Clock calculations - *Solved examples*

1. An accurate clock shows 7 a.m. Through how many degrees will the hour hand rotate when the clock shows 1 p.m.?

A. 154°

B. 180°

C. 170°

D. 160°

Solution:

We know that angle traced by hour hand in 12 hrs. = 360°

From 7 to 1, there are 6 hours.

Angle traced by the hour hand in 6 hours =6*(360/12)=180°

Option B is the correct answer.

2. By 20 minutes past 4, the hour hand has turned through how many degrees? If then the clock is 12 p.m.

A. 100°

B. 110°

C. 120°

D. 130°

Solution:

At 4 o'clock the hour hand is at 4 and has an angle of 30°*4=120°

An Hour hand travels 1/2° per minute In 20 minutes it will travel 20 *(1/2°) = 10°. Adding both we get 120° + 10° = 130°

Option D is the correct answer.

3. At what time between 5.30 and 6 will the hands of a clock be at right angles?

A. 44 minutes past 5

B.44 (7/11) minutes past 5

C.43 (7/11) minutes past 5

D. 43 minutes past 5

Solution:

Given: H = 5 and A = 90, since 5 and 6 lies in the first half, a positive sign is considered.

T = 2/11 [H*30±A]

T = 2/11 [5*30+90]

T = 2/11 [240] = 480/11= 43(7/11)

Option C is the correct answer.

4. What is the angle between the minute hand and the hour hand of a clock at 5.30?

A. 05°

B. 15°

C. 25°

D. 35°

Solution:

At 5 'o'clock the hour hand is at 5 and hence has made 30° angle.

From 5 to 5.30 its will travel for 30 minutes with a speed of ½ ° Therefore the total distance travelled will be 30 minutes* 1/2 = 15°

The full angle made by the hour hand will be 150°+15° = 165°.

The minute hand at 5 o'clock is at 12, and hence the angle made is zero. In 30 minutes, it will travel a distance of 30 minutes with a speed of 6° per minute. Therefore, the total distance travelled will be 30 minutes*6° = 180 °.

The angle between the minute and hour hand is 180 – 165 = 15

Option B is the correct answer.

5. How many times in a day, the hands of a clock are straight?

A. 22

B. 24

C. 44

D. 48

Solution:

The hands of clocks make a straight line of 180° about 22 times in 24 hours. Also, the hands coincide 22 times in 24 hours, the coincidence of the hands also forms a straight line. Hence, the total straight lines are 22+22 = 44.

Option C is the correct answer.

4.3 Calendar

The topic of calendars is essential for various competitive exams and placement tests. While it might initially seem challenging, the tricks and methods shared here will simplify the concepts, making calendars easy to understand and apply.

A calendar is a system for organizing and dividing time into days, weeks, months, and years. Calendars are based on astronomical events, such as the rotation of the Earth (day), the lunar cycle (month), and the Earth's orbit around the sun (year), and have been essential for managing time and planning in societies throughout history.

4.3.1 Basic Concepts and rules

- ***Leap Year***

A year with 366 days, in which February has 29 days.

A year is a leap year if it is divisible by 4. However, if it's a century year (ending in 00), it must be divisible by 400 to be a leap year. For example, 2000 was a leap year, but 1900 was not.

- ***Ordinary Year***

A year with 365 days, in which February has 28 days.

Non-leap years are not divisible by 4 or do not satisfy the century rule (not divisible by 400).

- ***Odd Days***

The number of days left after calculating complete weeks in a given period. Odd days help in determining the day of the week for a given date.

For example, if 10 days pass, it's 1 complete week (7 days) and 3 odd days.

- ***Day Codes***

Days of the week can be assigned numerical codes to simplify calculations:

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
0	1	2	3	4	5	6

- ***Month Codes***

Each month is given a code to simplify day calculations, particularly for non-leap and leap years:

Month	Code
January	For leap year: 6, For non-leap year: 0
February	For leap: 2, For non-leap year: 3
March	3
April	6
May	1
June	4
July	6
August	2
September	5
October	0
November	3
December	5

- ***Century Codes***

The century codes are used to simplify day-of-week calculations for dates across centuries.

Century	Code
1600-1699	6
1700-1799	4
1800-1899	2
1900-1999	0
2000>=	6

- ***Counting of weeks and days in year:***

(a) 1 ordinary year has 365 days = 52 weeks + 1 odd day

(b) 1 leap year has 366 days = 52 weeks + 2 odd days

- ***Types of Questions***

Type 1: Given a month, date, and year, use this data to find the day of the week.

Type 2: Given a day, with its date, find which day will be after x months, x days, or x years.

4.4 Calendars (Base 7)

A base-7 calendar, such as the 7date system, structures time using base-7 arithmetic for days and weeks, often pairing it with a standard base-10 year. This format aligns directly with the 7-day week, allowing for a consistent, reoccurring date structure where weeks are represented in base-7 (digits 0-6), often simplifying day-of-week calculations.

- ***7-date System*:** This system treats dates as a base-7 number where the day of the week is represented by the last digit, offering a direct mapping for weekly cycles.
- ***Base Calendar Definitions*:** In scheduling software, a "base calendar" defines standard working and non-working times (e.g., weekends, holidays) for projects.
- ***Other "Base 7" contexts:*** While not purely calendrical, 7-inch U-shaped wooden bases are popular for displaying desk calendars.
- ***7-date Calculation:*** A date might be represented to align with a 7-day, 7-week, or 7-month cycle, often to create a more consistent structure than the 12-month Gregorian system.
- ***Application:*** These systems are often used for specialized scheduling or as a mathematical exercise to simplify day-of-week calculation.
- **Implementation:** In CA 7, calendars are managed using online tools to define specific, recurring timeframes (DB.2.8 - CALMOD).

4.4.1 Tricks and Shortcuts for Calendar Questions

Let us understand them with the help of small and easy tricks.

- ***The Date-to-Day Code Trick***

Suppose we have given a date like 25 May 2003 and we have to calculate the day for this.

Trick

Step: 1 = last 2 digits of a year

Step: 2 = month code

Step: 3 = Date

Step: 4 = last 2 digits of year divided by 4(quotient)

Step: 5 = Year code

Now add all these and find its remainder with 7.

Now, whatever the value you are getting convert it into Week Day Code and We will get the required Day.

Solving the above example:

Step: 1 The last 2 digits of a year is 03 i.e 3.

Step: 2 month code for May is 1.

Step: 3 Date is 25.

Step: 4 The last 2 digits divided by 4 is 0 i.e 3/4 gives quotient as 0.

Step: 5 Year code is 6.

Adding them (values obtained after all the 5 steps)

We get (3 +1 + 25 + 0 + 6) = 35.

So, 35/7 = 0(Remainder).

And we have already mentioned in Trick's section that 0 is the Code for Sunday. So, the Weekday on 25 May 2003 was Sunday.

- **Day *Difference Trick***

It was Monday 15th October 1923. What was the day on 17 November 1923?

TRICK - We simply have to add the day's between two given dates, and add it to the code of the day given in question and divide it by 7 to get the remainder.

Solving the above example:

Since October has 31 days, there are 16 days from October 15 to October 31, and 17 days from November 1 to November 17.

Adding these gives (16 + 17) = 33 days.

Dividing 33 by 7, we get a remainder of 5.

Now, add 5 to the code for Monday (1, as given in the tricks), then divide by 7 to find the remainder: (5 + 1) mod 7 = 6. This remainder of 6 corresponds to Saturday.

Hence, it was Saturday on 17th November 1923.

4.5 Cubes and Cuboids

Cube and cuboid are three-dimensional shapes that consist of six faces, eight vertices and twelve edges. The primary difference between them is a cube has all its sides equal whereas the length, width and height of a cuboid are different. Both shapes look almost the same but have different

properties. The area and volume of cube, cuboid and also cylinder differ from each other.

In everyday life, we have seen many objects like a wooden box, a matchbox, a tea packet, a chalk box, a dice, a book, etc. All these objects have a similar shape. All these objects are made of six rectangular planes or square planes. In mathematics, the shape of these objects is either a cuboid or a cube. Here, in this article, we will learn the difference between cube and cuboid shapes with the help of their properties and formulas of surface area and volume.

4.5.1 Definition of Cube and Cuboid Shape

The cube and cuboid shapes in Maths are three-dimensional shapes. The cube and cuboid are obtained by giving a thickness to the 2D square and rectangle respectively.

Cube

A cube is a three-dimensional shape that is defined in the XYZ plane. It has six faces, eight vertices and twelve edges. All the faces of the cube are square in shape and have equal dimensions.

- A cube is a three-dimensional shape with six square faces, all of which are congruent (equal in size) and perpendicular to each other.
- All edges of a cube are equal in length.
- All angles between adjacent faces are right angles (90 degrees).
- The volume of a cube can be found using the formula:
- Volume = side × side × side (or simply side3).

Cuboid

A cuboid is also a polyhedron having six faces, eight vertices and twelve edges. The faces of the cuboid are parallel. But not all the faces of a cuboid are equal in dimensions. Hence, cube and cuboid shapes have six faces, eight vertices and twelve edges.

- A cuboid, also known as a rectangular prism, is a three-dimensional shape with six rectangular faces.
- Opposite faces of a cuboid are congruent and parallel to each other.
- All angles between adjacent faces are right angles (90 degrees).
- Unlike a cube, the lengths of the edges of a cuboid can be different.
- The volume of a cuboid can be found using the formula:
- Volume = length × width × height.

- A cube is a special type of cuboid where all edges are equal in length.

4.5.2 Difference Between Cube and Cuboid

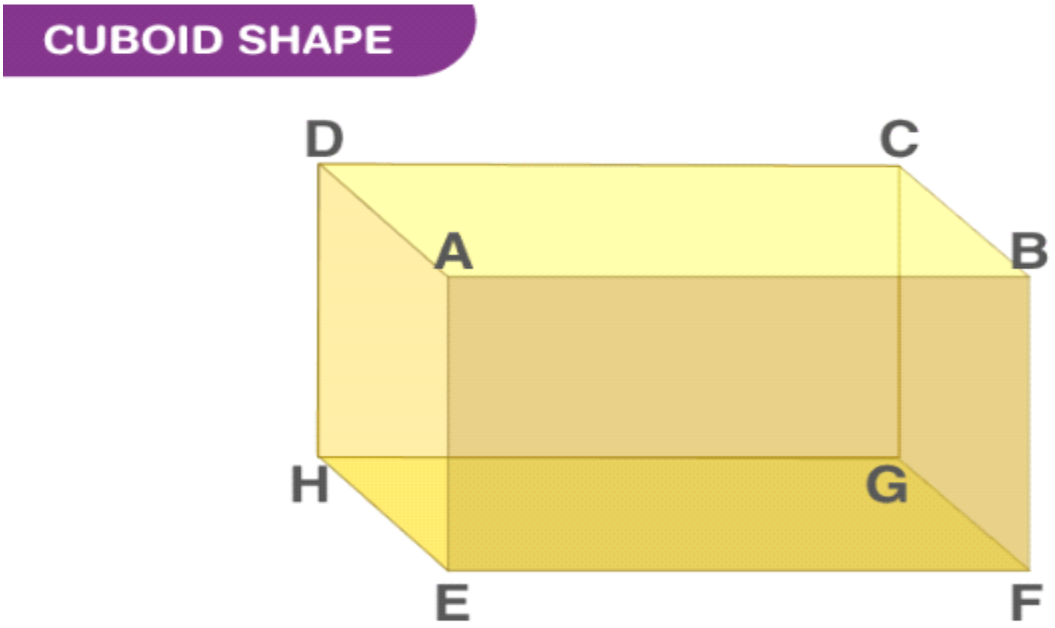
The difference between the cube and cuboid shapes are as follows:

- The sides of the cube are equal but for cuboids they are different.
- The sides of the cube are square, but for the cuboids they are in rectangular shape.
- All the diagonals of the cube are equal but a cuboid has equal diagonals for only parallel sides.

4.5.3 Cube and Cuboid Shape

As we already know, both cube and cuboid are in 3D shape, whose axes go along the x-axis, y-axis and z-axis. Now, let us learn in detail.

A cuboid is a closed 3-dimensional geometrical figure bounded by six rectangular plane regions.



4.5.4 Properties of a Cuboid

Below are the properties of the cuboid, its faces, base and lateral faces, edges and vertices.

- **Faces of Cuboid**

A Cuboid is made up of six rectangles, each of the rectangles is called the face. In the figure above, ABFE, DAEH, DCGH, CBFG, ABCD and EFGH are the 6 faces of the cuboid.

The top face ABCD and the bottom face EFGH form a pair of opposite faces. Similarly, ABFE,

DCGH, and DAEH, CBFG are pairs of opposite faces. Any two faces other than the opposite faces are called adjacent faces. Consider a face ABCD, the adjacent face to this are ABFE, BCGF, CDHG, and ADHE.

- **Base and lateral faces**

Any face of a cuboid may be called the base of the cuboid. The four faces which are adjacent to the base are called the lateral faces of the cuboid. Usually, the surface on which a solid rests is known to be the base of the solid. In Figure above, EFGH represents the base of a cuboid.

- **Edges**

The edge of the cuboid is a line segment between any two adjacent vertices. There are 12 edges, they are AB, AD, AE, HD, HE, HG, GF, GC, FE, FB, EF and CD and the opposite sides of a rectangle are equal. Hence, AB = CD = GH = EF, AE = DH = BF = CG and EH = FG = AD = BC.

- **Vertices of Cuboid**

The point of intersection of the 3 edges of a cuboid is called the vertex of a cuboid. A cuboid has 8 vertices. A, B, C, D, E, F, G and H represent vertices of the cuboid in above figure. By observation, the twelve edges of a cuboid can be grouped into three groups, such that all edges in one group are equal in length, so there are three distinct groups and the groups are named as length, breadth and height.

A solid having its length, breadth, and height all to be equal in measurement is called a cube. A cube is a solid bounded by six square plane regions, where the side of the cube is called the edge.

4.5.5 Properties of Cube

- A cube has six faces and twelve edges of equal length.
- It has square-shaped faces.
- The angles of the cube in the plane are at a right angle.
- Each face of the cube meets four other faces.
- Each vertex of the cube meets three faces and three edges.
- The opposite edges of the cube are parallel to each other.

4.5.6 Cube and Cuboid Formulas

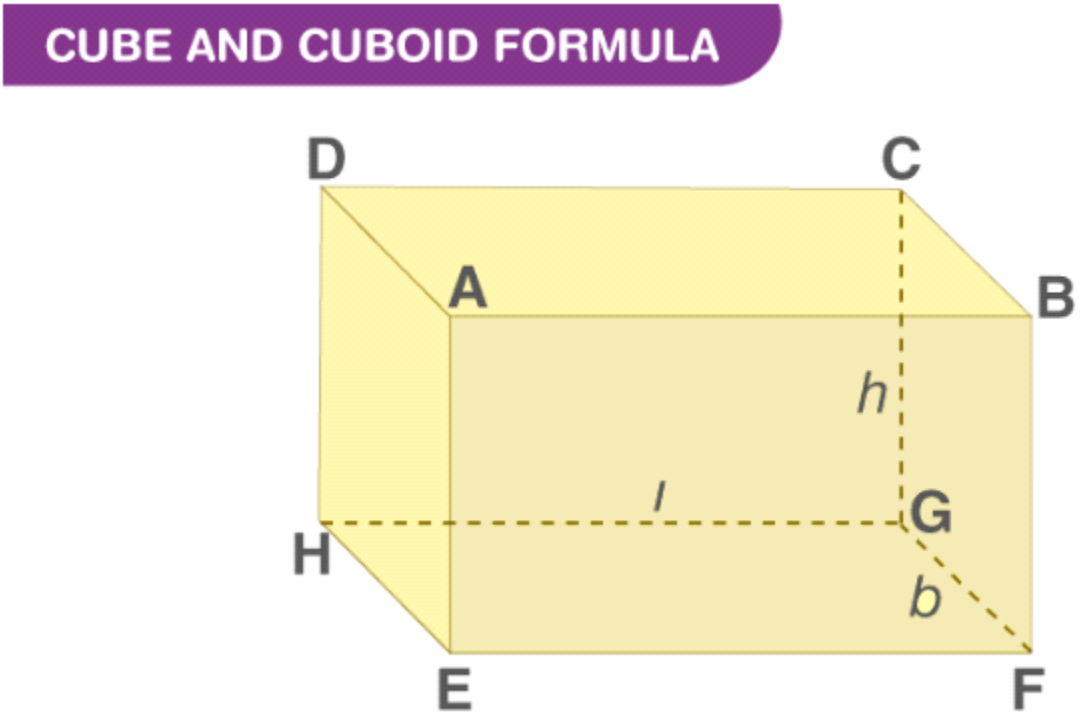
The formulas for cube and cuboid shapes are defined based on their surface areas, lateral surface

areas and volume.

Cube	Cuboid
Total Surface Area = $6(side)^2$	Total Surface area = 2 (length × breadth + breadth × height + length × height)
Lateral Surface Area = 4 $(Side)^2$	Lateral Surface area = 2 height(length + breadth)
Volume of cube = $(Side)^3$	Volume of the cuboid = (length × breadth × height)
Diagonal of a cube = $\sqrt{3}$(side)	Diagonal of the cuboid =$\sqrt{(}$ $length^2$ + $breadth^2$ +$height^2$)
Perimeter of cube = 12 × side	Perimeter of cuboid = 4 (length + breadth + height)

4.5.7 Surface Area of Cube and Cuboid

The surface area of a cuboid is equal to the sum of the areas of its six rectangular faces.



Consider a cuboid having the length to be ‘l’ cm, breadth be ‘b’ cm and height be ‘h’ cm.

Area of face EFGH = Area of Face ABCD = $(l \times b)$ cm^2

Area of face BFGC = Area of face AEHD = $(b \times h)$ cm^2

Area of face DHGC = Area of face ABFE = $(l \times h)$ cm^2

Total surface area of a cuboid = Sum of the areas of all its 6 rectangular faces

Total Surface Area of Cuboid= $2(lb + bh + lh)$

Example:

If the length, breadth and height of a cuboid are 5 cm, 3 cm and 4 cm, then find its total surface area.

Given, Length, l = 5 cm, Breadth, b = 3 cm and Height, h = 4 cm.

Total surface area (TSA) = $2(lb + bh + lh)$

$= 2(5 \times 3 + 3 \times 4 + 5 \times 4)$

$= 2(15 + 12 + 20)$

$= 2(47)$

$= 94$ sq.cm.

4.5.8 Lateral surface area of a Cuboid

The sum of surface areas of all faces except the top and bottom face of a solid is defined as the lateral surface area of a solid.

Consider a Cuboid of length, breadth and height to be l, b and h respectively.

Lateral surface area of the cuboid = Area of face ADHE + Area of face BCGF + Area of face ABFE + Area of face DCGH

$=2(b \times h) + 2(l \times h)$

$=2h(l + b)$

LSA of Cuboid = $2h(l + b)$

Example:

If the length, breadth and height of a cuboid are 5 cm, 3 cm and 4 cm, then find its lateral surface area.

Given, Length = 5 cm, Breadth = 3 cm and Height = 4 cm

LSA = $2h(l + b)$

LSA = $2 \times 4(5 + 3)$

LSA = $2 \times 4(8)$

LSA = $2 \times 32 = 64$ cm^2

4.5.9 Surface Area of a Cube

For cube, length = breadth = height

Suppose the length of an edge = l

Hence, surface area of the cube = $2(l \times l + l \times l + l \times l) = 2 \times 3l^2 = 6l^2$

Total Surface Area of Cube= $6l^2$

Example:

If the length of the side of the cube is 6 cm, then find its total surface area.

Given, side length = 6 cm

TSA of cube = $6l^2$

TSA = $6 (6)^2$

TSA = 6×36

TSA = 216 sq.cm

4.5.10 Lateral surface area of a Cube

Formula to find the Lateral surface area of the cube is:

$2(l \times l + l \times l) = 4l^2$

LSA of Cube = $4l^2$

Example:

If the length of the side of the cube is 6 cm, then find its lateral surface area.

Given,

Side length, l = 6 cm

LSA of cube = $4l^2$

LSA = $4 (6)^2$

LSA = 4 x 36 = 144 sq.cm

4.5.11 Volume of the Cube and Cuboid

Volume of Cuboid:

The volume of the cuboid is equal to the product of the area of one surface and height.

Volume of the cuboid = (length × breadth × height) cubic units

Volume of the cuboid = (l × b × h) cubic units

Example:

If the length, breadth and height of a cuboid are 5 cm, 3 cm and 4 cm, then find its volume.

Given,

Length (l) = 5 cm, Breadth (b) = 3 cm and Height (h) = 4 cm

Volume of cuboid = $l \times b \times h$

$V = 5 \times 3 \times 4$

V = 60 cubic cm

4.5.12 Volume of the Cube

The volume of the cube is equal to the product of the area of the base of a cube and its height. As we know already, all the edges of the cube are of the same length. Hence,

Volume of the cube = $l^2 \times h$

Since, l = h

Therefore,

Volume of the cube = $l^2 \times l$

Volume of the cube = l^3 cubic units

Example:

If the length of the side of the cube is 6 cm, then find its volume.

Given,

side length = 6 cm

Volume of cube = $side^3$

$V = 6^3$

V = 216 cubic cm

4.5.13 Diagonal of Cube and Cuboid

The length of diagonal of the cuboid is given by:

Diagonal of the cuboid = $\sqrt{(l^2 + b^2 + h^2)}$

The length of diagonal of a cube is given by:

Diagonal of a cube = $\sqrt{3}l$

4.5.14 Perimeter of Cube and Cuboid

The perimeter of the cuboid is based on its length, width and height. Since the cuboid has 12 edges and the value of its edges are different from each other, therefore, the perimeter is given

by:

Perimeter of a cuboid = 4 (l + b + h)

where l is the length

b is the breadth

h is the height

Example:

If the length, width and height of a cuboid are 5 cm, 3 cm and 4 cm, find its Perimeter.

Given,

Length = 5 cm, Width = 3 cm and Height = 4 cm

Perimeter = 4 (l + b + h) = 4 (5 + 3 + 4)

P = 4 (12)

P = 48 cm

The perimeter of the cube also depends upon the number of edges it has and the length of the edges. Since the cube has 12 edges and all the edges have equal length, the perimeter of the cube is given by:

Perimeter of a cube = 12l

where l is the length of the edge of the cube

Example: If the side length of the cube is 6 cm, then find its perimeter.

Given , l = 6 cm

The perimeter of cube = 12l

P = 12 × 6

P = 72 cm

4.5.15 Real Life Applications of Cube and Cuboid

Cubes and cuboids have practical applications in fields such as architecture, engineering, packaging, and design. Few of its applications are discussed below:

- ***Building and Construction***

One of the most common applications of cuboids is in the construction industry. Builders and architects use cuboids to design and plan buildings, rooms, and structures. For instance, rooms in a house are often represented as cuboids, with length, width, and height defining the dimensions of each room.

- ***Packaging Industry***

Cubes and cuboids are extensively used in the packaging industry to design boxes and containers for storing and transporting goods. The shape of these containers allows for efficient stacking and storage of products. For example, cereal boxes, shoeboxes, and shipping crates are all examples of cuboids used in packaging.

- ***Furniture Design***

Cuboids are commonly used in furniture design to create tables, cabinets, and shelves. For instance, a rectangular table can be represented as a cuboid, with its length, width, and height defining its dimensions. Similarly, bookshelves are often designed as cuboids to maximize storage space.

- ***Architecture and Urban Planning***

In architecture and urban planning, cubes are used to represent buildings and structures. Urban planners use models of cuboid-shaped buildings to visualize and plan city layouts. Additionally, cubes are used in the design of public spaces such as parks and plazas to create aesthetically pleasing and functional environments.

- ***Mathematical Modeling***

Cubes and cuboids are used in mathematical modeling to represent and analyze real-world phenomena. For example, in physics, cubes are used to model the behavior of particles in a crystalline structure. Similarly, in computer graphics, cuboids are used to create three-dimensional models of objects and environments.

- ***Computer Graphics and Animation***

In computer graphics and animation, cubes and cuboids are basic primitives used to create three-dimensional models of objects and environments. They serve as building blocks for more complex shapes and structures in virtual simulations, video games, and digital art.

- ***Manufacturing and Engineering***

In manufacturing and engineering, cubes and cuboids are used in designing components and structures. For example, machinery parts, electronic devices, and architectural elements are often designed with cuboidal shapes for ease of manufacturing and assembly.

4.5.16 Questions on Cuboid and Cube

1) What are a cube and a cuboid?

A cube is a three-dimensional shape having all its sides equal and the faces of the cube are square in shape. A cuboid is also a three-dimensional shape that has three pairs of equal sides parallel to each other and the faces of the cuboid are all in a rectangular shape.

2) How many edges does a cuboid have?

A cuboid has 12 edges, six faces and eight vertices.

3) What is the difference between a cuboid and a cube?

A cube is a three-dimensional figure whose all sides are equal i.e. all of its 6 faces are square. On the contrary, a cuboid is a three-dimensional figure whose all sides are not equal and all of its 6 faces are rectangles.

4) What are the formulas for cube and cuboid?

- Total surface area:

  Cube = $6 \times (\text{side})^2$

  Cuboid = $2(lb + bh + lh)$

- Lateral surface area:

  Cube = $4 \times (\text{side})^2$

  Cuboid = $2h(l + b)$

- Volume:

  Cube = $(\text{side})^3$

  Cuboid = (length × breadth × height)

5) Is a cube, a special kind of cuboid?

Yes, a cube is a special kind of cuboid where all the faces of the cuboid are of equal length. In a cuboid, there are 6 faces which are rectangles. If the rectangles have equal sides, they become squares and eventually, the cuboid becomes a cube.

6) Give examples of cubes and cuboids.

Examples of cubes are ice cubes, dice, Rubik's cube, etc. Examples of cuboids are books, bricks, Shoe boxes, etc.

7) **How many rectangular faces are there in a cuboid?**

There are 6 rectangular faces in a cuboid.

8) **What is the other name of a cube in Maths?**

In Mathematics, cube is also known as a square parallelepiped.

Check Your Progress

I) Clock: (Q1 – Q3):

Q1) A watch which gains 5 seconds in 3 minutes was set right at 7 a.m. In the afternoon of the same day, when the watch indicated quarter past 4 o'clock, the true time is :

a) 59 7 12 min. past 3
b) 4 p.m.
c) 58 7 11 min. past 3
d) 2 3 11 min. past 4
e) None of these
Answer: Option B

Explanation:

Time from 7 a.m. to 4.15 p.m. = 9 hours 15 min. = 37 4 hours

3 min. 5 sec. of this clock = 3 min. of the correct clock.

37 720 hours of this clock = 1 20 hours of the correct clock.

37 4 hours of this clock = [1 20 × 720 37 × 37 4] hours of the correct clock.

= 9 hours of the correct clock.

So, the correct time is 9 hours after 7 a.m. i.e. 4 p.m.

Q2) How much does a watch lose per day, if its hands coincide every 64 minutes?

a) 32 8 11 min.
b) 36 5 11 min.
c) 90 min.
d) 96 min.
e) None of these

Answer: Option A

Explanation:

55 min. spaces are covered in 60 min.

60 min. spaces are covered in [60 55 × 60] min. = 65 5 11 min.

Loss in 64 min. = [66 5 11 - 64] = 16 11 min.

Loss in 24 hours = [16 11 × 1 64 × 24 × 60] min. = 32 8 11 min.

Q3) How many times are the hands of a clock at right angle in a day?

a) 22
b) 24
c) 44
d) 48
e) None of these

Answer: Option C

Explanation:

In 12 hours, they are at right angles 22 times.

So, in 24 hours, they are at right angles 44 times.

II) Calendar: (Q1 – Q3):

Q1) Today is Monday. After 61 days it will be

a) Wednesday

b) Saturday

c) Tuesday

d) Thursday

e) None of these

Answer: Option B

Explanation:

Each day of the week is repeated after 7 days.

So, after 63 days, it will be Monday.

So, after 61 days, it will be Saturday.

Q2) Which of the following is not a leap year?

a) 700

b) 800

c) 1200

d) 200

e) None of these

Answer: . Option A

Explanation:

The century divisible by 400 is a leap year.

So, the year 700 is not a leap year.

Q3) January 1, 2007 was Monday. What day of the week lies on Jan. 1, 2008?

a) Monday b) Tuesday c) Wednesday d) Sunday e) None of these

Answer: Option B

Explanation:

The year 2007 is an ordinary year. So, it has 1 odd day.

1st day of the year 2007 was Monday.

1st day of the year 2008 will be 1 day beyond Monday.

Hence, it will the Tuesday.

III) Cube and Cuboid: (Q1 – Q3):

Q1) Find the total surface area of the cuboid with dimensions 2 inches × 3 inches × 7 inches.

Solution:

Given, Length (l) = 2 inches

Breadth (b) = 3 inches

Height (h) = 7 inches

Total Surface Area(TSA) = 2 (lb + bh + hl)

TSA = 2 (2 × 3 + 3 × 7 + 7 × 2)

= 2 (6 + 21 + 14)

= 2 × 41 = 82

So, the total surface area of this cuboid is 82 inches^2

Q2) The length, width and height of a cuboid are 12 cm, 13 cm and 15 cm, respectively. Find the lateral surface area of a cuboid.

Solution:

Given, Length (l) = 12 cm

Width (w) = 13 cm

Height (h) = 15 cm

Lateral surface area of a cuboid is given by:

LSA = 2h (l + w)

LSA = 2 × 15 (12 + 13)

= 30 × 25

= 750 cm^2

Q3) Find the surface area of a cube having its sides equal to 8 cm.

Solution:

Given, Length of the side 'a'= 8 cm

Surface area = $6a^2$

= 6×8^2

= 6 × 64

= 384 cm^2

Q4) If the side length of the cube shape object is 3 cm and the dimensions of the cuboid-shaped object are 2 cm × 4 cm × 6 cm. Find the volume of cube and cuboid shaped objects.

Solution:

Given: Side length of cube, l = 3 cm.

We know that the volume of cube = l^3 cubic units.

The volume of cube-shaped object = 3^3 = 27 cm^3.

Given: Dimension of the cuboid-shaped object = 2 cm × 4 cm × 6 cm.

We know that the volume of cuboid = lbh cubic units

The volume of cuboid-shaped object = 2 cm × 4 cm × 6 cm = 48 cm^3.

Therefore, the volume of the cube and cuboid shaped object are 27 cm^3 and 48 cm^3 respectively.

Self-Assessment Questions

Small Questions – LOCF Mapping Table

S.No	Small Question	CO	Bloom's Level	PO
1	Develop the basic clock formats.	CO1	creating	PO1
2	Define cube and cuboid.	CO2	Remembering	PO1
3	Show the important points and shortcuts of clocks calculations.	CO2	Remembering	PO2
4	Outline the properties of a cuboid.	CO3	Understanding	PO3
5	Spell the real life applications of cube and cuboid.	CO4	Remembering	PO4

Big Questions – LOCF Mapping Table

S.No	Big Question	CO	Bloom's Level	PO
1	Construct the structure of a clock.	CO1	Applying	PO1
2	Discuss the formulas for clock calculations.	CO2	Creating	PO1
3	Explain the difference between cube and cuboid.	CO2	Evaluating	PO2
4	Explain the tricks and shortcuts for calendar questions.	CO3	Evaluating	PO3
5	Evaluate the volume of the cube and cuboid.	CO4	Evaluating	PO4

UNIT V

PUZZLE SOLVING AND TIME MANAGEMENT

5.1 Introduction to Puzzle

5.2 Puzzle Solving

5.3 Solved Puzzles

5.4 Time Management Aptitude

5.5 Time and Work Formulas

5.1 Introduction to Puzzle

The word puzzle is derived from the French word pulse. It refers to a toy used to test a person's mental capacity and ability to solve a problem. Basic steps to solve puzzle reasoning involves solving a problem by analysing all the given data, arranging them in a particular order, and finding the required result. The steps involved in this process are analysing the information given and taking the required information from it, leaving the data that are not required.

A puzzle is a game, problem, or toy that tests a person's ingenuity or knowledge. In a puzzle, the solver is expected to put pieces together (or take them apart) in a logical way, in order to find the solution of the puzzle. There are different genres of puzzles, such as crossword puzzles, word-search puzzles, number puzzles, relational puzzles, and logic puzzles. The academic study of puzzles is called enigmatology.

Puzzles are often created to be a form of entertainment but they can also arise from serious mathematical or logical problems. In such cases, their solution may be a significant contribution to mathematical research.

5.1.1 Categories in Puzzles

Puzzles can be categorized as:

- Lateral thinking puzzles, also called "situation puzzles"
- Mathematical puzzles include the missing square puzzle and many impossible puzzles — puzzles which have no solution, such as the Seven Bridges of Königsberg, the three cups problem, and three utilities problem
- Sangaku (Japanese temple tablets with geometry puzzles)

- A chess problem is a puzzle that uses chess pieces on a chess board. Examples are the knight's tour and the eight queens puzzle.
- Mechanical puzzles or dexterity puzzles such as the Rubik's Cube and Soma cube can be stimulating toys for children or recreational activities for adults.
- Combination puzzles like Peg solitaire
- Construction puzzles such as stick puzzles
- Disentanglement puzzles,
- Folding puzzles
- Jigsaw puzzles. Puzz 3D is a three-dimensional variant of this type.
- Lock puzzles
- A puzzle box can be used to hide something — jewelry, for instance.
- Sliding puzzles (also called sliding tile puzzles) such as the 15 Puzzle and Sokoban
- Tiling puzzles like Tangram
- Metapuzzles are puzzles which unite elements of other puzzles.
- Paper-and-pencil puzzles such as Uncle Art's Funland, connect the dots, and nonograms
- Also the logic puzzles published by Nikoli: Sudoku, Slitherlink, Kakuro, Fillomino, Hashiwokakero, Heyawake, Hitori, Light Up, Masyu, Number Link, Nurikabe, Ripple Effect, Shikaku, and Kuromasu; takuzu.
- Spot the difference
- Tour puzzles like a maze
- Word puzzles, including anagrams, ciphers, crossword puzzles, Hangman (game), dropquotes, and word search puzzles. Tabletop and digital word puzzles include Bananagrams, Boggle, Bonza, Dabble, Letterpress (video game), Perquackey, Puzzlage, Quiddler, Ruzzle, Scrabble, Upwords, wordspot, and Words with Friends. Wheel of Fortune (U.S. game show) is a game show centered on a word puzzle.
- Puzzle video games
    - Tile-matching video game
    - Puzzle-platformer
    - Adventure game
    - Hidden object game & Minesweeper

5.2 Puzzle solving

Solutions of puzzles often require the recognition of patterns and the adherence to a particular kind of order. People with a high level of inductive reasoning aptitude may be better at solving such puzzles compared to others. But puzzles based upon inquiry and discovery may be solved more easily by those with good deduction skills. Deductive reasoning improves with practice.

Mathematical puzzles often involve BODMAS. BODMAS is an acronym which stands for Bracket, Of, Division, Multiplication, Addition and Subtraction.

In certain regions, PEMDAS (Parentheses, Exponents, Multiplication, Division, Addition and Subtraction) is the synonym of BODMAS. It explains the order of operations to solve an expression. Some mathematical puzzles require top to bottom convention to avoid the ambiguity in the order of operations. It is an elegantly simple idea that relies, as sudoku does, on the requirement that numbers appear only once starting from top to bottom as coming along.

5.2.1 Basic Steps to Solve Puzzles in Reasoning

Puzzles are unordered raw data given in any order for the user to solve it to make it correct. Puzzles in reasoning involve answering the questions based on the information. All the data which is required to find the result will be given in the question itself. Basic steps to solve puzzles in reasoning do not need much knowledge. It only requires analysis of the puzzle and solving it with the information collected

- ***Go through the question***

Reading and understanding the question correctly is more important to get an accurate result. You should go through all the information and cut it into parts to make it easy to understand.

- ***Create an idea of the whole question***

Conclude with all the information given and find the overall problems and theme of the given question. Use tables if necessary, arranging problems with tables will make the question easy.

- ***Focus on the required information needed and leave out unnecessary data***

Choose the data which gives the accurate answer to the question. Finding the result also depends on your ability to solve a puzzle.

5.2.2 Steps in solving Logical Puzzles

The steps involved in solving logical puzzles include.

- Read all the given information thoroughly.

- Collect all the required data.
- Arrange the data collected in a specific order or a tabular format.
- There can be more than one way to solve the puzzle, so arrange all the methods in different forms.
- Get rid of all the unnecessary information.
- Conclude with an answer.

5.2.3 What skills are needed to solve puzzles?

The answer to the question "what skills are needed to solve puzzles?" is mentioned below.

- **Problem-solving**

Problem-solving skills will help you to understand the problem correctly. You will be able to know the situation in which the problem was made and how it was caused. All this will help you to find a method to solve the problem.

- **Analytical skill**

It involves analysing the problem. Analysing involves examining the information available. It helps to know the reason behind a problem, how it happened, etc.

- **Creative skill**

It is the ability to think of a problem differently, in a unique way, to solve it easily.

- **Reasoning skill**

Reasoning skills consist of critical thinking, analysing, evaluation, and synthesis abilities.

- **Critical thinking**

Critical thinking involves thoroughly checking all the available data to conclude with the required data.

- **Evaluation**

Evaluation is the process of making a conclusion or giving an answer.

- **Thinking skills**

Thinking skill is the mind's capability to process information, find problems and connections, create new ideas, make new decisions, and apply all that knowledge to a situation or problem.

5.3 Solved Puzzles

5.1.6.1 Solved examples of puzzles in reasoning

1. Six programs are organised for a week in a school. Starting on Monday and ending on Sunday. The speech program is not conducted on Tuesday or Saturday. The dance competition is conducted after the music competition. Sports are not on Friday, and there is a holiday for one day between the dance competition and social service – campus cleaning. There is no program before the science exhibition.

a) On which day is the Speech competition organised?

Answer – Thursday

b) How many programs are organised between the Science exhibition and the Dance competition?

Answer – Three

c) If somebody wants to attend any two programs from Dance competition, social service, and speech and wishes that both days should come one after other. Then what is the possible combination of the programs that he or she can attend?

Answer – Social service and speech competition

2. Five friends, Ram, Joseph, Catherine, David, and Evans, travelled from Brazil to five different countries, the US, India, UK, Canada, and Russia, by five different types of transport. The vehicles they used for travel were aeroplanes, rockets, cars, ships, and bikes.

The person who went to the UK did not use a bike. Catherine went to Canada by ship, and Joseph went to India in a car. David travelled by Bike, and Evans travelled by rocket if Brazil was not connected by aeroplane to the US and UK.

a) Which of the person is using the wrong mode of transport to reach his destination?

Answer – the Evans and car

Solution:

Joseph goes to India; Catherine goes to Canada Ram travels by aeroplane to Russia. David travels by Bike, so he did not go to the UK. So, David goes to the US. Now the only person remaining is Evans, so Evans goes to the UK, which is the incorrect combination.

5.4 Time Management Aptitude

Time management aptitude involves the ability to plan, prioritize, and execute tasks efficiently to maximize productivity, often tested through scenarios on goal setting, delegation, and scheduling. Key skills include reducing procrastination, maintaining focus, and using tools like to-do lists or automation. It is essential for professional efficiency.

5.4.1 Important Aspects of Time Management Aptitude:

- **Prioritization:** Deciding the order of tasks based on importance and urgency.
- **Planning & Goal Setting:** Creating actionable, measurable plans for tasks.
- **Focus & Self-Discipline:** Minimizing distractions and maintaining concentration.
- **Delegation & Automation:** Assigning tasks to others or using technology to streamline workflows

5.4.2 How to Improve Time Management Skills:

- **Set Boundaries:** Learn to say "no" to non-essential tasks.
- **Use Techniques:** Apply methods like the Pomodoro technique or time blocking.
- **Track Time:** Analyze how you spend your time to identify inefficiencies.

5.4.3 Time Management in Aptitude Tests (Quantitative/General):

In competitive exams (like CAT or GATE), this refers to managing time to solve questions efficiently. Key strategies include:

- **Skipping/Moving On:** Not getting stuck on difficult, time-consuming questions (traps).
- **Elimination Technique:** Eliminating wrong options to speed up decision-making.
- **Mental Math & Shortcuts:** Using fast calculation tricks, such as LCM for work-based problems.
- **Practice:** Taking mock tests to build speed and accuracy.

5.5 Time and Work Formulas

"**Time and Work**" topic deals with the time taken by an individual or a group to complete a job or a piece of work and its efficiency. The formulas can completely help you to find a solution as soon as you read the question. Thus, it makes the solution and the related calculations simpler. Some of Important Formulas and Concepts on Time and Work are:

- **Work Done by a person** = Time Taken × Rate of Work

- **Rate of Work of a person** = 1 / Time Taken by him
- **Time Taken by him** = 1 / Rate of Work
- **If a piece of work or a job is done in n number of days, then the work done in one day** = 1/n
- **Total Work Done** = Number of Days × Efficiency
- Efficiency of work done and Time are inversely proportional to each other.
- M : W is the ratio of the number of men and women which are required to complete a piece of work, then the ratio of the time taken by them to complete the work will be W : M.
- If W_1 work is done by M_1 people in D_1 days, working T1 hours in a day and W_2 work is done by M_2 people in D_2 days, working T_2 hours in a day, then the relation between them will be

$$(M1 \times D1 \times T1 \times W2) = (M2 \times D2 \times T2 \times W1)$$

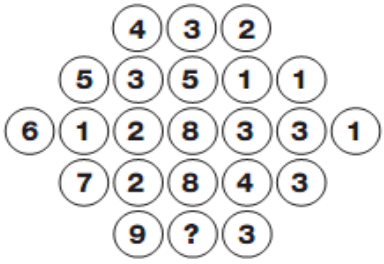
Check Your Progress

I) Puzzles: (Number puzzles, Missing letter puzzles, Logical Puzzles, Clock Puzzles)

1.1 Number puzzles: (Q1 – Q5):

Question 1:

What number comes inside the circle?

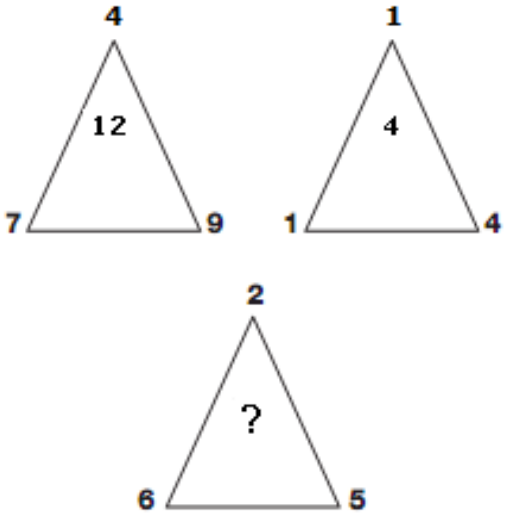


Answer: 6

Explanation: Looking at the diagram in rows, the central circle equals half the sum of the numbers in the other circles to the left and right of the centre.

Question 2:

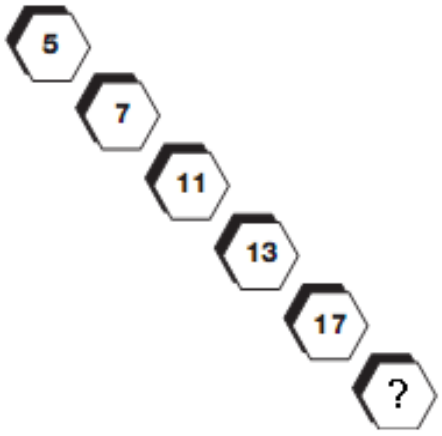
Which number replaces the question mark?



Answer: 9

Explanation: The number at the centre of each triangle equals the sum of the lower two numbers minus the top number.

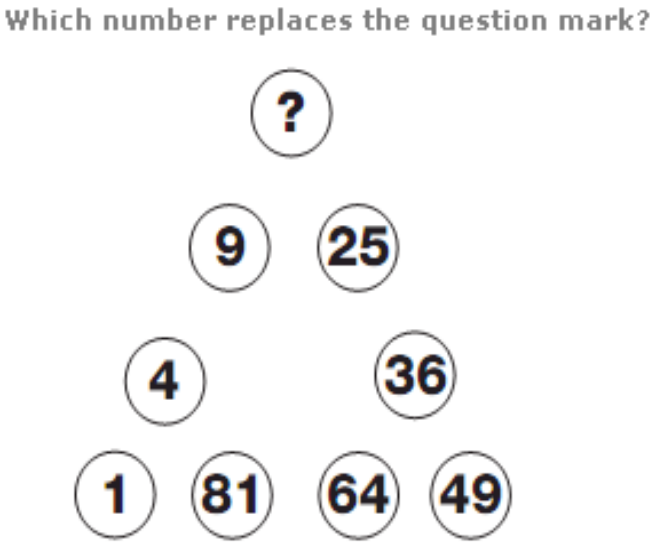
Which number completes the puzzle?



Answer: 19

Explanation: As you move diagonally down, numbers follow the sequence of Prime Numbers.

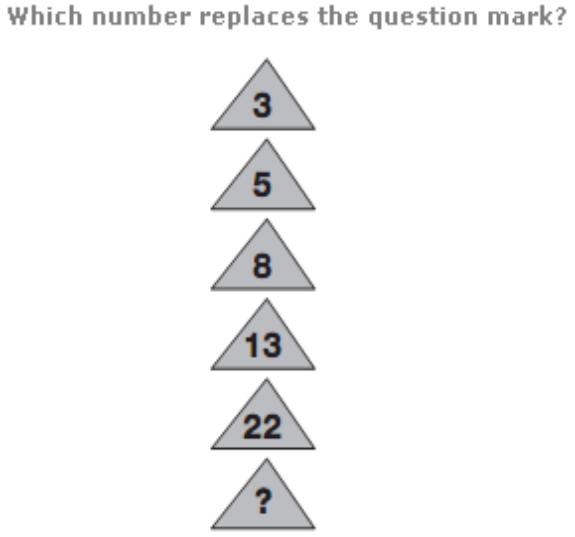
Question 3:



Answer: 16

Explanation: Starting bottom left and moving clockwise around the triangle, numbers follow the sequence of Square Numbers.

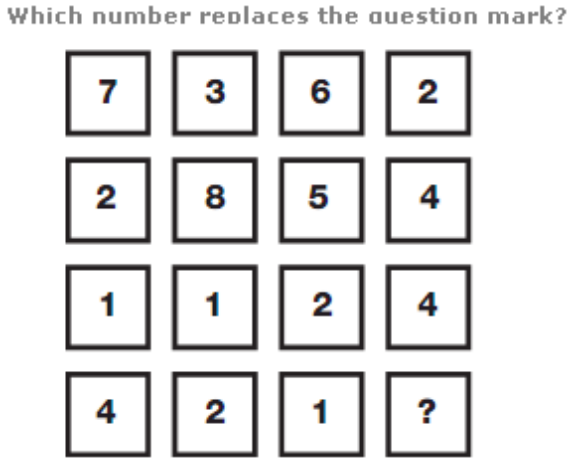
Question 4:



Answer: 39

Explanation: Working from top to bottom, double each number and subtract 1, then 2, then 3 etc.

Question 5:

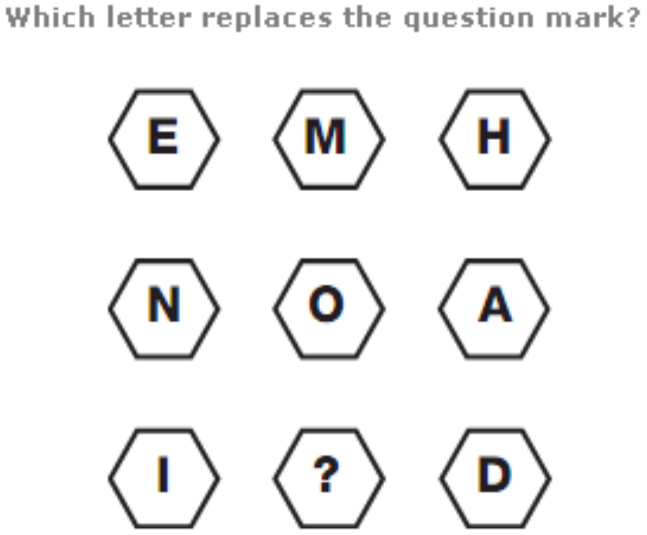


Answer: 4

Explanation: Working in columns, the sum of the numbers in each column is always 14.

1.2 Missing letter puzzles: (Q1 – Q5):

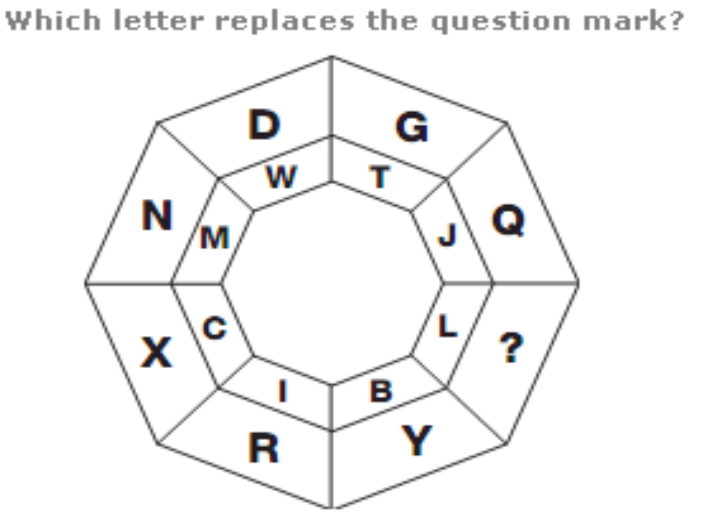
Question 1:



Answer: M

Explanation: Working in rows, add together the numerical values of the left and right hand letters to give the numerical value of the central letter.

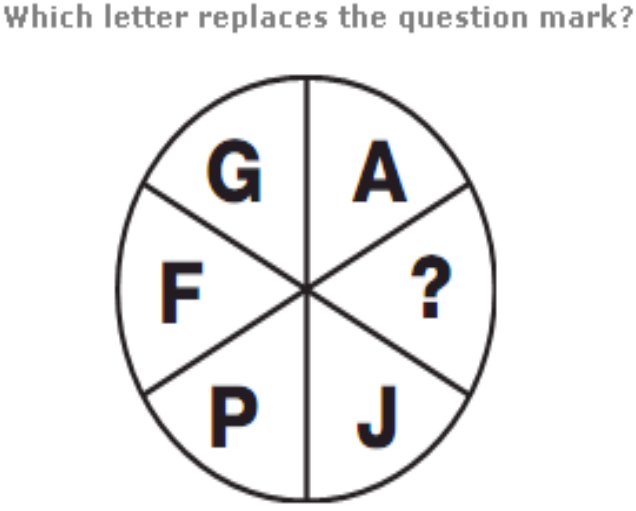
Question 2:



Answer: O

Explanation: In each segment of the diagram are a pair of letters, one of which is the same distance from the start of the alphabet as the other is from the end.

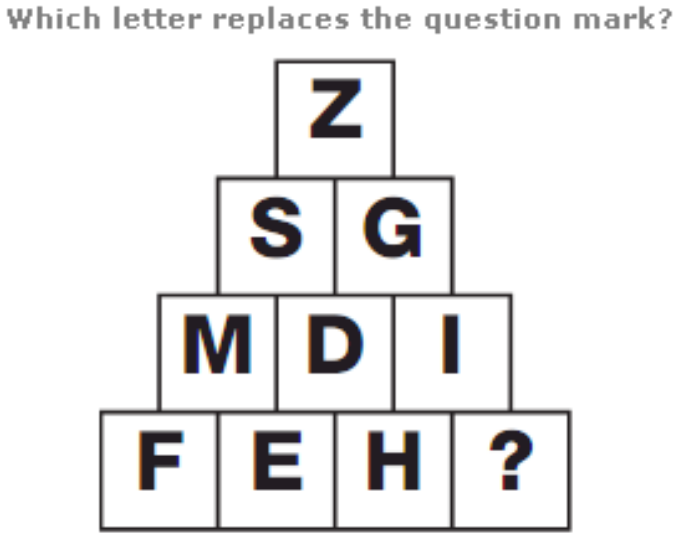
Question 3:



Answer: K

Explanation: The numerical values of the letters in opposite segments of the circle always add up to 17.

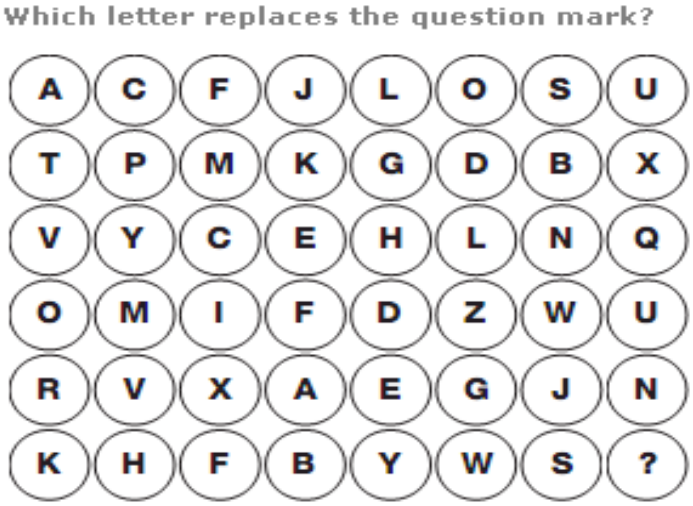
Question 4:



Answer: G

Explanation: The numerical values of the letters in each row add up to 26 each time.

Question 5:



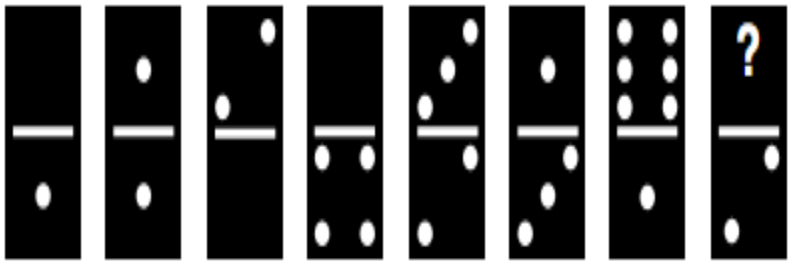
Answer: P

Explanation: Starting at the top left circle, and moving right, then down one row and moving left, in a snakes and ladders pattern, letters move through the alphabet in steps of 2, 3 and 4, repeating this pattern all the way down.

1.3 Logical Puzzle: (Q1 – Q5):

Question 1:

How many number of dots replaces the question mark?

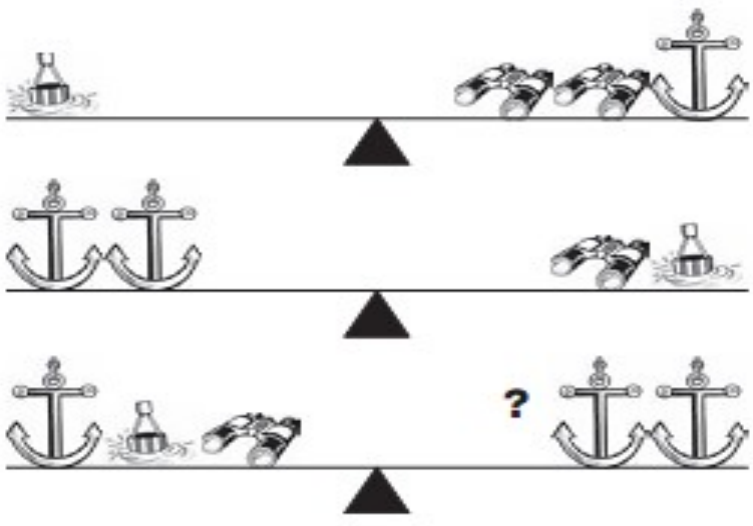


Answer: 3

Explanation: Starting on the left and working to the right, take pairs of dominoes and calculate the sum of the dots they are displaying. This sum follows the sequence 3, 6, 9 and 12.

Question 2:

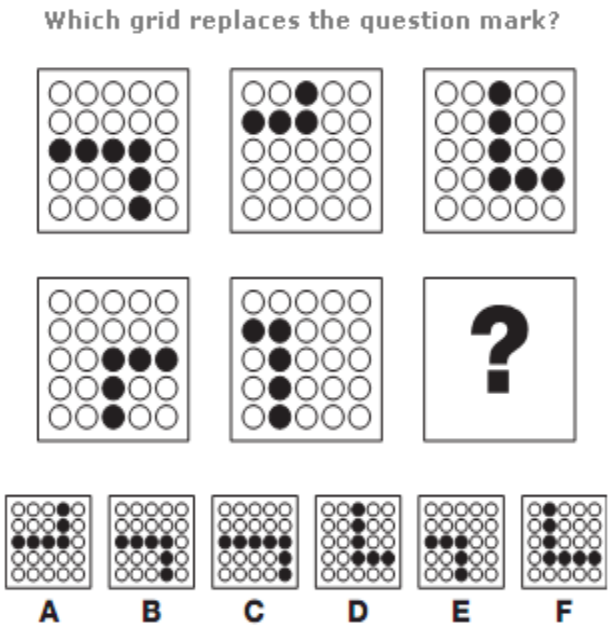
Which symbol is needed to make the scale balance?



Answer: Anchor

Explanation: The Binoculars = 1, the Anchor = 3 and the Buoy = 5

Question 3:



Answer: A

Explanation: In each diagram, there are 2 lines of black dots, joining two sides together. The sides joined by the dots moves 1/4 turn clockwise as you move from left to right.

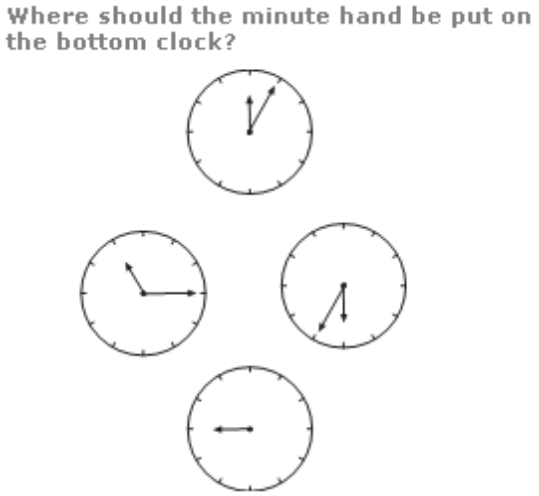
1.4 Clock Puzzles: (Q1 – Q5):

Question 1:

Answer:5:19

Explanation: Starting with the watch on the left, add 42 minutes to the time shown to give the time on the next watch to the right.

Question 2:



Answer: Hand pointing to 5

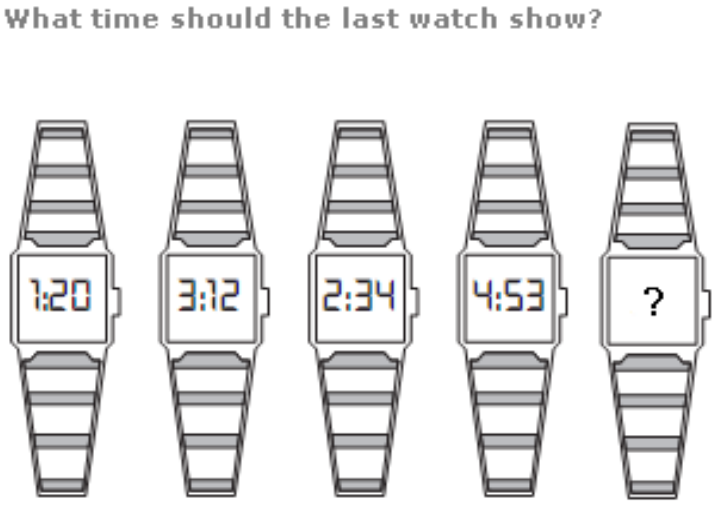
Explanation: Starting with the top clock and moving anti-clockwise around the others, the hour hand moves back 1 hour, then 2, then 3 etc, while the minute hand moves forward 10 minutes each time.

Question 3:

Answer: To the 5

Explanation: Start with the top left clock face, and move around the others in a clockwise direction. The sum of the numbers pointed to by the hour and minute hand follows the sequence 14, 15, 16, 17 and 18.

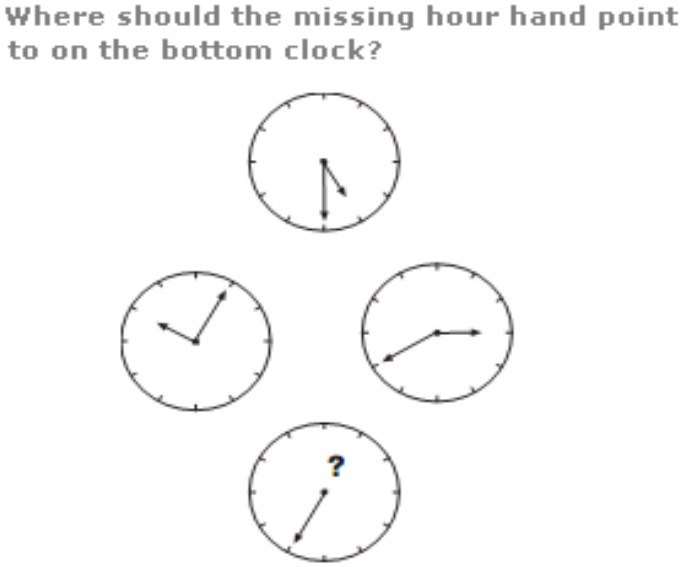
Question 4:



Answer: 6:45

Explanation: As you move from left to right, add 1 to the value of each digit on the watch, and rotate the digits one place to the left.

Question 5:



Answer: To the 4

Explanation: The sum of the numbers pointed to by the hour and minute hands is always 11.

II) Time management (Q1 – Q5):

Q1. A man can do a work in 20 days and a woman in 15 days. If they work on it together for 5 days, then the fraction of the work that is left is :

A. 1/12
B. 1/10
C. 5/12
D. 7/15
E. 8/15

Answer: C

Solution:

Man's 1 day's work = 1/20

Woman's 1 day's work = 1/15

(Man + woman)'s 1 day's work = (1/20 + 1/15) = 7/60

(Man + woman)'s 5 day's work = (7/60 × 5) = 7/12

Thus, Remaining work = 1 - 7/12 = 5/12

Q2. L can finish a work in 16 days and M can do the same work in 12 days. With help of N, they did the work in 4 days only. Then, N alone can do the work in how many days.

A. 48/5 days
B. 48/7 days
C. 48/11 days
D. 10 days
E. None of these

Answer: A

Solution:

(L + M + N)'s 1 day's work =1/4

L's 1 day's work = 1/16

M's 1 day's work = 1/12

Therefore, N's 1 day's work

= 1/4 - (1/16 + 1/12)

= 1/4 - 7/48 = 5/48

So, N alone can do the work in 48/5 days.

Q3. P, Q and R can do a job in 20, 30 and 60 days respectively. In how many days can P do the job if he is assisted by Q and R every third day?

A. 11 days
B. 15 days
C. 17 days
D. 16 days
E. 18 days

Answer: B

Solution:

P's 2 day's work = 2/20 = 1/10

(P + Q + R)'s 1 day's work

= (1/20 + 1/30 + 1/60)

= 6/60 = 1/10

Job done in 3 days = (1/10 + 1/10) = 1/5

Now, 1/5 jobs is done in 3 days

Whole job will be done in (3 x 5) = 15 days.

Q4. M's efficiency is three times N's efficiency. M can finish a job in 60 days less than N. If they work together, then in how many days the job will be done.

A. 20 days
B. 22.5 days
C. 25 days
D. 30 days
E. 24.5 days

Answer: B

Solution:

Ratio of times taken by M and N = 1 : 3 (Since the efficiency of M is three times to N)

Time difference is (3 - 1) = 2 days, while N take 3 days and M takes 1 day.

2 units = 60 days

1 unit = 30 days

So, M takes 30 days to do the job.

And N takes (30×3) = 90 days to do the job.

M's 1 day's work = 1/30

N's 1 day's work = 1/90

(M + N)'s 1 day's work =(1/30 + 1/90) = 2/45

M and N together can do the job in 45/2 days = 22.5 days.

Q5. Ankit alone can do a piece of work in 6 days and Bishal alone in 8 days. Ankit and Bishal undertook to do it for Rs. 4800. With the help of Dinesh, they completed the work in 3 days. How much is to be paid to Dinesh?

A. Rs. 1375
B. Rs. 1400
C. Rs. 1600
D. Rs. 600
E. Rs. 2000

Answer: D

Solution:

Ankit's 1day work = 1/6

Bishal's 1 day work = 1/8

(Ankit + Bishal + Dinesh)'s 1 day work =1/3

Dinesh's 1 day work = 1/3 - (1/6+1/8) = 1/24

*So, Dinesh's 3 day work = 3 * 1/24= 1/8*

If Dinesh contributed 8th part of work then he will receive 8th part of total payment

i.e., 4800 × 1/8 = 600

Self-Assessment Questions

Small Questions – LOCF Mapping Table

S.No	Small Question	CO	Bloom's Level	PO
1	Define Puzzles.	CO1	Remembering	PO1
2	What skills are needed to solve puzzles?	CO2	Remembering	PO1
3	Give the suitable example for logical puzzles.	CO2	Remembering	PO2
4	What are the key Aspects of Time Management Aptitude?	CO3	Remembering	PO3
5	Explain clock puzzles.	CO4	Understanding	PO4

Big Questions – LOCF Mapping Table

S.No	Big Question	CO	Bloom's Level	PO
1	Describe any three Puzzle solving methods.	CO1	Remembering	PO1
2	Discuss about the Categories in Puzzles.	CO2	Analyzing	PO1
3	What are the Basic Steps to Solve Puzzles in Reasoning?	CO2	Remembering	PO2
4	Explain the Steps in solving logical puzzles.	CO3	Understanding	PO3
5	List the important formulas and concepts of Time and Work.	CO4	Remembering	PO4