UPSC

Fourth Edition

CSAT

Theory & Practice

TOPIC WISE SEGREGATION WITH

LAST 15 YEARS SOLVED PYQs

Reading Comprehension

Quantitative Aptitude

Logical Reasoning

Ram Mohan Pandey

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CIVIL SERVICES APTITUDE TEST

Reading Comprehension

Quantitative Aptitude & Logical Reasoning

TOPIC WISE SEGREGATION WITH

LAST 15 YEARS SOLVED PYQs

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Preface

The journey of the CSAT paper has changed dramatically in the last few years. What was once seen as a qualifying hurdle has now become a test of clarity, patience, and true analytical ability. With UPSC steadily shifting toward logic based and application oriented questions since 2021, aspirants from every background, including mathematics and engineering, have felt the increasing weight of this paper.

As a teacher, my greatest joy has been watching students discover that CSAT is not about memorizing formulas, it is about understanding how we think, decide and apply logic in everyday situations. Some of the most beautiful moments in the classroom happen when a concept suddenly "clicks" and a student's confidence rises. Yet, I also see the uncertainty many aspirants feel because they struggle to find high-quality practice questions that truly reflect the UPSC standard. It is that concern, repeated year after year, that inspired the creation of this book.

With every edition, I have tried to stay true to one purpose **to give students a resource that builds clarity, confidence and genuine competence.**

The **Fourth Edition** continues this effort with thoughtful additions that reflect evolving exam trends:

- **A strengthened Number System section**, enriched with new questions from various UPSC examinations.
- **Complete inclusion of Reading Comprehension**, making this edition a full and balanced CSAT resource.
- **The solved CSAT 2025 question paper**, offering the latest benchmark for preparation.
- **A new chapter on Inequality in Reasoning**, now frequently asked in recent UPSC papers.

Along with these updates, the book retains its original spirit, simple explanations, formula free learning, solved examples and a wide range of practice questions supported by 15 years of topic wise previous year questions.

I remain deeply grateful to my students, whose dedication and trust give purpose to my work. Many of them have supported and encouraged me at every step. I also extend my heartfelt thanks to Mr. Rajnish Gupta, who has shaped the manuscript with remarkable patience and to Mr. Amitesh Kumar (AAKASH Printers) for bringing this book to life with care and precision.

Despite sincere efforts, perfection is always a work in progress. I welcome your suggestions and corrections so that future editions may become even more helpful.

As you prepare for the UPSC examination, I hope this book becomes more than just a study resource. I hope it becomes a companion that reduces your fear, strengthens your logic and helps you face the CSAT paper with calmness and clarity.

Wishing you strength, discipline and unwavering faith in your capabilities.

Ram Mohan Pandey

Contents

Quantitative Aptitude

Logical Reasoning

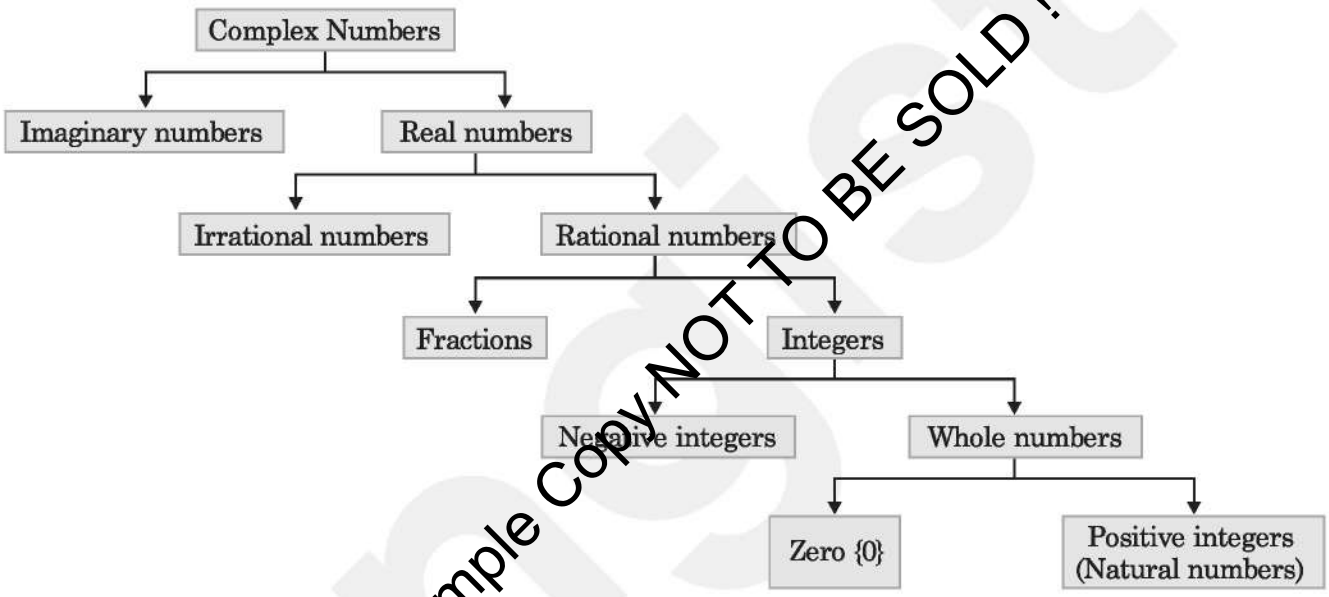
Reading Comprehension

Quantitative Aptitude

Chapter 1 Number System

1.1 Numbers

Basic Introduction



Prime number : A natural number which has only 2 factors *i.e.*, 1 and itself is called a prime number.
For example: 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, ... etc.

A prime number (>3) can always be expressed in the form of $6n \pm 1$ or $4n \pm 1$, where n is a natural number but the converse is *not* true.

Important facts about prime numbers :

a. 1 is neither prime nor composite number.
b. 2 is the only even prime number and the first prime number.
c. There are infinite prime numbers.
d. There are total 25 prime numbers up to 100.
e. There are total 46 prime numbers up to 200.

List of prime numbers from 1 to 100 is given below :

2	11	23	31	41	53	61	71	83	97
3	13	29	37	43	59	67	73	89	
5	17			47			79		
7	19								

EXAMPLES

1. The sum of three prime numbers is 100. If one of them exceeds another by 24. Find the largest among them ?

Sol: Sum of three numbers is 100, which is an even number, if sum of three numbers is an even number, then either one of them is even or all three of them are even.

In the given condition all three of them cannot be even, since they have to be prime numbers.

So, one number will be even and two of them will be odd. We know 2 is the only even prime number.

Let the three number are a, b, c

According to the question,

$a + b + c = 100$ ... (1)

Let $a = 2$

So, $b + c = 98$ ... (2)

According to the question,

$b - c = 24$

On solving these equation, we get

$b = 61$ and $c = 37$

So, the numbers are 2, 61 and 37.

Hence, 61 is the largest among them.

2. The product of two integers is 30, where the even integer is greater than the odd integer. What can be their minimum sum ?

Sol: If the product of two integers is 30, then we can have possible pairs as, (1, 30), (2, 15), (3, 10) and (5, 6).

But we need to minimize the sum, so we need to take negative integers.

Hence, (–1, –30), (–2, –15), (–3, –10), (–5, –6) pairs will be considered and in (–2, –15) we have, even integer is greater than the odd integer.

Hence, the sum will be = –2 – 15 = –17.

3. If $a \times b \times c \times d \times e = 45$, where a, b, c, d and e are distinct integers, then find $a + b + c + d + e$ = ?

Sol: Possible values of a, b, c, d and e are given below,

$a = 1$, $b = -1$, $c = 3$, $d = -3$, $e = 5$

Sum = –1 + 1 – 3 + 3 + 5 = 5.

4. If $a^b + b^a = 17$, where a, b are positive integers. How many solutions of the given equation exist ?

Sol: Four values of a and b are possible *i.e.*, (1, 16), (16, 1), (2, 3) and (3, 2).

For example: (1, 16), the value of $a^b + b^a = 1^{16} + 16^1 = 1 + 16 = 17$.

5. Find the value of the expression, 1 – 2 + 3 – 4 + 5 – 6 + 7 – 8 ..... + 99 – 100.

Sol: In the given sequence we can observe, 1 – 2 = –1, 3 – 4 = –1, 5 – 6 = –1, 7 – 8 = –1 and so on.

So, every pair is giving us –1 and total we have 50 pairs. Hence, final value is –50.

Or, alternately we can say final value will be $= -\left[\frac{\text{Total terms}}{2}\right] = -\left[\frac{100}{2}\right] = -50.$

6. Find the value of the expression, 7 – 8 + 9 – 10 ..... 99 – 100.

Sol: Here, we have 94 terms.

So, sum will be $= -\left[\frac{94}{2}\right] = -47.$

7. Find the value of the expression, –8 + 9 – 10 ..... 99 – 100.

Sol: Here, –8 has no pair. So, take it separately.

$$-8 + (9 - 10 + 11 - 12 \ldots\ldots + 99 - 100) = -8 + \left(-\frac{92}{2}\right) = -8 - 46 = -54.$$

8. What will be the value of the expression, 7 – 8 + 9 – 10 ..... + 1699 – 1700 + 1701 ?

Sol: The given expression can be re-written as (7 – 8 + 9 – 10 ..... + 1699 – 1700) + 1701.

Hence, inside the bracket we have 1694 terms.

So, the value of the expression $= -\frac{1694}{2} + 1701 = -847 + 1701 = 854.$

9. If $a^3 + b^3 = 217$ and $a^3 + b^3 + c^3 = d^3$, where a, b, c and d are distinct natural numbers, find $a + b + c + d$?

Sol: We need to solve this question by hit and trial method:

We know, $1^3 = 1$ and $6^3 = 216$

So, a or $b = 1$ or 6 (vice-versa) and $217 + c^3 = d^3$ so, $d^3 - c^3 = 217$

We need to think about 2 such perfect cubes whose difference is 217.

So, $c^3 = 512$ and $d^3 = 729$

Thus, $a = 1$, $b = 6$, $c = 8$ and $d = 9$.

Hence, $a + b + c + d = 1 + 6 + 8 + 9 = 24$.

1.2 Summation 'n' (Σn), Σn^2 and Σn^3

1.2.1 Sum of first 'n' natural numbers is denoted by

$$\Sigma n = 1 + 2 + 3 + \ldots + n = \frac{n(n+1)}{2}$$

For example, $\Sigma 5 = 1 + 2 + 3 + 4 + 5 = \frac{5 \times 6}{2} = 15.$

1.2.2 Sum of the squares of the first 'n' natural numbers is denoted by

$$\Sigma n^2 = 1^2 + 2^2 + 3^2 + \ldots + n^2 = \frac{n(n+1)(2n+1)}{6}$$

For example, $\Sigma 5^2 = 1^2 + 2^2 + 3^2 + 4^2 + 5^2 = \frac{5 \times 6 \times 11}{6} = 55.$

1.2.3 Sum of the cubes of the first 'n' natural numbers is denoted by

$$\Sigma n^3 = 1^3 + 2^3 + 3^3 + \ldots + n^3 = (\Sigma n)^2 = \left[\frac{n(n+1)}{2}\right]^2$$

For example, $\Sigma 5^3 = 1^3 + 2^3 + 3^3 + 4^3 + 5^3 = (\Sigma n)^2 = \left[\frac{5 \times 6}{2}\right]^2 = 15^2 = 225.$

1.2.4 Sum of first 'n' odd natural numbers = n^2.

For example, $1 + 3 + 5 = 9 = 3^2$. $1 + 3 + 5 + 7 = 16 = 4^2$. $1 + 3 + 5 + 7 + 9 = 25 = 5^2$.

7. How many key strokes are needed to type from 1 to 500 in a computer screen ?

Sol: Digits used to write from 1 to 9 = 9.

Digits used to write from 10 to 99 = 90 × 2 = 180.

Digits used to write from 100 to 500 = 401 × 3 = 1203.

So, digits used to write from 1 to 500 = 9 + 180 + 1203 = 1392.

8. The number of digits you have to type to write all the page numbers of a book starting from 1 (first page) is 2019. What is the number of pages in that book ?

Sol: Digits used to write from 1 to 9 = 9.

Digits used to write from 10 to 99 = 90 × 2 = 180.

So, digits used to write from 1 to 99 = 9 + 180 = 189.

Since, total digits used = 2019 (Given)

So, left digits = 2019 – 189 = 1830.

From 100 onwards, to write every number we need to type 3 digits.

So, $\frac{1830}{3} = 610$ numbers are required to type 1830 digits.

We have to write 610 numbers starting from 100.

So, we can go up to 709. Hence, the right answer is 709.

9. Find the average of the given series :

1, 2, 2, 3, 3, 3, 4, 4, 4, 4, 5, 5, 5, 5, 5, 6, 6, 6, 6, 6, 6, 7, 7, 7, 7, 7, 7, 7.

Sol: We know that, average $= \frac{\text{sum of terms}}{\text{number of terms}} = \frac{\Sigma 7^2}{\Sigma 7} = \frac{\frac{7\times 8\times 15}{6}}{\frac{7\times 8}{2}} = 5.$

10. If $1^3 + 2^3 + 3^3 + 4^3 + \ldots + 10^3 = 3025$, then what will be the value of $2^3 + 4^3 + 6^3 + 8^3 + \ldots + 20^3$?

Sol: $2^3 + 4^3 + 6^3 + 8^3 + \ldots + 20^3 = 2^3 (1^3 + 2^3 + 3^3 + 4^3 + \ldots + 10^3) = 8 \times 3025 = 24200.$

1.3 $xy - yx = 9|x - y|$, $xyz - zyx = 99|x - z|$, $xy + yx = 11(x + y)$

1.3.1 The difference between a 2-digit number 'xy' and the number obtained by interchanging the positions of its digits 'yx' is always divisible by 9 and equals $9|x - y|$.

Proof: $xy - yx = 10x + y - (10y + x)$

$= 10x + y - 10y - x = 9(x - y)$

To make the difference always positive, we use the modules.

So, we can say $xy - yx = 9|x - y|$.

1.3.2 Difference between a 3-digit number 'xyz' and its reverse 'zyx' is always a multiple of 99, and equals $99|x - z|$.

The difference between a 3-digit number 'xyz' and the number obtained by interchanging the positions of first and last digits 'zyx' is always divisible by which number.

Proof: We know, $xyz = 100x + 10y + z$ and $zyx = 100z + 10y + x$

So, $xyz - zyx = (100x + 10y + z) - (100z + 10y + x) = 99(x - z)$

To make the difference positive, we use modulus so, $xyz - zyx = 99|x - z|$

Hence, we can say the difference between a 3-digit number 'xyz' and the number obtained by interchanging the positions of first and last digits 'zyx' is always divisible 99.

6. Sum of a 2-digit number and its reverse is a multiple of 6, how many such numbers exist ?

Sol: We know that, $xy + yx = 11(x + y)$;

If $11(x + y)$ is a multiple of 6. So, $x + y$ has to be a multiple of 6.

Here, three cases are possible :

Case-1 :

$x + y = 6$

(15, 51), (24, 42), 33 and 60. Total 6 numbers.

Case-2 :

$x + y = 12$

(93, 39), (84, 48), (75, 57) and 66. Total 7 numbers.

Case-3 :

$x + y = 18$

99 is the only possibility. Hence, 1 number.

Case 1 + case 2 + case 3 = 6 + 7 + 1 = 14 numbers are possible.

1.4 Cyclicity (unit digit)

Cyclicity of 2

We all know,

$2^1 = \boxed{2}$	$2^5 = 3\boxed{2}$	$2^9 = 51\boxed{2}$
$2^2 = \boxed{4}$	$2^6 = 6\boxed{4}$	$2^{10} = 102\boxed{4}$
$2^3 = \boxed{8}$	$2^7 = 12\boxed{8}$	$2^{11} = 204\boxed{8}$
$2^4 = 1\boxed{6}$	$2^8 = 25\boxed{6}$	$2^{12} = 409\boxed{6}$

We can observe that the unit digit gets repeated after every 4^{th} power of 2. It is actually a cycle of 2, 4, 8, 6 which will get repeated all the time. Hence, we can say cyclicity of 2 is 4.

This means that, a number of the form

2^{4k+1} will have the last digit as 2.

2^{4k+2} will have the last digit as 4.

2^{4k+3} will have the last digit as 8.

2^{4k} will have the last digit as 6 (where $k = 1, 2, 3, \ldots$).

This is applicable not only for 2, but for all numbers ending in 2. Which can be concluded in the following table:

Form of power	Unit digit
$4n + 1$	2
$4n + 2$	4
$4n + 3$	8
$4n$	6

Similarly, we can find the cyclicity of other digit's too. Let's talk about the cyclicity of 3.

1.5 Exponents (Number of zeros)

If we need to find the maximum power of 2, that will completely divide 10!. Then we have to expand 10! and need to find how many times 2 is getting multiplied with 2.

For example,

$$10! = 1 \times 2 \times 3 \times 4 \times 5 \times 6 \times 7 \times 8 \times 9 \times 10$$

$$\downarrow \quad \downarrow \quad \downarrow \quad \downarrow \quad \downarrow$$

$$2\times1 \quad 2\times2 \quad 2\times3 \quad 2\times2\times2 \quad 2\times5$$

$$1 \quad 2 \quad 1 \quad 3 \quad 1$$

Total number of 2's = 1 + 2 + 1 + 3 + 1 = 8

So, 2^8 will divide 10! completely.

This method is feasible for smaller numbers like 10, 15, 20, etc. but for bigger numbers like 500, 700 or so on, this approach will not work. Hence, we have the following method to find total number of powers.

Algorithm

We can find the maximum power by successive division, till the division is possible.

Step 1: 10 will be divided by 2, which gives 5.

Step 2: 5 will be divided by 2, which gives 2 (greatest integer).

Step 3: 2 will be divided by 2, which gives 1. (we will stop here, since 1 is less than 2)

Step 4: Add the resultants of step 1, 2 and 3 *i.e.,* 5 + 2 + 1 = 8

So, 2^8 will divide 10! completely.

Let's try another example

What is the maximum power of 3, that completely divides 25!.

We can find the maximum power by successive division, till the division is possible.

Step 1: 25 will be divided by 3, which gives 8.

Step 2: 8 will be divided by 3, which gives (greatest integer is 2 and we will stop here, since 2 is less than 3).

Step 3: Add the resultants of step 1 and 2 i.e. 8 + 2 = 10. So, 3^{10} will divide 25! completely.

Note: This method is valid only for prime numbers *i.e.,* with the help of this method we can find powers of 2, 3, 5, 7 and other prime numbers, but we cannot find powers of composite numbers, such as 6, 8, 12 and so on.

EXAMPLES

1. Find out the maximum power of 2, that will completely divide 50!.

Sol: On dividing 50, successively by 2 we are getting the following result.

$$\frac{50}{2} = 25, \ \frac{25}{2} = 12, \ \frac{12}{2} = 6, \ \frac{6}{2} = 3, \ \frac{3}{2} = 1$$

To find powers, we have to add all the quotients *i.e.,* 25 + 12 + 6 + 3 + 1 = 47.

Hence, 50! can be completely divided by 2^{47}.

2. Find out the maximum power of 5, that will completely divide 50!.

Sol: On dividing 50, successively by 5 we are getting the following result.

$$\frac{50}{5} = 10, \ \frac{10}{5} = 2$$

To find powers, we have to add all the quotients *i.e.,* 10 + 2 = 12.

Hence, 50! can be completely divided by 5^{12}.

3. How many zeroes are there at the end of 20! ?

Sol: We know when 5 is multiplied with 2, then 0 is produced.

So, we need to check the pairs of 2's and 5's in 20!.

Number of 5's in 20! = 4 and number of 2's in 20! = 18.

Number of pairs of 2 and 5 = 4. So, 2 and 5 can be multiplied 4 times inside 20!.

Hence, we have 4 zeroes at the end of 20!.

Note: If we talk in terms of pairs, always lesser number of power will be the number of pairs, and in any number, powers of 5 will be always lesser than powers of 2. So, if we need to find number of zeros at the end of $n!$, we just need to find powers of 5 in $n!$.

4. How many zeroes are there at the end of 100! ?

Sol: Number of zeroes will be same as power of 5 in 100!.

Power of 5 in 100! = 20 + 4 = 24. $\left(\text{since, } \frac{100}{5} = 20,\ \frac{20}{5} = 4\right)$

Hence, 100! ends with 24 zeroes.

5. If N is the product of first 100 multiples of 10. Then find the number of zeros at the end of N ?

Sol: According to the question,

$N = 10 \times 1 \times 10 \times 2 \times 10 \times 3 \times \ldots\ldots \times 10 \times 100$

$= 10^{100}(1 \times 2 \times 3 \times \ldots\ldots \times 100) = 10^{100}(100!) = 100$ zeros + 24 zeros = 124 zeros.

6. If N is the product of first 100 multiples of 100. Then find the number of zeros at the end of N ?

Sol: According to the question,

$N = 100 \times 1 \times 100 \times 2 \times 100 \times 3 \times \ldots\ldots \times 100 \times 100$

$= 100^{100}(1 \times 2 \times 3 \times \ldots\ldots \times 100) = 100^{100}(100!) = 200$ zeros + 24 zeros = 224 zeros.

7. If $n!$ ends with 14 zeros, find the sum of all possible values of n ?

Sol: This question should be solved by hit and trial method.

Where we need to think about first such number whose factorial is ending with 14 zeros; and next 4 numbers will also follow the same thing.

60! ends with 14 zeros. So, 60!, 61!, 62!, 63!, 64! are ending 14 zeros.

So, required sum = 60 + 61 + 62 + 63 + 64 = 310.

8. If $n!$ ends with 30 zeros, how many values of n are possible ?

Sol: 124! is ending with 28 zeros while 125! is ending with 31 zeros.

So, there is no such number whose factorial is ending with 30 zeros.

1.6 Divisibility

Rules of divisibility by certain integers :

Divisibility by 2

A number is divisible by 2, if the last digit is even *i.e.,* 2, 4, 6, 8, or 0.

For example, 124 is divisible by 2 because it is even (it ends in a 4).

Divisibility by 3

If the sum of the digits is divisible by 3, then the number is divisible by 3.

For example, 129 is divisible by 3 because 1 + 2 + 9 = 12, and 12 is divisible by 3.

14. If a number is divided by 84, the remainder is 37. What will be the remainder if it is divided by 21 ?

Sol: Suppose, the number = $84x + 37$

On dividing the number by 21, $84x$ will leave 0 remainder and 37 will be the remainder as 16.

Hence, the overall remainder is 16.

15. Find the common factor of $(11^{15} + 15^{15})$ and $(11^{11} + 15^{11})$.

Sol: Since, $(a^n + b^n)$ is divisible by $(a + b)$, if n is odd natural number.

So, both the numbers will be divisible by 26 and from all the factors of 26 *i.e.,* 13 and 2 also.

16. What will be the remainder when $(27^{27} + 17^{27})$ is divided by 11 ?

Sol: Since, $(a^n + b^n)$ is divisible by $(a + b)$. So, $(27^{27} + 17^{27})$ will be divisible by 27 + 17 *i.e.,* 44.

Hence it is divisible by 11 also. So, remainder will be 0.

17. If AB × DED = ABAB,

AB × DEDED = ABABAB,

ABC × DEED = ABCABC, and

DED + DEDED + DEED = DDFEG,

Where A, B, C, D, E, F and G are different digits, what is the value of F × G ?

Sol: If AB × DED = ABAB,

So, DED = 101. Here, we can say, D = 1, E = 0

Thus, DED + DEDED + DEED =

$$\begin{array}{r} 1\ 0\ 1 \\ 1\ 0\ 1\ 0\ 1 \\ +\quad 1\ 0\ 0\ 1 \\ \hline 1\ 1\ 2\ 0\ 3 = \text{DDFEG} \end{array}$$

So, F = 2 and G = 3

Hence, F × G = 2 × 3 = 6.

1.7 Remainder theorem

Binomial expansion is given by $(a+b)^n = n_{c_0} a^n b^0 + n_{c_1} a^{n-1} b + n_{c_2} a^{n-2} b^2 + \ldots + n_{c_n} a^0 b^n$

If $(a + b)^n$ is divided by a, we will be having following expression.

$$\frac{(a+b)^n}{a} = \frac{n_{c_0} a^n b^0}{a} + \frac{n_{c_1} a^{n-1} b}{a} + \frac{n_{c_2} a^{n-2} b^2}{a} + \ldots + \frac{n_{c_n} a^0 b^n}{a}$$

Here in RHS side, remainder of last term will be having some significant value, rest will have the remainders as 0. Because in all other term we have a multiple of 'a' in numerator.

$$\frac{(a+b)^n}{a} = 0 + 0 + 0 + \ldots + \frac{b^n}{a}$$

Hence, while solving the questions we will follow the same approach.

For example, $\frac{4^{98}}{3} = \frac{(3+1)^{98}}{3} = 0 + 0 + 0 + \ldots + \frac{1^{98}}{3}$

Numerator can be expanded with the help of binomial expansion and the last (final) term of numerator will be $1^{98} = 1$.

And when 1 is divided by 3, remainder will be 1.

So, 4^{98} will give 1 as remainder, when it is divided by 3.

6. What will be the remainder of the expression $\frac{4^{64}}{6}$?

Sol: $\frac{4^n}{6}$ always gives remainder as 4. Here, n is any natural number.

7. What will be the remainder of the expression $\frac{11^{24}}{3}$?

Sol: $\frac{11^{24}}{3} = \frac{(12-1)^{24}}{3} = \frac{(-1)^{24}}{3} = \frac{1^{24}}{3} = 1$ (Remainder).

8. What will be the remainder of the expression $\frac{52!}{53}$?

Sol: According to Wilson's theorem the answer will be 52.

9. What will be the remainder of the expression $\frac{15^{19}+23^{19}}{19}$?

Sol: According to the property, numerator will be divisible by 38.
So, it is divisible by 19 also. Hence, the remainder is 0.

10. What will be the remainder of the expression $\frac{12^{73}+20^{73}+24^{73}+34^{73}}{30}$?

Sol: According to the property, numerator will be divisible by 90.
Hence, it is divisible by 30 also. Hence, the remainder is 0.

11. What will be the remainder of the expression $\frac{1+3^3+5^5+7^7+\cdots\cdots+51^{51}}{8}$?

Sol: Try to make pattern of remainders. The patterns will be 1, 3, 5, 7, 1, 3, 5, 7, 1, 3, 5, 7 and so on.
There are total 26 terms in numerator.
So, till 24^{th} terms the remainder will be 0 and 25^{th}, 26^{th} term will be 1 and 3 respectively.
Hence, final remainder will be 1 + 3 = 4.

12. What will be the remainder of the expression $\frac{3^0+3^1+3^2+3^3+\cdots\cdots+3^{79}}{13}$?

Sol: Here the pattern will be 1 + 3 + 9, 1 + 3 + 9, 1 + 3 + 9, ... and we have total 80 terms in numerator.
So, sum of 79^{th} and 80^{th} term will be final remainder.
Hence, final remainder will be 1 + 3 = 4.

1.8 LCM and HCF

1. Factors and Multiples : If a number a divides another number b exactly, we say that a is a *factor* of b. In this case, b is called a *multiple* of a.

2. Highest Common Factor (HCF) : The HCF of two or more than two numbers is the greatest number that divides each of them exactly.
   To find HCF: Express each one of the given numbers as the product of prime factors. The product of least powers of common prime factors gives HCF.

15. The HCF of two numbers is 20 and their LCM is 600, how many such pairs exist ?

Sol: Since, HCF is 20.

So, both numbers will be a multiple of 20.

Let first number is $20x$ and second number is $20y$.

We know that, HCF × LCM = product of 2 numbers

So, $20 \times 600 = 20x \times 20y$

Or, $xy = 30$

Here, x, y will be co-prime to each other.

So, possible combinations of x and y are (1, 30) (2, 15) (3, 10) (5, 6).

Possible pairs of positive integers are as follows:

$20 \times 1, 20 \times 30 = 20, 600$

$20 \times 2, 20 \times 15 = 40, 300$

$20 \times 3, 20 \times 10 = 60, 200$

$20 \times 5, 20 \times 6 = 100, 120$

Hence, 4 pairs are possible.

16. Find the greatest number that will divide 43, 91 and 183 so as to leave the same remainder in each case.

Sol: Required number = HCF of (91 – 43), (183 – 91) and (183 – 43) = HCF of 48, 92 and 140

$48 = 2^4 \times 3$

$92 = 2^2 \times 23$

$140 = 2^2 \times 5 \times 7$

So, HCF of (48, 92, 140) $= 2^2 = 4$.

17. Find the largest number which divides 62, 132 and 237 to leave the same remainder in each case.

Sol. Required number = HCF of (132 – 62), (237 – 132) and (237 – 62)

= HCF of 70, 105 and 175 = 35.

HCF and LCM of numbers.

18. Find the least number which when divided by 20, 25, 35 and 40 leaves remainders 14, 19, 29 and 34 respectively.

Sol: Here, (20 – 14) = 6, (25 – 19) = 6, (35 – 29) = 6 and (40 – 34) = 6.

Required number = (LCM of 20, 25, 35, 40) – 6 = 1394.

1.9 Factors

Factors are the numbers that can divide a number exactly.

Hence, after division, there is no remainder left.

To find the total number of factors of N.

Let us assume N is a natural number, for which we need to find the factors. If we convert N into the product of prime numbers by prime factorization method, we can represent it as :

$N = x^a \times y^b \times z^c$

where x, y and z are the prime numbers and a, b and c are their respective powers.

Total number of factors of a number $N = (a + 1)(b + 1)(c + 1)$.

Practice Set

Numbers

1. $2^{73} - 2^{72} - 2^{71}$ is the same as
   (a) 0 (b) 2^{70}
   (c) 2^{71} (d) 2^{72}

2. A positive integer is said to be a prime number if it is not divisible by any positive integer other than itself and 1. Let p be a prime number greater than 5, then $(p^2 - 1)$ is
   (a) never divisible by 6.
   (b) always divisible by 6, and may or may not be divisible by 12.
   (c) always divisible by 12, and may or may not be divisible by 24.
   (d) always divisible by 24.

3. The sum of two numbers is equal to thrice their difference. If the smaller of the numbers is 10, find the other number.
   (a) 15 (b) 20
   (c) 40 (d) None of these

4. A 2-digit number exceeds by 19 the sum of the squares of its digits and by 44 the double product of its digits. Find the number
   (a) 72 (b) 62
   (c) 22 (d) 12

5. Which one of the following is a prime number ?
   (a) 161
   (b) 221
   (c) 373
   (d) 437

6. How many 3-digit natural numbers N are there such that the sum of digits of N and $(N + 1)$ each is divisible by 8 ? For example, $N = 107$ doesn't satisfy as the sum of digits of $107 = 1 + 0 + 7 = 8$ is divisible by 8 but the sum of digits of $108 = 1 + 0 + 8 = 9$ is not.
   (a) 0
   (b) 5
   (c) 7
   (d) 10

7. Govind wants to number all the doors of his hotel rooms. To do this, he buys some stickers with numbers from 0 to 8, with "6" serving as a stand-in for "9" when flipped. He purchased 20 stickers of each of 9 types for a total of 180 stickers. If Govind starts numbering the doors from 1, then what will be the first number that he cannot form using his stickers ?
   (a) 66 (b) 67
   (c) 68 (d) 69

8. A two-digit number AB is multiplied by another two-digit number CB and the resulting number is a 3-digit number with the same digits DDD. Consider the following statements.
   1. Average of AB and CB is 30.
   2. $A + B + C$ is a perfect square.
   Which of the above statements is/are correct ?
   (a) 1 only
   (b) 2 only
   (c) Both 1 and 2
   (d) Neither 1 nor 2

9. A three-digit number ABC is multiplied by 6 and the resulting number is a 3-digit number with the same digits CCC. Consider the following statements.
   1. $A + B + C$ is a prime number.
   2. $A \times B + C$ is a perfect square.
   3. $C - A \times B$ is a perfect cube.
   (a) Only one statement is correct.
   (b) Only two statements are correct.
   (c) All three statements are correct.
   (d) None of three statements is correct.

10. Let ABC, BCA, CAB be 3-digit numbers such that $ABC + BCA + CAB = 1DD1$ which is a 4-digit number starting and ending in 1. What is the value of $A + B + C + D$?
    (a) 11
    (b) 12
    (c) 13
    (d) 23

ANSWER KEY

1. (c)	36. (d)	71. (a)	106. (a)	141. (b)	176. (a)	211. (d)	246. (a)
2. (d)	37. (a)	72. (b)	107. (a)	142. (c)	177. (b)	212. (b)	247. (a)
3. (b)	38. (d)	73. (c)	108. (d)	143. (b)	178. (d)	213. (a)	248. (b)
4. (a)	39. (d)	74. (b)	109. (c)	144. (a)	179. (a)	214. (c)	249. (a)
5. (c)	40. (a)	75. (c)	110. (c)	145. (a)	180. (c)	215. (c)	250. (a)
6. (d)	41. (b)	76. (c)	111. (d)	146. (a)	181. (b)	216. (a)	251. (a)
7. (b)	42. (c)	77. (c)	112. (b)	147. (a)	182. (a)	217. (c)	252. (a)
8. (d)	43. (c)	78. (b)	113. (c)	148. (d)	183. (d)	218. (b)	253. (d)
9. (a)	44. (b)	79. (b)	114. (b)	149. (a)	184. (c)	219. (b)	254. (c)
10. (c)	45. (b)	80. (c)	115. (a)	150. (b)	185. (b)	220. (b)	255. (c)
11. (c)	46. (a)	81. (c)	116. (b)	151. (b)	186. (a)	221. (c)	256. (a)
12. (c)	47. (b)	82. (b)	117. (c)	152. (c)	187. (a)	222. (a)	257. (c)
13. (a)	48. (b)	83. (d)	118. (d)	153. (c)	188. (a)	223. (c)	258. (c)
14. (c)	49. (d)	84. (c)	119. (a)	154. (a)	189. (b)	224. (b)	259. (c)
15. (d)	50. (d)	85. (b)	120. (d)	155. (b)	190. (a)	225. (a)	260. (c)
16. (b)	51. (c)	86. (b)	121. (c)	156. (b)	191. (d)	226. (c)	261. (b)
17. (b)	52. (a)	87. (d)	122. (b)	157. (c)	192. (a)	227. (b)	262. (c)
18. (b)	53. (a)	88. (c)	123. (b)	158. (a)	193. (b)	228. (d)	263. (c)
19. (c)	54. (a)	89. (c)	124. (b)	159. (c)	194. (b)	229. (d)	
20. (d)	55. (a)	90. (c)	125. (a)	160. (d)	195. (c)	230. (a)	
21. (a)	56. (d)	91. (a)	126. (b)	161. (c)	196. (a)	231. (c)	
22. (d)	57. (a)	92. (c)	127. (c)	162. (d)	197. (c)	232. (d)	
23. (b)	58. (a)	93. (d)	128. (d)	163. (a)	198. (a)	233. (c)	
24. (b)	59. (d)	94. (a)	129. (a)	164. (c)	199. (a)	234. (b)	
25. (d)	60. (d)	95. (b)	130. (b)	165. (d)	200. (c)	235. (b)	
26. (d)	61. (a)	96. (d)	131. (b)	166. (c)	201. (d)	236. (c)	
27. (d)	62. (d)	97. (c)	132. (a)	167. (b)	202. (b)	237. (d)	
28. (d)	63. (a)	98. (a)	133. (c)	168. (c)	203. (c)	238. (d)	
29. (b)	64. (b)	99. (d)	134. (c)	169. (a)	204. (c)	239. (d)	
30. (c)	65. (b)	100. (c)	135. (d)	170. (a)	205. (d)	240. (d)	
31. (d)	66. (d)	101. (d)	136. (b)	171. (c)	206. (c)	241. (c)	
32. (d)	67. (d)	102. (d)	137. (c)	172. (d)	207. (d)	242. (a)	
33. (d)	68. (d)	103. (d)	138. (a)	173. (d)	208. (a)	243. (a)	
34. (a)	69. (d)	104. (c)	139. (c)	174. (a)	209. (a)	244. (b)	
35. (c)	70. (c)	105. (c)	140. (b)	175. (d)	210. (c)	245. (a)	

Hints and Solutions

1. $2^{73} - 2^{72} - 2^{71} = 2^{71}(2^2 - 2 - 1) = 2^{71}(1)$
   Hence, option (c) is correct.

2. Take $p = 7, 11, 13$ and check for the options.
   Hence, option (d) is correct.

3. $x + y = 3(x - y) \rightarrow 2x = 4y$.
   If we take y as 10, we would get the value of x as 20.
   Hence, option (b) is correct.

4. Going through options we observe that both the condition are satisfied for option (a).
   Hence, option (a) is correct.

5. $161 = 23 \times 7$
   $221 = 13 \times 7$
   373 = Prime number
   $437 = 19 \times 23$
   Hence, option (c) is correct.

6. For all natural numbers, except ending in 9, the sum of digits increases by 1 for the following number. But for the number ending in exactly one 9, the sum of digits of the following number decreases by 8.
   For example, sum of digits of 19 is 1 + 9 = 10 and that of 20 is 2 + 0 = 2.
   Thus, the required numbers, N are:
   169, 259, 349, 439, 529, 619, 709, 789, 879, 969.
   Hence, option (d) is correct.

7. Sticker with number "6" is going to create bottleneck as it is being used faster in comparison to others.
   With 20 of these stickers, we can number the doors: 6, 9, 16, 19, 26, 29, 36, 39, 46, 49, 56, 59, 60, 61, 62, 63, 64, 65 and 66.
   Thus 67 is the first number that cannot be formed.
   Hence, option (b) is correct.

8. $DDD = D \times 111 = D \times 3 \times 37$.
   As LHS is product of two 2-digit numbers with same unit digit, the only possibility is for $D = 9$.
   Hence, the product becomes $27 \times 37 = 999$.
   So, average of 27 and 37 is 32. And $A + B + C = 2 + 3 + 7 = 12$ is not a perfect square.
   Hence, option (d) is correct.

9. C is a digit which when multiplied by 6 ends in C only. So, it can be 0, 2, 4, 6 or 8.
   Now only 8 satisfies as one sixth of 000, 222 and 444 is not a 3-digit number, while that of 666 is having same digits.
   Thus, $ABC = 888 \div 6 = 148$.
   Now $A + B + C = 1 + 4 + 8 = 13$ is a prime number but $A \times B + C = 1 \times 4 + 8 = 12$ is not a perfect square and $C - A \times B = 8 - 1 \times 4 = 4$ is not a perfect cube.
   Hence, option (a) is correct.

10. LHS = $(A + B + C) \times 111$ and RHS $= 1001 + 110 \times D = 11 \times (91 + 10 \times D)$.
    As LHS must be multiple of 11,
    So, certainly $A + B + C = 11$ and $D = 2$.
    so that $91 + 10 \times 2 = 111$.
    Hence, option (c) is correct.

11. $N = 6(2 + 4 + 6 + 8) \times 1111 = 6 \times 20 \times 11 \times 101$.
    So, N is always divisible by 24 (*i.e.*, 6×4) as well as 55 (*i.e.*, 5×11).
    Hence, option (c) is correct.

12. $M = (P + Q + R + S) \times 1111$
    $= (P + Q + R + S) \times 11 \times 101$
    Now $P + Q + R + S \leq 9 + 8 + 7 + 6 = 30$
    M can be divisible by 33 if $P + Q + R + S$ is multiple of 3 but M can never be divisible by 32.
    Hence, option (c) is correct.

13. $P + Q + P \cdot Q = 666$
    Adding 1 both sides, we get
    $1 + P + Q + P \cdot Q = 667$
    $(1 + P)(1 + Q) = 23 \cdot 29$
    $P = 22$ and $Q = 28$ or vice-versa
    So, $P + Q = 22 + 28 = 50$.
    Thus, only statement 1 is correct.
    Hence, option (a) is correct.

Previous Year Solved Questions

Numbers

1. A gardener has 1000 plants. He wants to plant them in such a way that the number of rows and the number of columns remains the same. What is the minimum number of plants that he needs more for this purpose ?
   (a) 14 (b) 24
   (c) 32 (d) 34 **[CSAT 2013]**

2. A person is standing on the first step from the bottom of a ladder. If he has to climbs 4 more steps to reach exactly the middle step, how many steps does the ladder have ?
   (a) 8 (b) 9
   (c) 10 (d) 11 **[CSAT 2016]**

3. There are some nectar-filled flowers on a tree and some bees are hovering on it. If one bee lands on each, flower, one bee will be left out. If two bees land on each flower, one flower will be left out. The number of flowers and bees respectively are
   (a) 2 and 4 (b) 3 and 2
   (c) 3 and 4 (d) 4 and 3 **[CSAT 2016]**

4. In aid of charity, every student in a class contributes as many rupees as the number of students in that class. With the additional contribution of Rs. 2 by one student only, the total collection is Rs. 443. Then how many students are there in the class ?
   (a) 12
   (b) 21
   (c) 43
   (d) 45 **[CSAT 2016]**

5. How many numbers are there between 100 and 300 which either begin with or end with 2 ?
   (a) 110
   (b) 111
   (c) 112
   (d) None of the above **[CSAT 2016]**

6. How many numbers are there between 99 and 1000 such that the digit 8 occupies the units place ?
   (a) 64 (b) 80
   (c) 90 (d) 104 **[CSAT 2017]**

7. The age of Mr. X last year was the square of a number and it would be the cube of a number next year. What is the least number of years he must wait for his age to become the cube of a number again ?
   (a) 42 (b) 38
   (c) 25 (d) 16 **[CSAT 2017]**

8. If X is between -3 and -1, and Y is between -1 and 1, then $X^2 - Y^2$ is in between which of the following ?
   (a) -9 and 1 (b) -9 and -1
   (c) 0 and 8 (d) 0 and 9 **[CSAT 2018]**

9. X and Y are natural numbers other than 1, and Y is greater than X. Which of the following represents the largest number ?
   (a) XY (b) X/Y
   (c) Y/X (d) $(X + Y)/XY$ **[CSAT 2018]**

10. If $x - y = 8$, then which of the following must be true ?
    1. Both x and y must be positive for any value of x and y.
    2. If x is positive, y must be negative for any value of x and y.
    3. If x is negative, y must be positive for any value of x and y.

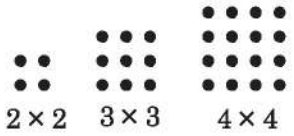
    Select the correct answer using the code given below.
    (a) 1 only
    (b) 2 only
    (c) Both 1 and 2
    (d) Neither 1 nor 2 nor 3 **[CSAT 2018]**

ANSWER KEY

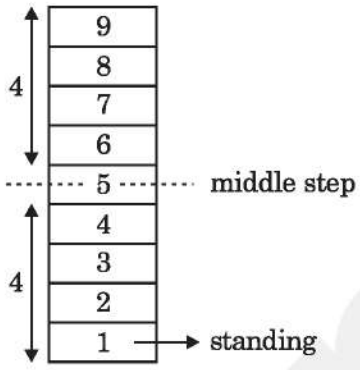
1. (b)	21. (a)	41. (d)	61. (c)	81. (c)	101. (a)	121. (a)	141. (b)
2. (b)	22. (c)	42. (d)	62. (c)	82. (c)	102. (d)	122. (c)	142. (c)
3. (c)	23. (c)	43. (c)	63. (a)	83. (b)	103. (c)	123. (a)	143. (b)
4. (b)	24. (d)	44. (a)	64. (d)	84. (c)	104. (a)	124. (c)	144. (c)
5. (a)	25. (c)	45. (d)	65. (b)	85. (b)	105. (b)	125. (d)	145. (d)
6. (c)	26. (c)	46. (a)	66. (c)	86. (b)	106. (d)	126. (a)	146. (d)
7. (b)	27. (b)	47. (b)	67. (a)	87. (b)	107. (b)	127. (b)	147. (b)
8. (d)	28. (b)	48. (c)	68. (c)	88. (b)	108. (c)	128. (d)	148. (c)
9. (a)	29. (a)	49. (a)	69. (d)	89. (b)	109. (b)	129. (c)	149. (d)
10. (d)	30. (d)	50. (d)	70. (b)	90. (d)	110. (c)	130. (a)	150. (c)
11. (c)	31. (d)	51. (c)	71. (b)	91. (b)	111. (a)	131. (a)	151. (d)
12. (c)	32. (b)	52. (d)	72. (b)	92. (d)	112. (d)	132. (b)	152. (c)
13. (d)	33. (c)	53. (a)	73. (c)	93. (d)	113. (b)	133. (b)	153. (b)
14. (c)	34. (b)	54. (c)	74. (b)	94. (b)	114. (d)	134. (d)	154. (a)
15. (b)	35. (c)	55. (d)	75. (d)	95. (b)	115. (a)	135. (b)	
16. (b)	36. (c)	56. (b)	76. (b)	96. (b)	116. (c)	136. (b)	
17. (d)	37. (d)	57. (a)	77. (c)	97. (d)	117. (b)	137. (b)	
18. (b)	38. (a)	58. (d)	78. (c)	98. (d)	118. (c)	138. (d)	
19. (a)	39. (d)	59. (c)	79. (a)	99. (a)	119. (c)	139. (b)	
20. (c)	40. (c)	60. (c)	80. (b)	100. (c)	120. (c)	140. (c)	

Hints and Solutions

1. Number of rows = number of column → possible only if a square formed.
Hence, we used to find a perfect square which is closed to 1000.



We know $32^2 = 1024$
Thus, we can 32 row × 32 column = 1024.
So, gardener need 24 more plants.
1000 + 24 = 1024 – 1000 = 24.
Hence, option (b) is correct.

2. 

4 + 4 + 1 = 9
Hence, option (b) is correct.

3. We can go through options:
(a) 2 flowers 4 bee →  2 bee left
(b) 3 flowers 2 bee →  1 flower left
(c) 3 flowers 4 bee →  • 1 bee left
 1 flower left. If 2 bee on 1 flower.
Hence, option (c) is correct.

4. Let x student are there in the class.
Each contribute Rs. x
So, total contribution = Rs. x^2
One student contributed addition = Rs. 2
According to the question,
$x^2 + 2 = 443$, or, $x^2 = 441$
So, $x = 21$.
Hence, option (b) is correct.

5. Number ending with 2 → 102, 112, 122, 132, 142, 152, 162, 172, 182, 192 = 10 numbers.
Number beginning with 2 → 201 to 299
= 100 numbers
So, total we have = 100 + 10 = 110 numbers either begin or end with 2.
Hence, option (a) is correct.

6. From 100 to 199 → 108, 118, 128, 138, 148, 158, 168, 178, 188, 198 → 10 numbers
Similarly, from 200 to 299 → 10 numbers
300 to 399 → 10 numbers
400 to 499 → 10 numbers
500 to 599 → 10 numbers
600 to 699 → 10 numbers
700 to 799 → 10 numbers
800 to 899 → 10 numbers
900 to 1000 → 10 numbers
So, total 10 × 9 = 90.
Hence, option (c) is correct.

7.

Last year age	Present age	Next year age
–1	0	1
6	7	8
25	26	27
62	63	64
123	124	125

His present age = 26
Last year age = 25 (square)
Next year age = 27 (cube)
He has to wait for his age to become 64 years.
So, he has to wait till 64 – 26 = 38 years.
Hence, option (b) is correct.

149. 1186 – 31 = 1155.

Total factors of 1155 which are less than 31 will be the answer of this question *i.e.*, 9.

Hence, option (d) is correct.

150. I. We have two numbers *i.e.*, 12 and 18 with same number of factors.

II. We have two numbers *i.e.*, 20 and 50 with same number of factors.

Hence, option (c) is correct.

151. The smallest 1-digit number having exactly 4 distinct factors is 6.

Factors of 6 = 1, 2, 3 and 6.

This question can be answered even without using any of the statements.

Hence, option (d) is correct.

152. $\left(\frac{1}{2}\right)^{-6} = 2^6 = 64$

$\left(\frac{1}{4}\right)^{-3} = 4^3 = 2^6 = 64$

$\left(\frac{1}{3}\right)^{-4} = 3^4 = 81$ largest number

$\left(\frac{1}{6}\right)^{-2} = 6^2 = 36$

Hence, option (c) is correct.

153. $2^{40}, 3^{21}, 4^{18}, 8^{12}$

$2^{40}, 3^{21}, (2^2)^{18}, (2^3)^{12}$

$2^{40}, 3^{21}, 2^{36}, 2^{36}$

2^{40} = not smallest = 4^{20}

3^{21} = smallest = 3^{31}

Using options answer cannot (c) and (d) both same and we already eliminated.

Hence, option (b) is correct.

154. True penalty for an incorrect answer = –7 marks (–5 – 2 = –7).

Maximum marks = 450

Obtained score less than the maximum marks = 450 – 387 = 63

So, the number of incorrect responses

$= \frac{63}{7} = 9.$

Hence, option (a) is correct.

Additional Questions from Other Competitive Exams

Numbers

1. n is a natural number. If n^5 is odd, which of the following is *true* ?

   A. n is odd

   B. n^3 is odd

   C. n^4 is even

   (a) A only (b) B only

   (c) C only (d) A and B only

2. $4^0 + 4^2 + 4^{-2} + 4^{1/2} + 4^{-1/2} =$

   (a) 4^0 (b) $4^{2\frac{1}{2}} + 4^{-2\frac{1}{2}}$

   (c) $19\frac{9}{16}$ (d) $22\frac{9}{16}$

3. If $a + b + c + d + e = 10$ (all positive numbers), then the maximum value of $a \times b \times c \times d \times e$ is

   (a) 12 (b) 32

   (c) 48 (d) 72

4. $(25 \div 5 + 3 - 2 \times 4) + (16 \times 4 - 3) =$

   (a) 61 (b) 22

   (c) $\frac{41}{24}$ (d) 16

5. How many 9-digit positive integers are there, the sum of squares of whose digits is 2 ?

   (a) 8 (b) 9

   (c) 10 (d) 11

6. For real numbers x and y, $x^2 + (y - 4)^2 = 0$. Then the value of $x + y$ is

   (a) 0

   (b) 2

   (c) $\sqrt{2}$

   (d) 4

7. The following sum is

   $1 + 1 - 2 + 3 - 4 + 5 - 6 \ldots -20 = ?$

   (a) 10

   (b) –10

   (c) –11

   (d) –9

8. Suppose n is a positive integer. Then $(n^2 + n)(2n + 1)$

   (a) may not be divisible by 2.

   (b) is always divisible by 2 but may not be divisible by 3.

   (c) is always divisible by 3 but may not be divisible by 6.

   (d) is always divisible by 6.

9. If $A \times B = 24$, $B \times C = 32$, $C \times D = 48$, then $A \times D$

   (a) cannot be found (b) is a perfect square

   (c) is a perfect cube (d) is odd

10. If N, E and T are distinct positive integers such that $N \times E \times T = 2013$, then which of the following is the maximum possible sum of N, E and T ?

    (a) 39 (b) 2015

    (c) 675 (d) 671

11. Which of the following numbers is a perfect square ?

    (a) 1022121 (b) 2042122

    (c) 3063126 (d) 4083128

12. Which of the following 7-digit numbers cannot be perfect squares ?

    1. 45xyz26

    2. 2xyz175

    3. xyz3310

    (a) 1 only (b) 2 only

    (c) 3 only (d) All of these

13. Which of the following numbers is a perfect square ?

    (a) 48841 (b) 58287

    (c) 68763 (d) 38262

14. Binomial theorem in algebra gives $(1 + x)^n = a_0 + a_1x + a_2x^2 + \ldots\ldots + a_nx^n$; where $a_0, a_1, \ldots\ldots, a_n$ are constants depending on n. What is the sum of $a_0 + a_1 + a_2 + \ldots\ldots + a_n$?

    (a) 2^n (b) n

    (c) n^2 (d) $n^2 + n$

ANSWER KEY

01. (d)	12. (d)	23. (b)	34. (c)	45. (c)	56. (b)	67. (d)	78. (a)
02. (c)	13. (a)	24. (b)	35. (a)	46. (c)	57. (d)	68. (a)	79. (d)
03. (b)	14. (a)	25. (b)	36. (b)	47. (a)	58. (a)	69. (b)	80. (a)
04. (a)	15. (c)	26. (c)	37. (d)	48. (d)	59. (b)	70. (a)	81. (c)
05. (a)	16. (c)	27. (d)	38. (a)	49. (d)	60. (a)	71. (c)	82. (b)
06. (d)	17. (d)	28. (b)	39. (a)	50. (a)	61. (c)	72. (c)	83. (b)
07. (d)	18. (a)	29. (c)	40. (b)	51. (b)	62. (c)	73. (c)	84. (a)
08. (d)	19. (a)	30. (c)	41. (b)	52. (c)	63. (b)	74. (a)	85. (d)
09. (b)	20. (d)	31. (d)	42. (a)	53. (d)	64. (d)	75. (d)	
10. (c)	21. (d)	32. (b)	43. (c)	54. (b)	65. (a)	76. (a)	
11. (a)	22. (d)	33. (b)	44. (b)	55. (a)	66. (c)	77. (b)	

Hints and Solutions

1. If n^5 is odd, then n is odd and any power of n is odd.

2. $4^0 + 4^2 + 4^{-2} + 4^{1/2} + 4^{-1/2}$

$$= 1 + 16 + \frac{1}{4^2} + 2 + \frac{1}{\sqrt{4}} = 19 + \frac{1}{16} + \frac{1}{2}$$

$$= 19 + \frac{1+8}{16} = 19 + \frac{9}{16} = 19\frac{9}{16}$$

3. The product $a \times b \times c \times d \times e$ will be maximum when each entity will be equal

i.e., $a = b = c = d = e$.

So, $a = b = c = d = e = 2$.

Hence, the maximum value of the product

$= a \times b \times c \times d \times e$

$= 2 \times 2 \times 2 \times 2 \times 2 = 2^5 = 32$.

4. The value of given expression is

$(25 \div 5 + 3 - 2 \times 4) + (16 \times 4 - 3)$

$= (5 + 3 - 8) + (64 - 3) = 61$.

5. The possible 9-digit positive numbers are :

110000000, 101000000, 100100000, 100010000, 100001000, 100000100, 100000010, 100000001

whose sum of squares of digits is 2.

6. $x^2 + (y-4)^2 = 0$

If the sum of 2 perfect squares is 0, then both of them separately must be 0.

(Since, perfect square cannot be negative)

So, $x^2 = 0$ or, $x = 0$

And $(y-4)^2 = 0$, or, $y - 4 = 0$. So, $y = 4$.

Hence, $x + y = 0 + 4 = 4$.

7. Given sequence is, $1 + 1 - 2 + 3 - 4 + 5 - 6 \ldots - 20$, can be written as

$1 + (1 - 2 + 3 - 4 + 5 - 6 \ldots + 19 - 20)$

We can observe inside the bracket every two terms are giving –1, so we have

$1 + (-1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1)$

$= 1 - 10 = -9$.

8. $(n^2 + n)(2n + 1) = n(n + 1)(2n + 1)$

If $n = 1$, then $n(n + 1)(2n + 1) = 1 \times 2 \times 3 = 6$

If $n = 2$, then $n(n + 1)(2n + 1) = 2 \times 3 \times 5 = 6 \times 5$

If $n = 3$, then $n(n + 1)(2n + 1) = 3 \times 4 \times 7 = 6 \times 14$

and so on.

So, $n(n + 1)(2n + 1)$ is always divisibly by 6.

9. $A \times B = 24$ ... (1)

$B \times C = 32$ ... (2)

$C \times D = 48$ ... (3)

On multiplying equation (1) and (3), we get

$A \times B \times C \times D = 24 \times 48$ ... (4)

On dividing equation (4) by equation (2), we get

$$\frac{A \times B \times C \times D}{B \times C} = \frac{24 \times 48}{32} = 36 = 6^2$$

Hence, $A \times D$ is a perfect square.

10. From prime factorization, we have

$2013 = 3 \times 671$

$2013 = 1 \times 3 \times 671$ is the only possible way in which 2013 can be expressed as the product of three distinct positive integers.

Sum = 1 + 3 + 671 = 675.

11. Here, 1022121 is perfect square number which is square of 1021.

12. No number can be a perfect square unless its digital root is 1, 4, 7 or 9.

For example, 4539 ends in 9, digit sum is $4 + 5 + 3 + 9 = 21 = 2 + 1 = 3$.

Therefore, 4539 is not a perfect square.

If unit digit of a perfect square is 5, then ten's digit has to be 2.

For example, $15^2 = 225$, the ten's digit is 2.

Another example, 25, 625, 1225, all are perfect square having unit digit 5 and tens digit is 2.

For example, 2*xyz*175, the last digit is 5 but tens digit is 7 of the given number which is other than 2.

84. We know that,
$2222 < 4096 \Rightarrow 2222 < 2^{12}$
$\Rightarrow (2222)^2 < (2^{12})^2 \Rightarrow (2222)^2 < 2^{24}$
So, $2222^2 < 2^{2222}$
Similarly,
$222 < 256 \Rightarrow 222 < 2^8 \Rightarrow (222)^{22} < (2^8)^{22}$
$\Rightarrow (222)^{22} < 2^{176}$
So, $(222)^{22} < 2^{2222}$
Also,
$22 < 32 \Rightarrow 22 < 2^5 \Rightarrow (22)^{222} < (2^5)^{222}$
$\Rightarrow (22)^{222} < 2^{1110}$
So, $(22)^{222} < 2^{2222}$
Thus, 2^{2222} is the largest number.
Hence, option (a) is correct.

85. Let the required base is 'x'
So, $5x^1 + 4x^0 = 49$
Or, $5x + 4 = 49$
Or, $5x = 45$
Or, $x = 9$
So, the base of this number system is 9.

Chapter 2 Ratio & Proportion

A ratio is a comparison of two numbers by division, where the first number is divided by the second (obviously non zero) number.

Since ratio is the quotient of two numbers divided in a definite order, so it should be taken care to write each ratio in that particular order.

For example, the ratio of 5 to 3 should be expressed in the following manner.

$\frac{5}{3}$ (fraction from) or 5 : 3 (colon form), since the ratio is a fraction, so if we multiply or divide both the terms of a ratio with a same number, the ratio does not get affected.

2.1 Continued ratio

Comparison can also be made for more than two quantities.

Let the length of a cuboidal block is 50 cm, breadth is 60 cm, and height is 70 cm, then the ratio of length, breadth and the height is 50 : 60 : 70, and since all the values are divisible by 10, so after division we get the ratio 5 : 6 : 7 which is in simplest form.

The first term is known as antecedent and the second term is known as consequent.

For example, In the ratio 5 : 9, 5 is antecedent and 9 is consequent.

2.2 Proportion

It is expressed as $a : b :: c : d$, means the way 'a' is related to 'b', the same way 'c' is related to 'd'.

Hence, a proportion is an equation that tells us the two ratios are equal.

Mathematically it can be expressed as $a : b :: c : d$, which means $\frac{a}{b} = \frac{c}{d}$ and by cross multiplication we get $ad = bc$.

Here the outer terms 'a' and 'd' are called the extremes of the proportion and the inner term 'b' and 'c' are called the means.

$a : b :: c : d \Rightarrow a \times d = b \times c$. So, product of extremes = product of means.

2.3 Fourth proportional

If $a : b :: c : d$, then 'd' is called fourth proportional to a, b, c.

For example, Find the fourth proportional to 4, 9 and 12.

Solution: Let the fourth proportional to 4, 9 and 12 be x. Then, $4 : 9 : 12 : x \Rightarrow 4 \times x = 9 \times 12$

$x = \frac{9 \times 12}{4} = 27$. Fourth proportional to 4, 9 and 12 is 27.

Practice Set

1. If $A : B = \frac{1}{2} : \frac{3}{8}$, $B : C = \frac{1}{3} : \frac{5}{9}$ and $C : D = \frac{5}{6} : \frac{3}{4}$, then the ratio A : B : C : D is
   (a) 4 : 6 : 8 : 10 (b) 6 : 4 : 8 : 10
   (c) 6 : 8 : 9 : 10 (d) 8 : 6 : 10 : 9

2. The ratio of $4^{3.5} : 2^5$ is same as
   (a) 2 : 1 (b) 4 : 1
   (c) 7 : 5 (d) 7 : 10

3. If $\frac{1}{5} : \frac{1}{x} = \frac{1}{x} : \frac{1}{1.25}$, then the value of x is
   (a) 1.5 (b) 2
   (c) 2.5 (d) 3.5

4. If $x : y = 5 : 2$, then $(8x + 9y) : (8x + 2y)$ is
   (a) 22 : 29 (b) 26 : 61
   (c) 29 : 22 (d) 61 : 26

5. If 15% of x = 20% of y, then $x : y$ is
   (a) 3 : 4 (b) 4 : 3
   (c) 17 : 16 (d) 16 : 17

6. The ratio of three numbers is 3 : 4 : 5 and the sum of their squares is 1250. The sum of the numbers is
   (a) 30 (b) 60
   (c) 60 (d) 90

7. Two numbers are respectively 20% and 50% more than a third number. The ratio of the two numbers is
   (a) 2 : 5
   (b) 3 : 5
   (c) 4 : 5
   (d) 6 : 7

8. If a carton containing a dozen mirrors is dropped, which of the following cannot be the ratio of broken mirrors to unbroken mirrors ?
   (a) 2 : 1
   (b) 3 : 1
   (c) 3 : 2
   (d) 7 : 5

9. If Rs. 510 be divided A, B, C in such a way that A gets $\frac{2}{3}$ of what B gets and B gets $\frac{1}{4}$ of what C gets, then their shares are respectively
   (a) Rs. 120, Rs. 240, Rs. 150
   (b) Rs. 60, Rs. 90, Rs. 360
   (c) Rs. 150, Rs. 300, Rs. 60
   (d) None of these

10. Between two railway stations the 1st, 2nd and 3rd class fares are in the ratio of 10 : 8 : 3 and in a year in a car the ratio of passengers in 1st, 2nd and 3rd class was 3 : 4 : 10 respectively. If the total sales proceeds of the ticket during a year was Rs. 8050, then find the amount for which the tickets of 2nd class during the reservation ?
    (a) Rs. 2400 (b) Rs. 2600
    (c) Rs. 2800 (d) Rs. 3200

11. Seats for Mathematics, Physics and Biology in a school are in the ratio 5 : 7 : 8. There is a proposal to increase these seats by 40%, 50% and 75% respectively. What will be the ratio of the total seats ?
    (a) 2 : 3 : 4 (b) 6 : 7 : 8
    (c) 6 : 8 : 9 (d) None of these

12. A sum of money is to be distributed among A, B, C, D in the proportion of 5 : 2 : 4 : 3. If C gets Rs. 1000 more than D, what is B's share ?
    (a) Rs. 500 (b) Rs. 1500
    (c) Rs. 2000 (d) None of these

13. If 40% of a number is equal to two-third of another number, what is the ratio of first number to the second number ?
    (a) 2 : 5 (b) 3 : 7
    (c) 5 : 3 (d) 7 : 3

14. What least number must be subtracted from each of the numbers 14, 17, 34 and 42 so that the remainders may be proportional ?
    (a) 0 (b) 1
    (c) 2 (d) 7

Previous Year Solved Questions

1. In a rare coin collection, there is one gold for every three non-gold coins. 10 more gold coins are added to the collection and the ratio of gold coins to non-gold coins would be 1 : 2. Based on the information, the total number of coins in the collection now becomes

   (a) 90 (b) 80

   (c) 60 (d) 50 **[CSAT 2013]**

2. The monthly incomes of Peter and Paul are in the ratio of 4 : 3. Their expenses are in the ratio of 3 : 2. If each save Rs. 6000 at end of the month, their monthly incomes respectively are (in Rs.)

   (a) 24000 and 18000

   (b) 28000 and 21000

   (c) 32000 and 24000

   (d) 34000 and 26000 **[CSAT 2015]**

3. The monthly incomes of X and Y are in the ratio of 4 : 3 and their monthly expenses are in the ratio of 3 : 2. However, each saves Rs. 6,000 per month. What is their total monthly income ?

   (a) Rs. 28,000 (b) Rs. 42,000

   (c) Rs. 56,000 (d) Rs. 84,000

   [CSAT 2017]

4. A sum of Rs. 2,500 is distributed among X, Y and Z in the ratio $\frac{1}{2}:\frac{3}{4}:\frac{5}{6}$. What is the difference between the maximum share and the minimum share ?

   (a) Rs. 300

   (b) Rs. 350

   (c) Rs. 400

   (d) Rs. 450 **[CSAT 2020]**

5. An amount of money was distributed among A, B and C in the ratio p : q : r.

   Consider the following statements:

   1. A gets the maximum share if p is greater than (q + r).
   2. C gets the minimum share if r is less than (p + q).

   Which of the above statements is/are correct ?

   (a) 1 only (b) 2 only

   (c) Both 1 and 2 (d) Neither 1 nor 2

   [CSAT 2021]

6. A Question is given followed by two Statements 1 and 2. Consider the Question and the Statements.

   A certain amount was distributed among X, Y and Z.

   Question: Who received the least amount ?

   Statement-1: X received $\frac{4}{5}$ of what Y and Z together received.

   Statement-2: Y received $\frac{2}{7}$ of what X and Z together received.

   Which one of the following is correct in respect of the above Question and the Statements ?

   (a) The Question can be answered by using one of the Statements alone, but cannot be answered using the other Statement alone.

   (b) The Question can be answered by using either Statement alone.

   (c) The Question can be answered by using both the Statements together, but cannot be answered using either Statement alone.

   (d) The Question cannot be answered even by using both the Statements together.

   [CSAT 2024]

Chapter 3 Partnership

Concept

When two or more than two persons run a joint venture with some mutual understanding, they are known as partners and this deal is known as partnership.

Profit distribution:

1. When all the partners invest for the same time, then the profit/loss is distributed among the partners in the ratio of their capital investments.
2. When investment are for different time periods, then equivalent capitals are calculated for a unit of time (by multiplying capital and unit of time). And the gain is distributed among the partners in this ratio.

Working and sleeping partners:

A partner who manages the business is known as working partner while a partner who only invests in the business is known as sleeping partner. In the case of sleeping partners, some percentage of profit directly goes to the managing partner and the rest profit is divided among the partners in the ratio of their capital investments.

EXAMPLES

1. A, B and C started a business by investing Rs. 1,20,000, Rs. 1,35,000 and Rs. 1,50,000 respectively. Find the share of each out of an annual profit of Rs. 56,700.

Sol: Ratio of shares of A, B and C = Ratio of their investments

$$= 120000 : 135000 : 150000 = 8 : 9 : 10$$

Since they have invested for the same time period, so the annual profit will be the distributed in the ratio 8 : 9 : 10 among them.

So, A's share $= \text{Rs.}\left(56700 \times \frac{8}{27}\right) = \text{Rs. } 16800$

B's share $= \text{Rs.}\left(56700 \times \frac{9}{27}\right) = \text{Rs. } 18900$

C's share $= \text{Rs.}\left(56700 \times \frac{10}{27}\right) = \text{Rs. } 21000$

Practice Set

1. Three partners A, B, C invest Rs. 34000, Rs. 26000 and Rs. 10000 respectively, in a business. Out of a total profit of Rs. 17500, A's share (in rupees) is
   (a) Rs. 8750 (b) Rs. 8500
   (c) Rs. 7500 (d) Rs. 3750

2. Harish and Kewal start a business jointly. If Harish invests Rs. 7000 for 9 months and Kewal invests Rs. 12000 for 7 months, then out of a total profit of Rs. 2730, Harish gets
   (a) Rs. 1170 (b) Rs. 910
   (c) Rs. 1560 (d) Rs. 2047.50

3. Arun, Maya and Stya started a shop by investing Rs. 27000, Rs. 81000 and Rs. 72000 respectively. At the end of the year the profit was distributed in the ratio of their investments. If Maya's share of profit be Rs. 36000, the total profit was
   (a) Rs. 63000 (b) Rs. 80000
   (c) Rs. 108000 (d) Rs. 116000

4. Two persons P and Q start a business together P invests Rs. 8000. If the shares of profit of P and Q be Rs. 360 and Rs. 480 respectively, the investment of Q (in rupees) is
   (a) Rs. 9000 (b) Rs. 12000
   (c) Rs. 10000 (d) Rs. 15000

5. A, B and C enter into a partnership with a capital in which A's contribution is Rs. 10000. If out of a total profit of Rs. 1000, A gets Rs. 500 and B gets Rs. 300, then C's capital is
   (a) Rs. 4000 (b) Rs. 5000
   (c) Rs. 6000 (d) Rs. 9000

6. A and B entered into partnership investing Rs. 12000 and Rs. 16000 respectively. After 3 months, B withdrew Rs. 5000 while A invested Rs. 5000 more. Out of a total annual profit of Rs. 16000, the share of A exceeds that of B by
   (a) Rs. 1000 (b) Rs. 1500
   (c) Rs. 2000 (d) Rs. 2500

7. Kamal started a business with Rs. 21000 and is joined afterwards by Vinod with Rs. 36000. After how many months did Vinod join, if the profits at the end of the year are divided equally ?
   (a) 3 months (b) 4 months
   (c) 5 months (d) 8 months

8. A and B start a business with initial investments in the ratio 12 : 11 and their annual profits were in the ratio 4 : 1. If A invested the money for 11 months, B invested for
   (a) 3 months (b) 4 months
   (c) $3\frac{2}{3}$ months (d) 6 months

9. A and B enter into partnership. A invests Rs. 16000 for 8 months and B remains in the business for 4 months. Out of a total annual profit, B claims $\frac{2}{7}$ of the profit. The contribution of B was
   (a) Rs. 10500 (b) Rs. 11900
   (c) Rs. 13600 (d) Rs. 12800

10. A and B invest in a business in the ratio 3 : 2. If 5% of the total profit goes to charity and A's share is Rs. 855, the total profit is
    (a) Rs. 1425 (b) Rs. 1500
    (c) Rs. 1537.50 (d) Rs. 1576

11. If 6 (A's capital) = 8 (B's capital) = 10 (C's capital), then the ratio of their capitals is
    (a) 3 : 4 : 5 (b) 6 : 8 : 10
    (c) 12 : 15 : 20 (d) 20 : 15 : 12

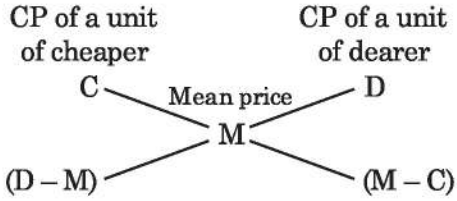
12. If A's capital is equal to twice B's capital and B's capital is three times C's capital, then the ratio of their capitals is
    (a) 2 : 1 : 3
    (b) 1 : 2 : 6
    (c) 6 : 3 : 1
    (d) 1 : 3 : 6

Chapter 4 Mixture & Alligation

Mixture and alligation is a very important and easy topic in arithmetic, which is applicable to many problems.

As we all know how to find the average of the given data but when it comes to some complex cases of weighted average, alligation can be a very useful tool to solve those questions.

If two ingredients are mixed together, there must be a cheaper variety and another will be a dearer one and we will get a mixture whose price will be somewhere between cheaper and dearer price depending upon the ratios of ingredients in the mixture.

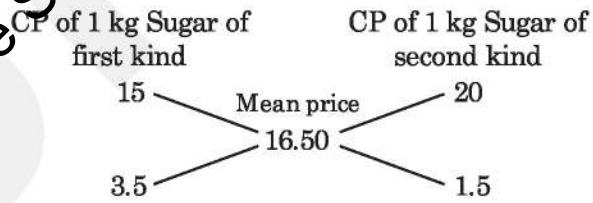


(Cheaper quantity) : (Dearer quantity) = $(d - m) : (m - c)$

EXAMPLES

1. In what ratio must a grocer mix two varieties of sugar costing Rs. 15 per kg and Rs. 20 per kg to get a mixture worth Rs. 16.50 per kg?

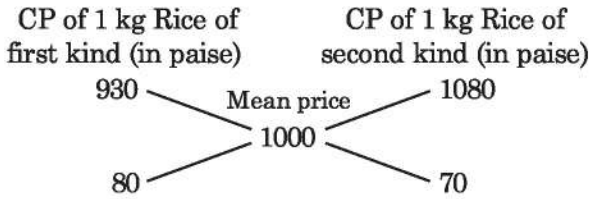
Sol: Using alligation :



Required ratio = 3.5 : 1.5 = 35 : 15 = 7 : 3.

2. In what ratio rice at Rs. 9.30 per kg must be mixed with rice at Rs. 10.80 per kg as to get the mixture worth Rs. 10 per kg.

Sol: Using alligation :



Required ratio = 80 : 70 = 8 : 7.

Practice Set

1. In what ratio must a grocer mix two varieties of pulses costing Rs. 15 and Rs. 20 per kg respectively so as to get a mixture worth Rs. 16.50 per kg ?
   (a) 3 : 7 (b) 5 : 7
   (c) 7 : 3 (d) 7 : 5

2. Find the ratio in which rice at Rs. 7.20 a kg be mixed with rice at Rs. 5.70 a kg to produce a mixture worth Rs. 6.30 a kg.
   (a) 1 : 3 (b) 2 : 3
   (c) 3 : 4 (d) 4 : 5

3. In what ratio must tea at Rs. 62 per kg be mixed with tea at Rs. 72 per kg so that the mixture must be worth Rs. 64.50 per kg ?
   (a) 3 : 1 (b) 3 : 2
   (c) 4 : 3 (d) 5 : 3

4. In what ratio must water be mixed with milk costing Rs. 12 per litre to obtain a mixture worth of Rs. 8 per litre ?
   (a) 1 : 2 (b) 2 : 1
   (c) 2 : 3 (d) 3 : 2

5. The average of marks obtained by 120 candidates in a certain examination is 35. If the average marks obtained by passed candidates are 39 and those of the failed candidates are 15, what is the number of candidates who passed the examination ?
   (a) 100
   (b) 120
   (c) 80
   (d) 40

6. The average salary of all the workers in a workshop is Rs. 8000. The average salary of 7 technicians is Rs. 12000 and the average salary of the rest is Rs. 6000. The total number of workers in the workshop is
   (a) 20 (b) 21
   (c) 23 (d) 22

7. In a family of 8 adults and some minors, the average consumption of rice per head per month is 10.8 kg, while the average consumption for adults is 15 kg per head and for minors it is 6 kg per head. The number of minors in the family is
   (a) 8 (b) 6
   (c) 7 (d) 9

8. The average daily wages of some workers of a factory is Rs. 92. There are 300 male and 200 female workers working in the factory. Each female worker receives Rs. 20 less than a male worker. The daily wages of a male worker is
   (a) Rs. 80 (b) Rs. 96
   (c) Rs. 100 (d) Rs. 120

9. The average of marks scored by the students of a class is 68. The average of marks of the girls in the class is 80 and that of boys is 60. What is the percentage of boys in the class?
   (a) 40 (b) 60
   (c) 6 (d) 70

10. The average monthly salary of the workers in a workshop is Rs. 8500. If the average monthly salary of 7 technicians is Rs. 10000 and average monthly salary of the rest is Rs. 7800 the total number of workers in the workshop is
    (a) 18 (b) 20
    (c) 22 (d) 24

11. The average mathematics marks of two sections A and B of class IX in the annual examination is 74. The average marks of section A is 77.5 and that of section B is 70. The ratio of the number of students of section A and B is
    (a) 7 : 8
    (b) 7 : 5
    (c) 8 : 7
    (d) 8 : 5

Hints and Solutions

1. Let the capacity of two glasses = 4 liters
According to the question,

	Milk	Water
Glass 1	2 L :	2 L
Glass 2	3 L :	1 L

Their contents are then poured into another vessel.
Total milk in that vessel = 2 + 3 = 5 liters
Total water in that vessel = 2 + 1 = 3 liters
Final ratio in vessel = Milk : Water = 5 : 3
Hence, option (d) is correct.

2. Let the capacity of two glasses = 12 liters
According to the question,

	Milk	Water
Glass 1	4 L :	8 L
Glass 2	3 L :	9 L

Their contents are then poured into another vessel.
Total milk in that vessel = 4 + 3 = 7 liters
Total water in that vessel = 8 + 9 = 17 liters
Final ratio in vessel = Milk : Water = 7 : 17
Hence, option (a) is correct.

3. Concentration of sugar in vessel A

$$= \frac{30}{180} = \frac{1}{6} \text{ g/ml}$$

Concentration of sugar in vessel B

$$= \frac{40}{280} = \frac{1}{7} \text{ g/ml}$$

Concentration of sugar in vessel C

$$= \frac{20}{100} = \frac{1}{5} \text{ g/ml}$$

The more concentration of sugar means more sweetness of solution.
Vessel C > vessel A > vessel B
So, the solution of B is less sweet than solution C.
Hence, option (d) is correct.

4. Male Female

5200 4200

5000

800 : 200

4 : 1

The percentage of male employees

$$= \frac{4}{5} \times 100 = 80\%$$

Hence, option (b) is correct.

5. Let the capacity of the container = 6 liters
According to the question,
It has 3 liters of milk and 3 liters of water
$\frac{1}{3}$rd of this milk = 2 liters
So, 2 liters of water will be added to these 2 liters of milk.
Now total volume of the mixture = 4 liters
These 4 liters contains 1 liter of water *i.e.*, 25%
Hence, option (a) is correct.

6. According to the marks obtained by students in English, we can have the following diagram:

Girls Boys

9 8

8.8

0.8 : 0.2

4 : 1

Now, let us assume there are 4 girls and 1 boy in the class.
Thus, total marks of the class in Hindi
$= 8 \times 4 + 7 \times 1 = 32 + 7 = 39$
So, the average marks in Hindi

$$= \frac{39}{4+1} = \frac{39}{5} = 7.8.$$

Hence, option (a) is correct.

Chapter 5 Problems based on Ages

Concept :

The difference between the ages of two persons does not change with time while the ratio changes in a regular interval.

For example :

Year	Age of 'A'	Age of 'B'	Ratio
2000	16 years	20 years	4 : 5
2004	20 years	24 years	5 : 6
2008	24 years	28 years	6 : 7
2012	28 years	32 years	7 : 8
2016	32 years	36 years	8 : 9
2020	36 years	40 years	9 : 10

In the above table we can easily observe in the interval of 4 years, the ratio of ages is changing regularly. This regular difference of years is known as interval size. To find the age of a person in any given years, we just multiply the interval size with the ratio term corresponding to the person.

Let we need to find age of B in 2008, for that we just multiply interval size i.e. 4 with the ratio term corresponding to B in 2008 *i.e.* 7.

So, the age of B in 2008 will be $7 \times 4 = 28$ years.

1. The present ages of A and B are in the ratio 4 : 5. 8 years hence the ratio will become 5 : 6, find out the present age of A ?

Sol:

	A		B
Present ratio	4	:	5
8 years hence	5	:	6

In 8 years, ratio term of A is changing from 4 to 5 and that of B is changing from 5 to 6. So the interval size is 8 years.

Hence, present age of A = $4 \times 8 = 32$ years and present age of B = $5 \times 8 = 40$ years.

2. The present ages of A and B are in the ratio 7 : 8. 5 years hence the ratio will become 8 : 9, find out the present age of B ?

Sol:

	A		B
Present ratio	7	:	8
5 years hence	8	:	9

In 5 years, ratio term of A is changing from 7 to 8 and that of B is changing from 8 to 9.

So, the interval size is 5 years.

Hence, present age of A = $5 \times 7 = 35$ years and present age of B = $5 \times 8 = 40$ years.

Practice Set

1. A father is twice as old as his son. 20 years ago, the age of the father was 12 times the age of the son. The present age of the son is
   (a) 20 years (b) 25 years
   (c) 22 years (d) 26 years

2. A is twice as old as B. 12 years ago, A was five times as old as B. Find the present age of A
   (a) 16 years (b) 32 years
   (c) 24 years (d) 28 years

3. The age of the father 4 years ago was 8 times the age of his son. At present the father's age is 4 times that of his son. Find the present age of son
   (a) 9 years (b) 7 years
   (c) 14 years (d) 18 years

4. 12 years ago, the ratio of the ages of Ram and Rahim is 2 : 3. If the ratio of their present ages is 5 : 6, what will be the total of their present ages
   (a) 46 years
   (b) 42 years
   (c) 44 years
   (d) 48 years

5. A father was 4 times as old as his son 8 years ago. Eight years hence, father will be twice as old as his son. Find the sum of their present ages
   (a) 56 years
   (b) 58 years
   (c) 40 years
   (d) None of these

6. A's mother was four times as old as A, ten years ago. After ten years she will be twice as old as A. Then A's present age is
   (a) 30 years
   (b) 20 years
   (c) 24 years
   (d) 25 years

7. A man says to his son, "seven years ago I was seven times as old as you were and three years hence 1 will be three times as old as you will be." there ages are
   (a) 60 years, 12 years
   (b) 52 years, 12 years
   (c) 42 years, 12 years
   (d) 50 years, 15 years

8. Sunil was three times as old as Sandeep 6 years back. Sunil will be $\frac{5}{3}$ times as old as Sandeep 6 years hence. How old is Sandeep today ?
   (a) 18 years (b) 24 years
   (c) 12 years (d) 15 years

9. The age of a father 10 years ago was thrice the age of his son. Ten years hence, the father's age will be twice that of his son. The ratio of their present ages is
   (a) 8 : 5
   (b) 7 : 3
   (c) 5 : 2
   (d) 9 : 5

10. At present the age of the father is 6 times the age of his son, 4 years hence the fathers' age would be 5 times that of his son. What is the sum of the present ages of father and his son ?
    (a) 116 years
    (b) 112 years
    (c) 114 years
    (d) 111 years

11. At present the age of the father is 4 times the age of his son, 3 years hence the father's age would be thrice that of his son. What is the sum of the present ages of father and his son ?
    (a) 20 years
    (b) 25 years
    (c) 30 years
    (d) 60 years

34. Lokesh's father was 36 years of age when he was born while his mother was 34 years of age when his sister 3 years younger to him was born. What is the sum of ages of his parents when his sister will be 9 years old?
    (a) 77 years
    (b) 91 years
    (c) 73 years
    (d) 87 years

35. The incomes of A and B are in the ratio 3 : 2 and their expenditures are in the ratio 5 : 3, if each saves Rs. 2500, then find the expenditure of B ?
    (a) Rs. 5000
    (b) Rs. 4000
    (c) Rs. 4500
    (d) Rs. 7500

ANSWER KEY

1. (c)	6. (b)	11. (c)	16. (b)	21. (c)	26. (d)	31. (d)	34. (b)
2. (b)	7. (c)	12. (b)	17. (a)	22. (a)	27. (d)	32. (b)	35. (d)
3. (b)	8. (c)	13. (d)	18. (b)	23. (c)	28. (d)	33. (b)	
4. (c)	9. (b)	14. (d)	19. (c)	24. (a)	29. (a)		
5. (a)	10. (b)	15. (b)	20. (b)	25. (d)	30. (b)		

Chapter 6 Average

Average is an equal distribution of total value among all the members of the group or an average of a data set is the central value. Mathematically it is defined as the ratio between sum of data and the number of data.

EXAMPLES

1. Find the average of first ten natural numbers ?

Sol: The average of first ten natural numbers $= \frac{1+2+3+.....+10}{10} = \frac{55}{10} = 5.5.$

2. Find the average of first ten consecutive odd natural numbers ?

Sol: The average of first ten consecutive odd natural numbers $= \frac{1+3+5+.....+19}{10} = 10.$

3. Find the average of first six consecutive even natural numbers ?

Sol: $\frac{2+4+6+8+10+12}{6} = 7.$

4. The average of seven consecutive odd natural numbers is 79. Find the largest among them ?

Sol: The average of seven consecutive odd natural number will be the exactly middle number *i.e.*, 4^{th} term.

These numbers will be 73, 75, 77, 79, 81, 83, 85.

Hence, the largest among those numbers is 85.

5. The average of eight consecutive odd natural numbers is 50. Find the least among them ?

Sol: These numbers will be 43, 45, 47, 49, 51, 53, 55, 57.

Hence, the least among those numbers is 43.

6. Find the average of 1, 2, 2, 3, 3, 3, 4, 4, 4, 4, 5, 5, 5, 5, 5, 6, 6, 6, 6, 6, 6, 7, 7, 7, 7, 7, 7, 7.

Sol: The average will be $\frac{1\times1+2\times2+3\times3+4\times4+5\times5+6\times6+7\times7}{1+2+3+4+5+6+7} = \frac{\Sigma7^2}{\Sigma7} = \frac{7\times8\times15}{6\times\frac{7\times8}{2}} = 5.$

6.1 Contribution concept :

When any quantity joins a group, they bring in surplus or deficit. This surplus/deficit is equally distributed among all the participants including the new entrants.

Practice Set

1. The arithmetic mean (average) of the first 10 whole numbers is
   (a) 5 (b) 4
   (c) 5.5 (d) 4.5

2. The average of the first 100 positive integers is
   (a) 100 (b) 51
   (c) 50.5 (d) 49.5

3. The average of seven consecutive positive integers is 26. The smallest of these integers is
   (a) 21 (b) 23
   (c) 25 (d) 26

4. The average of 5 consecutive natural numbers is m. If the next three natural numbers are also included, how much more than m will the average of these 8 numbers be ?
   (a) 2 (b) 1
   (c) 1.4 (d) 1.5

5. The marks of a student in English, Mathematics, Physics and Chemistry are respectively 59, 83, 75 and 43. Find his average marks
   (a) 66 (b) 63
   (c) 64 (d) 65

6. There are 21 classes in a college. The total number of students in the college is 840. Find the average number of students in each class
   (a) 39
   (b) 40
   (c) 41
   (d) 44

7. The sum of seven numbers is 235. The average of first three numbers is 23 and the average of last three numbers is 42. Find the fourth number
   (a) 39
   (b) 41
   (c) 40
   (d) 44

8. A man purchased 5 cows at Rs. 1500 each. 6 cows at Rs. 2000 each and 9 cows at Rs. 2500 each. Find the average cost of cows
   (a) Rs. 2200 (b) Rs. 2300
   (c) Rs. 2100 (d) Rs. 2400

9. 30 horses were purchased for Rs. 12000. The average cost of 12 horses out of them is Rs. 250. Find the average cost of the remaining horses
   (a) Rs. 500 (b) Rs. 600
   (c) Rs. 650 (d) Rs. 550

10. Total weekly emoluments of the workers of a factory is Rs. 1534. Average weekly emolument of a worker is Rs. 118. The number of workers in the factory is
    (a) 16 (b) 14
    (c) 13 (d) 12

11. A student was asked to find the arithmetic mean of the following 12 numbers 3, 11, 7, 9, 15, 13, 8, 19, 17, 21, 14 and x. He found the mean to be 12. The value of x will be
    (a) 3 (b) 7
    (c) 17 (d) 31

12. The average income of 40 persons is Rs. 4200 and that of another 35 persons is Rs. 4000. The average income of the whole group is
    (a) Rs. 4100
    (b) Rs. $4106\frac{1}{3}$
    (c) Rs. $4106\frac{2}{3}$
    (d) Rs. $4108\frac{1}{3}$

13. The average of 7 consecutive numbers is 20. The largest of these numbers is
    (a) 24
    (b) 23
    (c) 22
    (d) 20

Previous Year Solved Questions

1. A student on her first 3 tests received an average score of N points. If she exceeds her previous average score by 20 points on her fourth test, then what is the average score for the first 4 tests ?
   (a) $N + 20$ (b) $N + 10$
   (c) $N + 4$ (d) $N + 5$ **[CSAT 2011]**

2. The sum of the ages of 5 members comprising a family, 3 years ago was 80 years. The average age of the family today is the same as it was 3 years ago, because of an addition of a baby during the intervening period. How old is the baby ?
   (a) 6 months
   (b) 1 year
   (c) 2 years
   (d) 2 years and 6 months **[CSAT 2016]**

3. The average monthly income of a person in a certain family of 5 is Rs. 10,000. What will be the average monthly income of a person in the same family if the income of one person increased by Rs. 1,20,000 per year ?
   (a) Rs. 12,000 (b) Rs. 16,000
   (c) Rs. 20,000 (d) Rs. 24,000
   [CSAT 2016]

4. Suppose the average weight of 9 persons is 50 kg. The average weight of the first 5 persons is 45 kg, whereas the average weight of the last 5 persons is 55 kg. Then the weight of the 5^{th} person will be
   (a) 45 kg (b) 47.5 kg
   (c) 50 kg (d) 52.5 kg
   [CSAT 2017]

5. There are thirteen 2-digit consecutive odd numbers. If 39 is the mean of the first five such numbers, then what is the mean of all the thirteen numbers ?
   (a) 47 (b) 49
   (c) 51 (d) 45 **[CSAT 2017]**

6. The average rainfall in a city for the first four days was recorded to be 0.40 inch. The rainfall on the last two days was in the ratio of 4 : 3. The average of six days was 0.50 inch. What was the rainfall on the fifth day ?
   (a) 0.60 inch (b) 0.70 inch
   (c) 0.80 inch (d) 0.90 inch
   [CSAT 2017]

7. The average marks of 100 students are given to be 40. It was found later that marks of one student were 53 which were misread as 83. The corrected mean marks are
   (a) 39 (b) 39.7
   (c) 40 (d) 40.3 **[CSAT 2019]**

8. A family has two children along with their parents. The average of the weights of the children and their mother is 50 kg. The average of the weights of the children and their father is 52 kg. If the weight of the father is 60 kg, then what is the weight of the mother ?
   (a) 48 kg (b) 50 kg
   (c) 52 kg (d) 54 kg **[CSAT 2019]**

9. The average age of a teacher and three students is 20 years. If all the three students are of same age and the difference between the age of the teacher and each student is 20 years, then what is the age of the teacher ?
   (a) 25 years (b) 30 years
   (c) 35 years (d) 45 years
   [CSAT 2020]

10. In a class, there are three groups A, B and C. If one student from group A and two students from group B are shifted to group C, then what happens to the average weight of the students of the class ?
    (a) It increases.
    (b) It decreases.
    (c) It remains the same.
    (d) No conclusion can be drawn due to insufficient data.
    [CSAT 2020]

17. The average of three numbers p, q and r is k. p is as much more than the average as q is less than the average. What is the value of r ?

(a) k

(b) k – 1

(c) k + 1

(d) $\frac{k}{2}$ **[CSAT 2025]**

ANSWER KEY

1. (d)	4. (c)	7. (b)	9. (c)	11. (c)	13. (c)	15. (b)	17. (a)
2. (b)	5. (a)	8. (d)	10. (c)	12. (a)	14. (b)	16. (d)	
3. (a)	6. (c)						

Hints and Solutions

1. Sum of score in three tests = 3N
Score in fourth test = N + 20
Total score for 4 tests = 3N + N + 20 = 4N + 20
Average score for the first 4 tests

$$= \frac{4N+20}{4} = \frac{4(N+5)}{4} = N+5$$

So, the average score for the first 4 tests = N + 5.
Hence, option (d) is correct.

2. $$\text{Average} = \frac{\text{sum of observation}}{\text{no. of observation}}$$

Present age of 5 member
= 80 + 3 × 5 = 95 years
Average age of 5 member 3 years ago

$$= \frac{80}{5} = 16 \text{ years}$$

According to the question,
The average age of 6 member at present is same as average age of 5 member 3 years ago.
Thus, sum of 6 member (including baby) at present = 16 × 6 = 96 years
Age of baby = 96 – 95 = 1 year
So, the age of baby = 1 year
Hence, option (b) is correct.

3. Monthly income of the family
= 5 × 10000 = Rs. 50,000
Increase in the salary of one person per month

$$= \frac{120000}{12} = \text{Rs. } 10000$$

Now, monthly salary of family
= 50,000 + 10,000 = Rs. 60,000
Average salary of family of 5 person

$$= \frac{60000}{5} = \text{Rs. } 12,000$$

So, the average salary of the family of 5 person is Rs. 12,000
Hence, option (a) is correct.

4. According to the question,
Total weight of the 9 people = 50 × 9 = 450 kg
Weight of the first five people = 45 × 5 = 225 kg
Weight of the last five people = 55 × 5 = 275 kg
Total weight of the first and the last five people
= 225 + 275 = 500 kg
Now, weight of the fifth person
= 500 – 450 = 50 kg
So, the weight of the 5th person = 50 kg.
Hence, option (c) is correct.

5. The average of first five consecutive odd natural numbers will be the exactly middle number i.e., 3rd term = 39 (given)
So, first five terms are 35, 37, 39, 41, 43.
The average of 13 consecutive odd natural numbers = 7th term.
These numbers are 35, 37, 39, 41, 43, 45, 47.
So, mean of all the 13 numbers = 47.
Hence, option (a) is correct.

6. Let the rainfall on fifth and sixth day be respectively $4x$ and $3x$ inches.
Total rainfall on fifth and sixth day will be $7x$. $(4x + 3x)$
Total rainfall for first 4 days
= 0.4 × 4 = 1.6 inch
Total rainfall in 6 days = $1.6 + 7x$
According to the question,

$$\frac{1.6+7x}{6} = 0.5$$

$$\text{Average} = \frac{\text{sum of all observations}}{\text{no. of observations}}$$

$x = 0.2$
So, the rainfall on the fifth day
= 0.2 × 4 = 0.80 inch
Hence, option (c) is correct.

Chapter 7 Percentage

7.1 Fraction values table

Fraction values	Percentage values	Fraction values	Percentage values
$\frac{1}{1}$	100%	$\frac{1}{11}$	$9\frac{1}{11}\%$
$\frac{1}{2}$	50%	$\frac{1}{12}$	$8\frac{1}{3}\%$
$\frac{1}{3}$	$33\frac{1}{3}\%$	$\frac{1}{13}$	$7\frac{9}{13}\%$
$\frac{1}{4}$	25%	$\frac{1}{14}$	$7\frac{1}{7}\%$
$\frac{1}{5}$	20%	$\frac{1}{15}$	$6\frac{2}{3}\%$
$\frac{1}{6}$	$16\frac{2}{3}\%$	$\frac{1}{16}$	$6\frac{1}{4}\%$
$\frac{1}{7}$	$14\frac{2}{7}\%$	$\frac{1}{17}$	$5\frac{15}{17}\%$
$\frac{1}{8}$	$12\frac{1}{2}\%$	$\frac{1}{18}$	$5\frac{5}{9}\%$
$\frac{1}{9}$	$11\frac{1}{9}\%$	$\frac{1}{19}$	$5\frac{5}{19}\%$
$\frac{1}{10}$	10%	$\frac{1}{20}$	5%

7.2 Application of fraction values

1. If $16\frac{2}{3}\%$ of a number is added to the number itself, it becomes 1470. Find out the original number ?

Sol: We know that, $16\frac{2}{3}\% = \frac{1}{6}$

If we add $\frac{1}{6}$ of the number to the number itself, it becomes $\frac{7}{6}$ of itself.

According to the question, $\frac{7}{6} = 1470$. Hence, the original number = 1260.

Practice Set

Effective percentage change

1. When the price of an article was reduced by 20% its sale increased by 80%. What was the net effect on the sale ?
   (a) 44% increase (b) 44% decrease
   (c) 66% increase (d) 75% increase

2. The length of a rectangle is increased by 10% and breadth decreased by 10%. Then the area of the new rectangle is
   (a) neither decreased nor increased
   (b) increased by 1%
   (c) decreased by 1%
   (d) decreased by 10%

3. If a number is increased by 25% and the resulting number is decreased by 25%, then the percentage increase or decrease finally is
   (a) no change
   (b) decreased by $6\frac{1}{4}\%$
   (c) increased by $6\frac{1}{4}\%$
   (d) increased by 6%

4. The price of an article was first increased by 10% and then again by 20%. If the last increased price be Rs. 33, the original price was
   (a) Rs. 30 (b) Rs. 27.50
   (c) Rs. 26.50 (d) Rs. 25

5. The number of employees working in a farm is increased by 25% and the wages per head are decreased by 25%. If it results in x% decrease in total wages, then the value of x is
   (a) 0% (b) 25%
   (c) 20% (d) $\frac{25}{4}\%$

6. If price of a book is first decreased by 25% and then increased by 20%, the net change in the price of the book will be
   (a) 10% decrease (b) 5% decrease
   (c) no change (d) 5% increase

7. The price of an article is reduced by 25% but the daily sale of the article is increased by 30%. The net effect on the daily sale receipts is
   (a) $2\frac{1}{2}\%$ increase (b) $2\frac{1}{2}\%$ decrease
   (c) 2% increase (d) 2% decrease

8. Salary of a person is first increased by 20%, then it is decreased by 20%. Percentage change in his salary is
   (a) 4% decreased (b) 4% increased
   (c) 8% decreased (d) 20% increased

9. The tax imposed on an article is decreased by 10% and its consumption increases by 10%. Find the percentage change in revenue from it
   (a) 10% increase (b) 2% decrease
   (c) 1% decrease (d) 11% increase

10. The price of a table is Rs. 400 more than that of a chair. If 6 tables and 6 chairs together cost Rs. 4800, by what percent is the price of the chair less than that of the table ?
    (a) $33\frac{1}{3}\%$ (b) 50%
    (c) $66\frac{2}{3}\%$ (d) None of these

Successive change and discount

11. The price of an article was decreased by 10% and again reduced by 10%. By what percent should the price have been reduced once, in order to produce the same effect as these two successive reductions ?
    (a) 15% (b) 19%
    (c) 20% (d) 25%

12. The cost of an article worth Rs. 100 is increased by 10% first and again increased by 10%. The total increase in rupees is
    (a) 20 (b) 21
    (c) 110 (d) 121

Previous Year Solved Questions

1. In a group of persons, 70% of the persons are male and 30% of the persons are married. If two-sevenths of the males are married, what fraction of the females is single ?

   (a) $\frac{2}{7}$ (b) $\frac{1}{3}$

   (c) $\frac{3}{7}$ (d) $\frac{2}{3}$ **[CSAT 2011]**

2. The tank-full petrol in Arun's motor-cycle lasts for 10 days. If he starts using 25% more everyday, how many days will the tank-full petrol last ?

   (a) 5

   (b) 6

   (c) 7

   (d) 8 **[CSAT 2013]**

3. A and B decide to travel from place X to place Y by bus. A has Rs. 10 with him and he finds that it is 80% of the bus fare for two persons. B finds that he has Rs. 3 with him and hands it over to A. In this context, which one of the following statements is correct ?

   (a) Now the money A has just enough to buy two tickers.

   (b) A still needs Rs. 2 for buying the tickets.

   (c) After buying the two tickets A will be left with 50 paise.

   (d) The money A now has is still not sufficient to buy two tickets.

   [CSAT 2014]

4. A gardener increased the area of his rectangular garden by increasing its length by 40% and decreasing its width by 20%. The area of the new garden

   (a) has increased by 20%.

   (b) has increased by 12%.

   (c) has increased by 8%.

   (d) is exactly the same as the old area.

   [CSAT 2014]

5. As per agreement with a bank, a businessman had to refund a loan in some equal installments without interest. After paying 18 installments he found that 60 percent of his loan was refunded. How many installments were there in the agreement ?

   (a) 22 (b) 24

   (c) 30 (d) 33 **[CSAT 2014]**

6. An automobile owner reduced his monthly petrol consumption when the prices went up. The price-consumption relationship is as follows:

Price (in Rs. per litre)	40	50	60	75
Monthly consumption (in litres)	60	48	40	32

   If the price goes up to Rs. 80 per litre, his expected consumption (in litres) will be

   (a) 30 (b) 28

   (c) 26 (d) 24 **[CSAT 2015]**

7. In a test, a candidate attempted only 8 questions and secured 50% marks in each of the questions. If the obtained a total of 40% in the test and all questions in the test carried equal marks, how many questions were there in the test ?

   (a) 8 (b) 10

   (c) 15 (d) 16 **[CSAT 2015]**

8. Candidates in a competitive examination consisted of 60% men and 40% women. 70% men and 75% women cleared the qualifying test and entered the final test where 80% men and 70% women were successful. Which of the following statements is correct ?

   (a) Success rate is higher for women.

   (b) Overall success rate in below 50%.

   (c) More men cleared the examination than women.

   (d) Both (a) and (b) above are correct.

   [CSAT 2015]

39. The price (p) of a commodity is first increased by k%; then decreased by k%; again increased by k%; and again decreased by k%. If the new price is q, then what is the relation between p and q ?

(a) $p(10^4 - k^2)^2 = q \times 10^8$

(b) $p(10^4 - k^2)^2 = q \times 10^4$

(c) $p(10^4 - k^2) = q \times 10^4$

(d) $p(10^4 - k^2) = q \times 10^8$ **[CSAT 2025]**

40. The petrol price shot up by 10% as a result of the hike in crude oil prices. The price of petrol before the hike was Rs. 90 per litre. A person travels 2200 km every month and his car gives a mileage of 16 km per litre. By how many km should he reduce his travel if he wants to maintain his expenditure at the previous level ?

(a) 180 km (b) 200 km

(c) 220 km (d) 240 km

[CSAT 2025]

ANSWER KEY

1. (d)	6. (a)	11. (d)	16. (d)	21. (b)	26. (d)	31. (a)	36. (d)
2. (d)	7. (b)	12. (d)	17. (d)	22. (d)	27. (b)	32. (a)	37. (d)
3. (c)	8. (c)	13. (d)	18. (b)	23. (c)	28. (a)	33. (c)	38. (d)
4. (b)	9. (c)	14. (b)	19. (a)	24. (c)	29. (a)	34. (a)	39. (a)
5. (c)	10. (b)	15. (c)	20. (b)	25. (b)	30. (b)	35. (b)	40. (b)

Hints and Solutions

1. Let the number of total person be 100
According to the question,

	Male	Female
	70	30
Married :	20	10

Now, unmarried female = 30 – 10 = 20

Required fraction $= \frac{20}{30} = \frac{2}{3}$

So, fraction of the females is single $= \frac{2}{3}$.

Hence, option (d) is correct.

2. Let the Arun uses 100 liters of petrol every day
Petrol uses in 10 days = 10 × 100 = 1000
If Arun starts using 25% more every day, then
Petrol uses in one day = 100 × 125% = 125

Now, number of days $= \frac{1000}{125} = 8$ days

So, the tank-full petrol lasts = 8 days.
Hence, option (d) is correct.

3. Let total fare of two persons be Rs. x
According to the question,
80% of Rs. x = Rs. 10

$x = \frac{10 \times 100}{80} = \text{Rs. } 12.5$

Now, the total money of A and B
= 10 + 3 = Rs. 13
But Rs. 12.5 required to buying the tickets for two persons.
Money left = Rs. (13 – 12.5) = Rs. 0.5
After buying the two tickets A will be left with 50 paise.
Hence, option (c) is correct.

4. Let the initial length and breadth is 10 units each

	Initial	Final
Length	10	14
Breadth	10	8
Area	100	112

So, the overall change in the area of the garden

$= \frac{112 - 100}{100} \times 100 = 12\%$

Since the result is positive, so the area of garden is increased by 12%.
Hence, option (b) is correct.

5. According to the question,
60% of installments = 18

100% of installments $= \frac{18 \times 100}{60} = 30.$

So, number of installments are 30.
Hence, option (c) is correct.

6.

Price (in Rs. per litre)	40	50	60	75	80
Monthly consumption (in litres)	60	48	40	32	**30**
Monthly expenditure (in Rs.)	2400	2400	2400	2400	2400

Here monthly expenditure is same for each month *i.e.*, Rs. 2400.
Hence, option (a) is correct.

7. Let the marks of each question is 10
Total marks got by the candidate
= 8 × (50% of 10) = 8 × 5 = 40 marks
According to the question,
He obtained total of 40% marks
So, 40% = 40 marks
100% = 100 marks
Total marks of the test = 100

Total number of questions $= \frac{100}{10} = 10$

Hence, option (b) is correct.

35. P Q R
64 80 100 (Let)

We need to find 100 is what percentage more than 64.

So, $\frac{36}{64}\times 100 = \frac{9}{16}\times 100 = 56.25\%$.

Hence, option (b) is correct.

36. Let the original number is 4.

According to the question,

True result = $4 \times 4 = 16$

Mistakenly got result $= \frac{4}{4} = 1$

Percentage change in the result

$= \frac{15}{16}\times 100 = 93.75\%$

Hence, option (d) is correct.

37. P Q R
150 100 (Let) 120

According to the question,

P + Q + R = 370 = 3330 $\Rightarrow$ 9 times

So, P = 150×9 = Rs. 1,350.

Hence, option (d) is correct.

38. Let the team Y's average run rate = k

Team Y's score in 18 overs = 18k

Team Y's score in 12 overs with 50% higher run rate = 12×1.5 k = 18k.

Here we can have the multiple values of k.

So, score of team X cannot be determined

Hence, option (d) is correct.

39. According to the question,

$$p\left(1+\frac{k}{100}\right)^2\left(1-\frac{k}{100}\right)^2 = q$$

$$\frac{p}{100^4}(100+k)^2(100-k)^2 = q$$

$$\frac{p}{10^8}(10^4-k^2)^2 = q$$

Hence, option (a) is correct.

40. To maintain the same expenditure the person has to reduce $\frac{1}{11}$ of his travel

i.e., $\frac{1}{11}\times 2200 = 200$ km.

Hence, option (b) is correct.

Chapter 8 Profit & Loss

Terms related to Profit and Loss

Cost Price (CP) : The price at which an article is bought (purchased) is known as the *cost price*.

Selling Price (SP) : The price at which an article is sold is known as *selling price*.

Profit : If selling price is greater than cost price, then profit occurs.

Loss : If cost price is greater than selling price, then loss occurs.

Marked price / List price / MRP : The price which is printed on an article is known as Marked price / List price or MRP of the article.

Discount : Discount means the concession given to the customer on (MRP) marked price. (Discount is always given on marked price)

Note :

Profit or loss is always calculated with respect to cost price. (If we calculate profit or loss on selling price, it will be a mistake. However, sometimes questions are based on this concept also).

Mathematical Interpretation of Profit or Loss : If we sell an article at a profit of 10%, means we are selling the article at 110% of our cost price.

Similarly, if we are selling on article at 10% loss, means we are selling our article at 90% of cost price.

8.1 Based on CP and SP

1. If the cost price is Rs. 60 and profit percent is 20%. Find out the selling price.

Sol: Profit = 20% of Rs. 60 $= \frac{20 \times 60}{100}$ = Rs. 12

SP = CP + Profit = 60 + 12 = Rs. 72.

2. Find out the selling price, if cost price is Rs. 80 and loss percent is 15%.

Sol: Loss = 15% of Rs. 80 $= \frac{15 \times 80}{100}$ = Rs. 12

SP = CP – Loss = 80 – 12 = Rs. 68.

3. Find out the cost price, if selling price is Rs. 80 and profit percent is 25%.

Sol: Selling price = 125% of CP

According to the question,

125% of CP = Rs. 80

100% of CP $= \frac{80}{125} \times 100$ = Rs. 64.

Practice Set

Based on CP and SP

1. A man wanted to sell an article with 20% profit, but he actually sold at 20% loss for Rs. 480. At what price he wanted to sell it to earn the profit ?
   (a) Rs. 720 (b) Rs. 840
   (c) Rs. 600 (d) Rs. 750

2. By selling an article for Rs. 240, a man incurs a loss of 10%. At what price should he sell it, so that he makes a profit of 20% ?
   (a) Rs. 264 (b) Rs. 288
   (c) Rs. 300 (d) Rs. 320

3. By selling an article for Rs. 72, there is a loss of 10%. In order to gain 5%, its selling price should be
   (a) Rs. 87 (b) Rs. 85
   (c) Rs. 80 (d) Rs. 84

4. A man buys a cycle for Rs. 1400 and sells it at a loss of 15%. What is the selling price of the cycle ?
   (a) Rs. 1202 (b) Rs. 1190
   (c) Rs. 1160 (d) Rs. 1000

5. The ratio of cost price and selling price is 5 : 4, the loss percent is
   (a) 20% (b) 25%
   (c) 40% (d) 50%

6. If an article is sold for Rs. 178 at a loss of 11%, what should be its selling price in order to earn a profit of 11% ?
   (a) Rs. 222.50 (b) Rs. 267
   (c) Rs. 435 (d) Rs. 222

7. By selling a table for Rs. 350 instead of Rs. 400, loss percent increases by 5%. The cost price of table is
   (a) Rs. 1050
   (b) Rs. 417.50
   (c) Rs. 435
   (d) Rs. 1000

8. If selling price of an article is $\frac{8}{5}$ times its cost price, the profit percent on it is
   (a) 120% (b) 160%
   (c) 40% (d) 60%

9. On selling an article for Rs. 651, there is a loss of 7%. The cost price of that article is
   (a) Rs. 744 (b) Rs. 751
   (c) Rs. 793 (d) Rs. 700

10. The ratio of the CP and SP of an article is 20 : 21. What is the gain percent ?
    (a) 5% (b) 5.5%
    (c) 6% (d) 6.25%

11. In selling an article for Rs. 76, there is a profit of 52%. If it is sold for Rs. 75, the profit percent will be
    (a) 44 (b) 46
    (c) 48 (d) 50

12. The ratio of the cost price and selling price of an article is 5 : 6. What is the percentage of profit ?
    (a) 20%
    (b) 15%
    (c) 12.5%
    (d) 10%

13. Oranges are bought at 7 for Rs. 3. At what rate per hundred must they be sold to gain 33% ?
    (a) Rs. 56
    (b) Rs. 60
    (c) Rs. 58
    (d) Rs. 57

14. On selling an article for Rs. 105 a trader loses 9%. To gain 30% he should sell the article at
    (a) Rs. 126
    (b) Rs. 144
    (c) Rs. 150
    (d) Rs. 139

37. A tradesman gives 4% discount on the marked price and gives 1 article free for buying every 15 articles and thus gains 35%. The marked price is above the cost price by
(a) 20% (b) 39%
(c) 40% (d) 50%

38. A trader marked his goods at 20% above the cost price. He sold half the stock at the marked price, one quarter at a discount of 20% on the marked price and the rest at a discount of 40% on the marked price. His total gain is
(a) 2% (b) 4.5%
(c) 13.5% (d) 15%

39. If books bought at prices ranging from Rs. 200 to Rs. 350 are sold at prices ranging from Rs. 300 to Rs. 425, what is the greatest possible profit that might be made in selling eight books?
(a) Rs. 400
(b) Rs. 600
(c) Cannot be determined
(d) None of these

ANSWER KEY

1. (a)	6. (d)	11. (d)	16. (a)	21. (c)	26. (b)	31. (d)	36. (b)
2. (d)	7. (d)	12. (a)	17. (b)	22. (b)	27. (d)	32. (a)	37. (d)
3. (d)	8. (d)	13. (d)	18. (d)	23. (a)	28. (b)	33. (c)	38. (a)
4. (b)	9. (d)	14. (c)	19. (b)	24. (d)	29. (a)	34. (d)	39. (d)
5. (a)	10. (a)	15. (b)	20. (a)	25. (a)	30. (c)	35. (c)	

Hints and Solutions

1. We know that, if the SP of two articles is the same, on the first article there is a gain of x% while on the second it is a loss of x%. So, overall there is a loss of $\left(\frac{x^2}{100}\right)\%$

   So, the overall loss $= \left(\frac{10^2}{100}\right)\% = 1\%$

   So, he suffers a loss of 1%.
   Hence, option (c) is correct.

2. Marked price : Cost price = 110 : 90 = 11 : 9
   Marked price = Rs. 770
   $11x = 770$, then $x = 70$
   Cost price of toy = $9x = 9 \times 70$ = Rs. 630
   So, the cost price of a toy is Rs. 630.
   Hence, option (c) is correct.

3. Let the cost price of cell phone be $100x$ rupees
   Selling price at which Gopal sold cell phone
   $= 100x + 10\%$ of $100x = 110x$
   Cost price of cell for Ram will be $110x$
   Selling price of the cell phone by Ram
   $= 110x - 10\%$ of $110x = 99x$
   Profit percent for Gopal
   $= \frac{100x - 99x}{100x} \times 100$
   (he get a profit of x rupees on cost price of $100x$)
   = 1%
   Hence, option (c) is correct.

4. CP of the article
   = average of (20, 40)
   $= \frac{20 + 40}{2}$ = Rs. 30.
   So, the original cost of the article = Rs. 30.
   Hence, option (c) is correct.

5. According to the question,
   80% of CP of car = 3,00,000
   So, 100% of CP of car $= \frac{300000}{80} \times 100 = 375000.$
   So, he spent to buy the car = 3,75,000
   Hence, option (d) is correct.

6. Using both the statements together, we can say, $p = 17$, $q = 16$ and $r = 17$.
   Hence, option (c) is correct.

Chapter 9 Time, Speed and Distance

We all know, Speed $= \frac{\text{Distance}}{\text{Time}}$

x km/h $= \frac{5x}{18}$ m/s and y m/s $= \frac{18y}{5}$ km/h

EXAMPLES

1. How many seconds does Aditya take to cover a distance of 400 m if he runs at a speed of 20 km/h ?

Sol: Speed = 20 km/h $= \left(20 \times \frac{5}{18}\right)$ m/s $= \frac{50}{9}$ m/s. So, time taken to cover 400 m $= \left(400 \times \frac{9}{50}\right)$ s = 72 seconds.

2. A cyclist covers a distance of 750 m in 2 minutes 30 seconds. What is the speed in km/h of the cyclist ?

Sol: Time = 2 minutes 30 seconds = 150 seconds. Speed $= \frac{750}{150}$ m/s $= 5$ m/s $= 5 \times \frac{18}{5}$ km/h $= 18$ km/h.

3. A man in a train notices that he can count 21 telephone posts in one minute. If they are known to be 50 metres apart, then at what speed is the train travelling ?

Sol: We know that, for n poles $(n - 1)$ intervals will be required.

So, total distance covered by the train in 1 minute = 20 × 50 = 1000 meter = 1 km

Train covers 1 km in 1 minute so in 60 minutes the train goes 60 km. So, speed of the train = 60 km/h.

9.1 Average speed $= \frac{\text{Total distance}}{\text{Total time}}$

4. A man covered first 50 km at 25 km/h, next 30 km at 5 km/h and last 20 km at 10 km/h. Find out the average speed during the entire journey ?

Sol:

50 km	30 km	20 km
25 km/h	5 km/h	10 km/h

Time taken to cover 50 km $= \frac{50}{25} = 2$ hours and time taken to cover 30 km $= \frac{30}{5} = 6$ hours

Time taken to cover 20 km $= \frac{20}{10} = 2$ hours

Total distance covered = 50 + 30 + 20 = 100 km and total time taken = 2 + 6 + 2 = 10 hours

Hence, average speed $= \frac{\text{Total distance}}{\text{Total time}} = \frac{100}{10} = 10$ km/h.

Previous Year Solved Questions

1. If a bus travels 160 km in 4 hours and a train travels 320 km in 5 hours at uniform speeds, then what is the ratio of the distances travelled by them in one hour ?
   (a) 8 : 5 (b) 5 : 8
   (c) 4 : 5 (d) 1 : 2 **[CSAT 2011]**

2. Mr. Kumar drives to work at an average speed of 48 km/h. The time taken to cover the first 60% of the distance is 10 minutes more than the time taken to cover the remaining distance. How far is his office ?
   (a) 30 km (b) 40 km
   (c) 45 km (d) 48 km **[CSAT 2012]**

3. A thief running at 8 km/hr is chased by a policeman who speed is 10 km/hr. If the thief is 100 m ahead of the policeman, then the time required for the policemen to catch the thief will be
   (a) 2 minutes
   (b) 3 minutes
   (c) 4 minutes
   (d) 6 minutes **[CSAT 2013]**

4. A person can walk a certain distance and drive back in six hours. He can also walk both ways in 10 hours. How much time will he take to drive both ways ?
   (a) Two hours
   (b) Two and a half hours
   (c) Five and a half hours
   (d) Four hours **[CSAT 2013]**

5. A worker reaches his factory 3 minutes late if his speed from his house to the factory is 5 km/hr. If he walks at a speed of 6 km/hr, then he reaches the factory 7 minutes early the distance of the factory from his house is
   (a) 3 km
   (b) 4 km
   (c) 5 km
   (d) 6 km **[CSAT 2014]**

6. Two cars start towards each other, from two places A and B which are at a distance of 160 km. They start at the same time 08 : 10 am. If the speeds of the cars are 50 km and 30 km/h respectively, they will meet each other at
   (a) 10:10 am
   (b) 10:30 am
   (c) 11:10 am
   (d) 11:20 am **[CSAT 2014]**

7. In a 500 metres race, B starts 45 meters ahead of A, but A wins the race while B is still 35 metres behind. What is the ratio of the speed of A to B assuming that both start at the same time ?
   (a) 25 : 21 (b) 25 : 20
   (c) 5 : 3 (d) 5 : 7 **[CSAT 2015]**

8. Two cities A and B are 360 km apart. A car goes from A to B with a speed of 40 km/hr and returns to A with a speed of 60 km/hr. What is the average speed of the car ?
   (a) 45 km/hr (b) 48 km/hr
   (c) 50 km/hr (d) 55 km/hr
   [CSAT 2015]

9. A daily train is to be introduced between station A and station B starting from each end at 6 am and the journey is to be completed in 42 hours. What is the number of trains needed in order to maintain the shuttle service ?
   (a) 2 (b) 3
   (c) 4 (d) 7 **[CSAT 2016]**

10. A and B walk around a circular park. They start at 8 am from the same point in the opposite directions. A and B walk at a speed of 2 rounds per hour and 3 rounds per hour respectively. How many times shall they cross each other after 8:00 am and before 9:30 am ?
    (a) 7 (b) 6
    (c) 5 (d) 8 **[CSAT 2016]**

Hints and Solutions

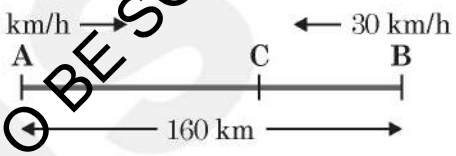
1. Distance covered by a bus in 4 hours = 160 km.
Distance covered by a bus in 1 hour
$= \frac{160}{4} = 40$ km
Further, distance covered by a train in 5 hours = 320 km
Distance covered by a train in 1 hour
$= \frac{320}{5} = 64$ km
So, the required ratio
$= \frac{40}{64} = \frac{5}{8} = 5 : 8.$
Hence, option (b) is correct.

2. Time taken to cover 60% of the distance is 10 minutes more than to cover that of 40%.
So, the time required to cover 20% of distance is 10 minutes.
Thus, time required to cover 100% of distance
$= \frac{10}{20} \times 100 = 50$ minutes
Total distance $= 48 \times \frac{50}{60} = 40$ km
Hence, option (b) is correct.

3. If we consider the difference of speeds, policeman is 2 km/h leading speed and he can catch the thief at 100 m ahead by
$\frac{100 \text{ m}}{2 \text{ km/h}} = \frac{100}{1000 \times 2} \times 60 = 3$ minutes.
Hence, option (b) is correct.

4. 2-way walk = 10 hours
1-way walk = 5 hours
1-way walk + 1 way drive = 6 hours
1 way drive = 6 – 5 = 1 hour
So, 2-way drive take 2 hours
Hence, option (a) is correct.

5. Let the distance = x km
According to the question,
$\frac{x}{5} - \frac{3}{60} = \frac{x}{6} + \frac{7}{60}$
$\frac{x}{5} - \frac{x}{6} = \frac{10}{60} = \frac{1}{6}$
$\frac{x}{30} = \frac{1}{6}$
$x = 5$ km
Hence, option (c) is correct.

6. 

Suppose the cars meet at point C after 't' hours.
AC = $50t$ and BC = $30t$
$50t + 30t = 160$
$t = \frac{160}{80} = 2$ hours
So, the cars will meet at 10:10 am
Hence, option (a) is correct.

7. Total distance = 500 m
Distance covered by A= 500 m
Distance covered by B = 500 – 45 – 35
= 500 – 80 = 420
$\frac{\text{Speed of A}}{\text{Speed of B}} = \frac{\frac{\text{distance of A}}{\text{time}}}{\frac{\text{distance of B}}{\text{time}}}$
$= \frac{500}{\text{time}} \times \frac{\text{time}}{420} = \frac{500}{420} = \frac{25}{21} = 25 : 21.$
Hence, option (a) is correct.

Chapter 10 Trains

10.1 Concept

- When a train passes a Person / Pole / Tree, train covers the distance which is equal to it's own length (since the length of the Person / Pole / Tree is negligible in comparison to the length of the train).
- When a train passes a Platform / Bridge / Tunnel, train covers a distance which is equal to it's own length + the length of the Platform.

EXAMPLES

1. A train 100 m long is running at the speed of 30 km/h. Find the time taken by it to pass a man standing near the railway line.

Sol: Speed of the train $= \left(30 \times \frac{5}{18}\right)$ m/s $= \left(\frac{25}{3}\right)$ m/s

Distance travelled in passing the standing man = 100 m

Hence, required time taken $= \frac{100}{\left(\frac{25}{3}\right)} = \left(100 \times \frac{3}{25}\right) = 12$ seconds.

2. A train is running at a speed of 132 km/h. If the length of the train is 110 metres, how long will it take to cross a railway bridge 165 metres long ?

Sol: Speed of train $= \left(132 \times \frac{5}{18}\right)$ m/s $= \left(\frac{110}{3}\right)$ m/s

Distance covered in passing the railway bridge = (110 + 165) m = 275 m

Hence, $\left(275 \times \frac{3}{110}\right) = \frac{15}{2} = 7\frac{1}{2}$ seconds.

3. A train 150 m long is running with a speed of 68 km/h. In what time will it pass a man who is running at 8 km/h in the same direction in which the train is going ?

Sol: Speed of the train relative to man = (68 – 8) km/h $= \left(60 \times \frac{5}{18}\right)$ m/s $= \left(\frac{50}{3}\right)$ m/s

Time taken by the train to cross the man

= Time taken by it to cover 150 m at $\left(\frac{50}{3}\right)$ m/s $= \left(150 \times \frac{3}{50}\right)$ seconds $= 9$ seconds.

Chapter 11 Boats & Streams

Upstream (U) : To row the boat against the flow.

Downstream (D) : To row the boat with the flow.

Let the speed of the boat in still water = 'B'.

Let the speed of the stream (current) = 'S'.

So, $D = B + S$ ... (1)

$U = B - S$ ... (2)

Solving equations (1) and (2), we get

$B = \frac{D+U}{2}$ and $S = \frac{D-U}{2}$

EXAMPLES

1. A man can row upstream at 7 km/h and downstream at 10 km/h. Find man's rate in still water and the rate of current.

Sol: Rate in still water $= \frac{1}{2}(10+7)$ km/h $= 8.5$ km/h

Rate of current $= \frac{1}{2}(10-7)$ km/h $= 1.5$ km/h

2. A man takes 3 hours 45 minutes to row a boat 15 km downstream of a river and 2 hours 30 minutes to cover a distance of 5 km upstream. Find the speed of the river current in km/h.

Sol: Rate downstream $= \left(\frac{15}{3\frac{3}{4}}\right)$ km/h $= \left(15 \times \frac{4}{15}\right)$ km/h $= 4$ km/h

Rate upstream $= \left(\frac{5}{2\frac{1}{2}}\right)$ km/h $= \left(5 \times \frac{2}{5}\right)$ km/h $= 2$ km/h

Speed of the river current $= \frac{4-2}{2}$ km/h $= 1$ km/h.

Practice Set

1. In one hour, a boat goes 11 km along the stream and 5 km against the stream. The speed of the boat in still water (in km/h) is
   (a) 3 (b) 5
   (c) 8 (d) 9

2. A man can row upstream at 8 km/h and downstream at 13 km/h. The speed of the stream is
   (a) 2.5 km/h (b) 4.2 km/h
   (c) 5 km/h (d) 10.5 km/h

3. A man rows downstream 32 km and 14 km upstream. If he takes 6 hours to cover each distance, then the velocity (in km/h) of the current is
   (a) $\frac{1}{2}$ (b) 1
   (c) $1\frac{1}{2}$ (d) 2

4. A boat running downstream covers a distance of 16 km in 2 hours while for covering the same distance upstream, it takes 4 hours. What is the speed of the boat in still water ?
   (a) 4 km/h (b) 6 km/h
   (c) 8 km/h (d) Data inadequate

5. A boatman goes 2 km against the current of the stream in 1 hour and goes 1 km along the current in 10 minutes. How long will it take to go 5 km in stationary water ?
   (a) 40 minutes (b) 1 hour
   (c) 1 hr 15 min (d) 1 hr 30 min

6. A man takes half time in rowing a certain distance downstream than upstream. What is the ratio of the speed in still water to the speed of current ?
   (a) 1 : 2 (b) 2 : 1
   (c) 1 : 3 (d) 3 : 1

7. A man takes twice as long to row a distance against the stream as to row the same distance in favour of the stream. The ratio of the speed of the boat (in still water) and the stream is
   (a) 2 : 1 (b) 3 : 1
   (c) 3 : 2 (d) 4 : 3

8. A boat running upstream takes 8 hours 48 minutes to cover a certain distance, while it takes 4 hours to cover the same distance running downstream. What is the ratio between the speed of the boat and speed of the water current respectively ?
   (a) 2 : 1
   (b) 3 : 1
   (c) 3 : 2
   (d) None of these

9. If a boat goes 7 km upstream in 42 minutes and the speed of the stream is 3 km/h, then the speed of the boat in still water is
   (a) 4.2 km/h (b) 9 km/h
   (c) 13 km/h (d) 21 km/h

10. A man's speed with the current is 15 km/h and the speed of the current is 2.5 km/h. The man's speed against the current is
    (a) 8.5 km/h (b) 9 km/h
    (c) 10 km/h (d) 12.5 km/h

11. If a man rows at the rate of 5 km/h in still water and his rate against the current is 3.5 km/h, then the man's rate along the current is
    (a) 4.25 km/h (b) 6 km/h
    (c) 6.5 km/h (d) 8.5 km/h

12. A boat can travel with a speed of 13 km/h in still water. If the speed of the stream is 4 km/h, find the time taken by the boat to go 68 km downstream
    (a) 2 hours (b) 3 hours
    (c) 4 hours (d) 5 hours

Previous Year Solved Question

1. A man takes half time in rowing a certain distance downstream than upstream. What is the ratio of the speed in still water to the speed of current ?

   (a) 1 : 2

   (b) 2 : 1

   (c) 1 : 3

   (d) 3 : 1 **[CSAT 2020]**

Sol: Let the speed of the boat in still water is x km/h

And the speed of the stream is y km/h.

Downstream = $(x + y)$ km/h

Upstream = $(x - y)$ km/h

Ratio of time downstream : upstream = 1 : 2

Ratio of speed downstream : upstream = 2 : 1

$(x + y) : (x - y) = 2 : 1$

$x + y = 2x - 2y$

$x = 3y$

$$\frac{x}{y} = \frac{3}{1}$$

Speed of the boat in still water : Speed of stream = 3 : 1

So, ratio of the speed in still water to the speed of current is 3 : 1.

Hence, option (d) is correct.

Chapter 12 Time and Work

This is one of the very much logical and practical topics of Quantitative aptitude. The approach that we are going to follow here, is LCM approach, and this LCM will be considered as the total work.

EXAMPLES

1. A does a work in 10 days and B does the same work in 15 days. In how many days they together will do the same work ?

Sol: A = 10 days — 3

B = 15 days — 2

30

Total work = LCM of (3, 2) = 30 units

A is doing $\frac{30}{10}$ = 3 units in 1 day

B is doing $\frac{30}{15}$ = 2 units in 1 day

Together they are doing = 3 + 2 = 5 units in 1 day.

Hence, time taken by them to complete the total work, working together $= \frac{30}{5} = 6$ days.

2. Worker A can complete a piece of work in 8 hours and B in 10 hours. In how many hours both of them working together will complete it ?

Sol: A = 8 hours — 5

B = 10 hours — 4

40

Total work = LCM of (8, 10) = 40 units

A is doing $\frac{40}{8}$ = 5 units in 1 hour

B is doing $\frac{40}{10}$ = 4 units in 1 hour

Together they are doing = 5 + 4 = 9 units in 1 hour

Hence, time taken by them to complete the total work, working together $= \frac{40}{9} = 4\frac{4}{9}$ hours.

33. A, B and C can do a piece of work in 11 days, 20 days and 55 days respectively, working alone. How soon can the work be done if A is assisted by B and C on alternate days ?

(a) 7 days (b) 8 days

(c) 9 days (d) 10 days

34. 10 men can complete a piece of work in 15 days and 15 women can complete the same work in12 days. If all the 10 men and 15 women work together, in how many days will the work get completed ?

(a) 6 (b) $6\frac{1}{3}$

(c) $6\frac{2}{3}$ (d) $7\frac{2}{3}$

35. If 5 men or 8 women can do a piece of work in 12 days, how many days will be taken by 2 men and 4 women to do the same work ?

(a) 15 days (b) $13\frac{1}{2}$ days

(c) $13\frac{1}{3}$ days (d) 10 days

36. 6 men or 12 women can do a piece of work in 20 days. In how many days can 8 men and 16 women do twice as big as this work ?

(a) 2 days (b) 5 days

(c) 15 days (d) 10 days

37. 3 men or 5 women can do a work in 12 days. How long will 6 men and 5 women take to finish the work ?

(a) 20 days (b) 10 days

(c) 4 days (d) 15 days

ANSWER KEY

1. (c)	6. (c)	11. (b)	16. (c)	21. (c)	26. (b)	31. (d)	36. (c)
2. (b)	7. (a)	12. (c)	17. (c)	22. (b)	27. (b)	32. (b)	37. (c)
3. (d)	8. (d)	13. (a)	18. (b)	23. (b)	28. (a)	33. (b)	
4. (a)	9. (c)	14. (b)	19. (b)	24. (b)	29. (a)	34. (c)	
5. (c)	10. (d)	15. (b)	20. (a)	25. (b)	30. (a)	35. (c)	

Hints and Solutions

1. Let the remaining food will last of 'x' days.
Equating the quantity of food both sides, we get
$1000 \times 30 = 1000 \times 10 + 2000 \times x$
$1000 \times 20 = 2000 \times x$
$x = 10$ days
Hence, option (d) is correct.

2. Let the work be x
The efficiency of Ram and Shyam be R and S
Ram and Shyam can complete the whole work
$= 4 \times \frac{10}{6} = 6 \times \frac{2}{3}$ days
Remaining work after 4 days
$= (R + S) \times \frac{8}{3} = S \times 8$
R : S = 2 : 1
Ram can complete the whole work
$= \frac{3 \times \frac{20}{3}}{2} = 10$ days
So, Ram takes to complete the entire job alone in 10 days.
Hence, option (c) is correct.

3. W can do 25% of a work in 30 days.
So, W can do the complete work in 120 days.
X can do $\frac{1}{4}$th of the work in 10 days.
So, X can do the complete work in 40 days.
Y can do 40% of the work in 40 days.
So, Y can do 100% of the work in 100 days.
Z can do $\frac{1}{3}$rd of the work in 13 days.
So, Z can do the complete work in 39 days.
Thus, it is clear from the results that Z will complete the work first.
Hence, option (d) is correct.

4. Let the work done by Q in 1 day = x units.
So, the work done by P in 1 day = $3x$ units.
Work done by R in 1 day $= \frac{3x + x}{4} = x$ units.
So, the ratio of earnings = P = $3x$: Q = x : R = x
= 3 : 1 : 1.
Hence, option (a) is correct.

5. Initial units of work = 8 units
Out of which, 7 units are completed in 21 days.
So, the number of days that man takes in completing one unit of work $= \frac{21}{7} = 3$ days
Now, amount of new work
= 8 + 50% of 8 = 8 + 4 = 12 units
Work remaining = 12 – 7 = 5 units
So, the time taken by the man to complete the rest of the work = 5 × 3 = 15 days
Hence, option (d) is correct.

6. Since, the comparative efficiencies of man and women are not known, we cannot determine the time taken by 12 men and 24 women to complete the given work.
So, the data is inadequate to draw any conclusion.
Hence, option (d) is correct.

7. A, B, C work independently on alternate days.
A, B, C working independently can do a piece of work in 8, 16, and 12 days respectively.
Let the total amount of work be LCM (8, 16, 12) = 48 units
So, Efficiency of A $= \frac{48}{8} = 6$ units/day
Efficiency of B $= \frac{48}{16} = 3$ units/day
Efficiency of C $= \frac{48}{12} = 4$ units/day

The amount of work done in 3 days (Monday + Tuesday + Wednesday) = 6 + 3 + 4 = 13 units

The cycle of work then repeats every 3 days.

To find out when the work will be finished, we need to find out how many full cycles of 3 days can be completed before the total work of 48 units is done.

$\frac{48 \text{ units}}{13 \text{ units per cycle}}$ = 3 cycles with a remainder of 9 units

This means that 3 full cycles of 3 days will be completed, which is 9 days, and 9 units of work will be remaining.

On the 10th day (Monday), A will work and do 6 units. This leaves 3 units of work remaining.

On the 11th day (Tuesday), B will work and do 3 units, completing the work.

Thus, the work will be finished on the 11th day, which is a Thursday.

So, statement 1 is correct and statement 2 is incorrect.

Hence, option (a) is correct.

8. We know that, efficiency is inversely proportional to time.

Ratio of time 6 : 5

Ratio of efficiency 5 : 6

$\frac{1}{5}$

$\Rightarrow \frac{1}{5} = 20\%$

Hence, option (c) is correct.

9. X = 6 hours — 4

Y = 8 hours — 3 — 24 units

Z = 8 hours — 3

According to the question,

Work will be done in the pattern

4, 3, 4, 3, 4, 3, ...

So, in this manner work done in 6 hours = 21 units

Now rest work = 24 – 21 = 3 units

To minimise time, X has to do this 3 units work.

X can do 3 unit work in $\frac{3}{4}$ hours

i.e., 45 minutes.

So, total time required = 6 hours 45 minutes.

Hence, option (c) is correct.

10. For set (X): 70% in 14 minutes, so 100% in 20 minutes.

Similarly, we can have the following results:

X → 20 pipes → 20 minutes

Y → 10 pipes → 16 minutes

Z → 16 pipes → 40 minutes

(leak)

Since, half of the pipes of set X are closed so they will take double time *i.e.*, 40 minutes.

Similarly, only half of the pipes of set Y are open so they will take double the time *i.e.*, 32 minutes.

All pipes of the set (Z) are open so they will take 40 minutes to empty the tank.

If all of them are working together, the complete tank would be filled in 32 minutes and half the tank would be filled in 16 minutes.

Hence, option (d) is correct.

11. X = 18 days — 8

Y = 24 days — 6 — 144

Z = 16 days — 9

Work done by Y in $8\frac{2}{3}$ days $= \frac{26}{3} \times 6 = 52$.

Remaining work = 144 – 52 = 92.

Remaining work will be done by all of them together $= \frac{92}{23} = 4$ days.

Hence, option (b) is correct.

Chapter 13 Pipes and Cisterns

This topic is the continuation of Time and work only, the approach of solving questions is similar to that of the last topic. The only difference here is that the HCF would be considered as the capacity of the tank.

EXAMPLES

1. Two pipes A and B can fill a tank in 36 hours and 45 hours respectively. If both the pipes are opened simultaneously, how much time will be taken to fill the tank ?

Sol: $A = 36$ hours — 5; $B = 45$ hours — 4; 180

Total work = LCM of (36, 45) = 180 units

A is doing $\frac{180}{36} = 5$ units in 1 hour and B is doing $\frac{180}{45} = 4$ units in 1 hour

Together they are doing = 5 + 4 = 9 units in 1 hour.

Hence, time taken by them to complete the total work, working together $= \frac{180}{9} = 20$ hours.

2. Two pipes can fill a tank in 10 hours and 12 hours respectively while a third pipe empties the full tank in 20 hours. If all the three pipes operate simultaneously, in how much time will the tank be filled ?

Sol: $A = 10$ hours — 6; $B = 12$ hours — 5; $C = 20$ hours (Leak) — –3; 60

Total work = LCM of (10, 12, 20) = 60 units

A is doing $\frac{60}{10} = 6$ units in 1 hour and B is doing $\frac{60}{12} = 5$ units in 1 hour

Here, C is a leak pipe. So, it's work will be treated as negative work.

C is doing $\frac{60}{20} = -3$ units in 1 hour

Together they are doing = 6 + 5 – 3 = 8 units in 1 hour.

Hence, time taken by them to complete the total work, working together $= \frac{60}{8} = 7.5$ hours.

Chapter 14 Permutations and Combinations

14.1 Basic Counting Principle

And → '×'
Or → '+'

EXAMPLES

1. If a coin is tossed and a dice is thrown. Find out total number of all the possible outcomes ?

Sol: Total possible outcomes are given as following :

Dice	1	2	3	4	5	6	} 6	and	Dice	1	2	3	4	5	6	} 6
Coin	H	H	H	H	H	H			Coin	T	T	T	T	T	T	

Total 6 + 6 = 12
Coin 'and' Dice
2 × 6 = 12
Here 'and' means product.

2. A Mock Test contains 2 sections with 3 and 4 questions respectively. In how many ways can a student select one question from each sections ?

Sol:

Section A	a_1	a_2	a_3	
Section B	b_1	b_2	b_3	b_4

Possible selection of questions
(a_1b_1), (a_1b_2), (a_1b_3), (a_1b_4) = 4
(a_2b_1), (a_2b_2), (a_2b_3), (a_2b_4) = 4
$(a_3\ b_1)$, (a_3b_2), (a_3b_3), (a_3b_4) = 4
Total ways to select questions = 4 + 4 + 4 = 12 = (3 × 4)
= Questions in Section A × Questions in Section B.

3. There are 6 trains running from New Delhi to Bhopal. A man goes from New Delhi to Bhopal and comes back with a different train. In how many ways this can be done ?

Sol:

New Delhi	T_1	T_2	T_3	T_4	T_5	T_6
Bhopal	T_1	T_2	T_3	T_4	T_5	T_6

For onward journey man has 6 choices and for downward journey he has 5 choices.
So, total number of ways = 6 × 5 = 30.

ANSWER KEY

1. (a)	10. (d)	19. (c)	28. (b)	37. (b)	46. (a)	55. (b)	64. (d)
2. (d)	11. (c)	20. (a)	29. (b)	38. (b)	47. (c)	56. (c)	65. (b)
3. (d)	12. (a)	21. (b)	30. (d)	39. (c)	48. (d)	57. (c)	66. (a)
4. (c)	13. (b)	22. (d)	31. (c)	40. (b)	49. (b)	58. (c)	
5. (c)	14. (c)	23. (b)	32. (c)	41. (b)	50. (c)	59. (b)	
6. (b)	15. (c)	24. (c)	33. (b)	42. (a)	51. (a)	60. (c)	
7. (a)	16. (b)	25. (a)	34. (d)	43. (b)	52. (d)	61. (d)	
8. (d)	17. (c)	26. (d)	35. (a)	44. (d)	53. (a)	62. (a)	
9. (a)	18. (d)	27. (d)	36. (c)	45. (b)	54. (a)	63. (c)	

Hints and Solutions

1. There can be many ways.
   One of the possible way is the exchange of S and A (CSAT → CAST) and after that C and A (CAST → ACST).
   Hence, option (a) is correct.

2. $2^{10} = 1024$ unique sequences are possible.
   Hence, option (d) is correct.

3. For one pair of black shoes, we require one left black and one right black. Consider the worst case situation:
   7LB + 5LB + 5RW + 1RB or
   7RB + 5LW + 5RW + 1LB = 18 shoes.
   Hence, option (d) is correct.

4. For one pair of correct shoes, one of the possible combinations is 7LB + 5LW + 1R(B or W) = 13.
   Some other cases are also possible with at least 13 shoes.
   Hence, option (c) is correct.

5. $\underset{\downarrow}{P_1} \quad \underset{\downarrow}{P_2} \quad \underset{\downarrow}{P_3} \quad \underset{\downarrow}{P_4} \quad \underset{\downarrow}{P_5}$
   $8 \times 8 \times 8 \times 8 \times 8 = 8^5$
   Hence, option (c) is correct.

6. He can solve 4 questions from section 1 and 2 question from section 2 or 3 and 3 or 2 and 4 questions from each section respectively

A	B
a_1	b_1
a_2	b_2
a_3	b_3
a_4	b_4
a_5	b_5

A	B
2	4
3	3
4	2

   $= {}^5C_2 \times {}^5C_4 + {}^5C_3 \times {}^5C_3 + {}^5C_4 \times {}^5C_2$
   $= 10 \times 5 + 10 \times 10 + 5 \times 10 = 50 + 100 + 50 = 200.$
   Hence, option (b) is correct.

7. Only two values are possible $2^{12} = 4^6 = 4096$ and $3^8 = 6561$.
   Hence, option (a) is correct.

8. $6! = 1 \times 2 \times 3 \times 4 \times 5 \times 6 = 720 = 8 \times 9 \times 10$.
   Thus, $P! = 7! \times 8 \times 9 \times 10 = 10!$
   So, $P = 10$, thus sum of digits of $P = 1 + 0 = 1$.
   Hence, option (d) is correct.

9. Use the property ${}^nC_r = {}^nC_{n-r}$ to see that the two values would be equal at $n = 11$.
   Since, ${}^{11}C_3 = {}^{11}C_8$.
   Hence, option (a) is correct.

10. Total number of handshakes for n persons
    $= {}^nC_2 = \frac{n(n-1)}{2}$
    According to the question,
    $\frac{n(n-1)}{2} = 28$ (given)
    Going through options, we get $n = 8$.
    Hence, option (d) is correct.

11. Total number of handshakes for n persons
    $= {}^nC_2 = \frac{n(n-1)}{2}$
    According to the question,
    $n = 10$, so required number of handshakes
    $= \frac{10 \times (10-1)}{2} = \frac{10 \times 9}{2} = 45.$
    Hence, option (c) is correct.

12. Let the number of boys be B, then
    ${}^BC_2 = 36 \Rightarrow B = 9$.
    Let the number of girls be G, then
    ${}^GC_2 = 66 \Rightarrow G = 12$.
    Therefore, total number of students in the class $= 12 + 9 = 21$.
    Hence, total number of matches $= {}^{21}C_2 = 210$.
    Hence, number of matches between one boy and one girl $= 210 - (36 + 66) = 108$.
    Hence, option (a) is correct.

13. Going through options, for option (a), we get 12 participants in the tournament, which means in this case there would be $2 \times {}^{10}C_2 = 90$ matches amongst the men and $2 \times {}^{10}C_1 \times {}^2C_1 = 40$ matches between one man and one woman.

Previous Year Solved Questions

1. Three flags, each of different colour, are available for a military exercise. Using these flags, different codes can be generated by waving
   1. single flag of different colours or
   2. any two flags in a different sequence of colour

   Or

   3. three flags in a different sequence of colours.

   The maximum number of codes that can be generated, is

   (a) 6 (b) 9
   (c) 15 (d) 18 **[CSAT 2003]**

2. A two member committee comprising of one male and one female member is to be constituted out of five males and three females. Amongst the females, Mrs. A refused to be a member of the committee in which Mr. B is taken as the member. In how many different ways can the committee be constituted ?

   (a) 11 (b) 12
   (c) 13 (d) 14 **[CSAT 2003]**

3. In a question of a test paper, there are five items each under List-A and List-B. The examinees are required to match each item under List-A with its corresponding correct item under List-B. Further, it is given that
   1. no examinee has given the correct answer.
   2. answers of no two examinees are identical.

   Which is the maximum number of examinees who took this test ?

   (a) 24 (b) 26
   (c) 119 (d) 129 **[CSAT 2004]**

4. Nine different letters are to be dropped in three different letter boxes. In how many different ways can this be done ?

   (a) 27
   (b) 3^9
   (c) 9^2
   (d) $3^9 - 3$ **[CSAT 2004]**

5. In how many different ways can six players be arranged in a line such that two of them, Ajit and Mukherjee, are never together ?

   (a) 120 (b) 240
   (c) 360 (d) 480 **[CSAT 2004]**

6. On a railway route between two places A and B, there are 20 stations on the way. If 4 new stations are to be added, how many types of new tickets will be required if each ticket is issued for a one way journey ?

   (a) 14 (b) 48
   (c) 96 (d) 108 **[CSAT 2005]**

7. 2 men and 1 woman board a bus in which 5 seats are vacant. One of these five seats is reserved for ladies. A women may or may not sit on the seat reserved for ladies but a man cannot sit on the seat reserved for ladies. In how many different ways can the five seats occupied by these passengers ?

   (a) 15 (b) 36
   (c) 48 (d) 60 **[CSAT 2005]**

8. A square is divided into 9 identical smaller squares. Six identical balls are to be placed in these smaller square such that each of the three rows gets at least one ball (one ball in one square only). In how many different ways can this be done ?

   (a) 27 (b) 36
   (c) 54 (d) 81 **[CSAT 2005]**

9. There are 10 identical coins and each one of them has 'H' engraved on its one face and 'T' engraved on its other face. These 10 coins are lying on a table and each one of them has 'H' face as the upper face. In one attempt, exactly four (neither more nor less) coins can be turned upside down. What is the minimum total number of attempts in which the 'T' faces of all the 10 coins can be brought to be the upper faces ?

   (a) 4 (b) 7
   (c) 8 (d) Not possible
   [CSAT 2005]

ANSWER KEY

1. (c)	10. (c)	19. (c)	28. (c)	37. (d)	46. (c)	55. (b)	64. (c)
2. (d)	11. (d)	20. (c)	29. (b)	38. (d)	47. (a)	56. (c)	65. (c)
3. (c)	12. (b)	21. (c)	30. (a)	39. (d)	48. (d)	57. (c)	66. (c)
4. (b)	13. (d)	22. (b)	31. (d)	40. (c)	49. (d)	58. (c)	67. (c)
5. (d)	14. (c)	23. (c)	32. (c)	41. (d)	50. (d)	59. (d)	68. (d)
6. (d)	15. (a)	24. (b)	33. (d)	42. (a)	51. (b)	60. (a)	69. (c)
7. (b)	16. (c)	25. (c)	34. (b)	43. (c)	52. (b)	61. (d)	70. (d)
8. (d)	17. (b)	26. (d)	35. (d)	44. (b)	53. (b)	62. (b)	71. (a)
9. (a)	18. (b)	27. (a)	36. (b)	45. (c)	54. (c)	63. (b)	

Hints and Solutions

1. 1. Number of ways of arranging three colours taken 1 at a time $= {}^3P_1 = \frac{3 \times 2!}{2!} = 3$.

   2. Number of ways of arranging three colours taken 2 at a time $= {}^3P_2 = \frac{3!}{1!} = 6$.

   3. Number of ways of arranging three colours taken 3 at a time $= {}^3P_3 = 6$.

   So, maximum number of codes = number of ways of arranging these flags = 3 + 6 + 6 = 15.

   Hence, option (c) is correct.

2. For each combination, let us name the females and males:

Female (3)	Male (5)
A	B
C	D
E	F
	G
	H

   Since A can't go with B, it will make team with four males in four ways AD, AF, AG, AH. Since there is no restriction with female C and E, they may combine with 5 males in 5 different ways each.

   So, total number of ways = 4 + 5 + 5 = 14

   Hence, option (d) is correct.

3. Since, answers of no. two examinees are identical, so first item in List-A can be matched with any of the 5 items in List-B. It can be done in 5 ways. Similarly, 2nd item in List-A can be matched with any of the remaining 4 items in List-B.

   It can be done in 4 ways.

   Continuing in the same way,

   No. of ways of arranging the items

   $= 5 \times 4 \times 3 \times 2 \times 1 = 120$

   Now, in this arrangement there is one such arrangement, which is the correct answer.

   So, maximum number of examinees = no. of ways of arrangement of items = 120 – 1 = 119

   Hence, option (c) is correct.

4. First letter can be dropped into any of the 3 boxes. It can be done in 3 ways.

   Similarly, second letter can also be dropped into any of the 3 boxes in 3 ways and so on.

   So, total number of ways = $3 \times 3 \times 3 \times \ldots$ up to 9 times $= 3^9$

   Hence, option (b) is correct.

5. Total number of ways of arrangement for six players = 6!

   Let us take Ajit and Mukerjee as one entity.

   So, now there are (6 – 2 + 1) = 5 players

   These 5 players can be arranged in 5! ways and Ajit and Mukerjee can be arranged among themselves in 2! ways.

   Thus, number of ways, when Ajit and Mukerjee are always together = 5! × 2!

   So, number of ways when they are never together = total number of ways – number of ways when they are always together

   $= 6! - (5! \times 2!)$

   $= 6 \times 5! - (5! \times 2!)$

   $= 5!\ (6 - 2) = 480$

   Hence, option (d) is correct.

6. For (10 + A + B) = 12 stations, number of tickets required, when 4 new stations are added for one way journey = 12 × 4 = 48

   Also, each 4 new stations require (16 – 1) = 15 new tickets for one way journey.

   Number of tickets for 4 new stations

   = 15 × 4 = 60

   So, total new tickets = 60 + 48 = 108

   Hence, option (d) is correct.

Similarly, for the third and fourth stripes, they cannot be the same colour as the stripe before them, so there are 2 options for each of them.

So, the total number of different ways to design the flag is $3 \times 2 \times 2 = 24$.

Hence, option (c) is correct.

70. There are five tasks that need to be assigned to five persons. Here two cases are possible.

Case 1: Task-2 is assigned to R.

Case 2: Task-2 is assigned to S.

Tasks	Case 1	Case 2
1	S or T. So, 2 possible ways	R or T. So, 2 possible ways
2	R	S
3	3 possible ways	3 possible ways
4	2 possible ways	2 possible ways
5	1 possible way	1 possible way

In case 1, total number of possible ways

$= 2 \times 1 \times 3 \times 2 \times 1 = 12$ ways.

In case 2, total number of possible ways

$= 2 \times 1 \times 3 \times 2 \times 1 = 12$ ways.

So, the assignment can be done in $12 + 12$

$= 24$ ways.

Hence, option (d) is correct.

71. All the possible values are given below :

$$\begin{array}{r} 1\ 2\ 3\ 4 \\ 1\ 2\ 4\ 3 \\ 1\ 3\ 2\ 4 \\ 1\ 3\ 4\ 2 \\ 1\ 4\ 2\ 3 \\ +1\ 4\ 3\ 2 \\ \hline 7\ 9\ 9\ 8 \end{array}$$

Hence, option (a) is correct.

Chapter 15 Probability

Introduction

Probability is the chance of occurrence of an event, mathematically it can be represented as percentage or fraction. Maximum chance and minimum chance of an event can be 100% and 0 respectively.

Mathematical formula of probability is given by, $p(E) = \frac{n(E)}{n(S)}$

Here, $n(S)$ is sample space and $n(E)$ is the required outcome.

EXAMPLES

1. If a fair coin is tossed. Find the probability of getting a head ?

Sol. Required probability $= \frac{1}{2}$.

2. What will be the sample space in case of (i) 2 coins, (ii) 3 coins, (iii) 2 dice ?

Sol. Total outcomes of n coins $= 2^n$ and total outcomes of n dice $= 6^n$.

(i) Sample space in case of 2 coins $= 2^2 = 4$ *i.e.*, (H, H), (H, T), (T, H) and (T, T).

(ii) Sample space in case of 3 coins $= 2^3 = 8$ *i.e.*,

$1 \rightarrow$ H H H
$2 \rightarrow$ H H T
$3 \rightarrow$ H T H
$4 \rightarrow$ H T T
$5 \rightarrow$ T H H
$6 \rightarrow$ T H T
$7 \rightarrow$ T T H
$8 \rightarrow$ T T T

(iii) Sample space in case of 2 dice $= 6^2 = 36$.

3. If 2 coins are tossed, find the probability of getting (i) at least 1 head, (ii) at most 2 tails, (iii) exactly 1 head.

Sol. Sample space in case of 2 coins $= 2^2 = 4$ i.e., (H, H), (H, T), (T, H) and (T, T)

(i) Probability of getting at least 1 head $= \frac{3}{4}$.

(ii) Probability of getting at most 2 tails $= 1$.

(iii) Probability of getting exactly 1 head $= \frac{2}{4} = \frac{1}{2}$.

Additional Questions from Other Competitive Exams

1. Two integers are picked at random from the first 15 positive integers without replacement. What is the probability that the sum of the two numbers is 20 ?

   (a) $\frac{3}{4}$ (b) $\frac{1}{21}$

   (c) $\frac{1}{105}$ (d) $\frac{1}{20}$

2. A fair die was thrown three times and the outcome was repeatedly six. If the die is thrown again what is the probability of getting six ?

   (a) $\frac{1}{6}$ (b) $\frac{1}{216}$

   (c) $\frac{1}{1296}$ (d) 1

3. Two students are solving the same problem independently. If the probability that the first one solves the problem is $\frac{3}{5}$ and the probability that the second solves the problem is $\frac{4}{5}$, what is the probability that at least one of them solves the problem ?

   (a) $\frac{17}{25}$ (b) $\frac{19}{25}$

   (c) $\frac{21}{25}$ (d) $\frac{23}{25}$

4. Out of 6 unbiased coins, 5 are tossed independently and they all result in heads. If the 6^{th} is now independently tossed, the probability of getting head is

   (a) 1

   (b) 0

   (c) $\frac{1}{2}$

   (d) $\frac{1}{6}$

5. 12 balls, 3 each of the colours red, green, blue and yellow are put in a box and mixed. If 3 balls are picked at random, without replacement, the probability that all 3 balls are of the same colour is

   (a) $\frac{1}{4}$ (b) $\frac{1}{12}$

   (c) $\frac{1}{36}$ (d) $\frac{1}{55}$

6. A multiple choice exam has 4 questions, each with 4 answer choices. Every question has only one correct answer. The probability of getting all answers correct by independent random guesses for each one is

   (a) $\frac{1}{4}$ (b) $\left(\frac{1}{4}\right)^4$

   (c) $\frac{3}{4}$ (d) $\left(\frac{3}{4}\right)^4$

7. A certain multiple choice question has four options of which at least one is correct. If a student answers at random choosing at least one option, what is the probability that the student selects the exact combination of correct option(s) ?

   (a) $\frac{1}{3}$ (b) $\frac{1}{4}$

   (c) $\frac{1}{12}$ (d) $\frac{1}{15}$

8. A box contains 10 red balls and 12 white balls. Two balls are drawn from the box at random, one by one without replacement. What is the probability that the second ball is red ?

   (a) $\frac{1}{2}$ (b) $\frac{5}{11}$

   (c) $\frac{3}{10}$ (d) $\frac{9}{16}$

Chapter 16 Data Interpretation

Pie-charts

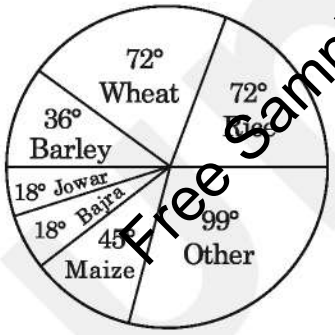
For a pie chart, the central angle is 360° that represents 100% of the value.

Hence, we have following table :

360° = 100%	3.6° = 1%	18° = 5%
180° = 50%	36° = 10%	54° = 15%
90° = 25%	72° = 20%	108° = 30%
45° = 12.5%	144° = 40%	

Pie-chart

Directions (1 to 5) : The pie-chart provided below gives the distribution of land (in a village) under various food crops. Study the pie-chart carefully and answer the questions that follow.



Distribution of areas (in acres) under various food crops.

1. Which combination of three crops contribute to 50% of the total area under the food crops ?
   (a) Wheat, Barley and Jowar
   (b) Rice, Wheat and Jowar
   (c) Rice, Wheat and Barley
   (d) Bajra, Maize and Rice

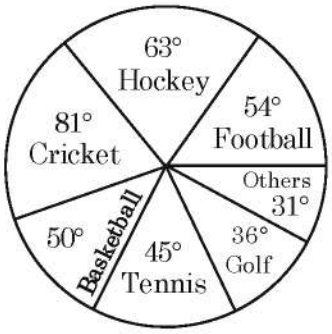
2. If the total area under Jowar was 1.5 million acres, then what the area (in million acres) under rice ?
   (a) 6 (b) 7.5
   (c) 9 (d) 4.5

3. If the production of wheat is 6 times that of barley, then what is the ratio between the yield per acre of wheat and barley ?
   (a) 3 : 2 (b) 3 : 1
   (c) 12 : 1 (d) 2 : 3

4. If the yield per acre of rice was 50% more than that of barley, then the production of barley is what percent of that of rice ?
   (a) 30% (b) $33\frac{1}{3}\%$
   (c) 35% (d) 36%

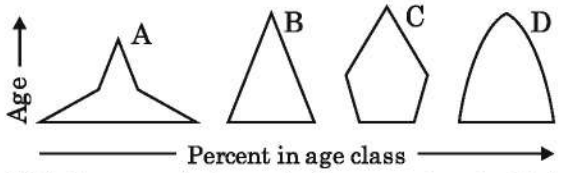
5. If the total area goes up by 5%, and the area under wheat production goes up by 12%, then what will be the angle for wheat in the new pie-chart ?
   (a) 62.4° (b) 76.8°
   (c) 80.6° (d) 84.2°

Directions (6 to 10) : Study the following graph carefully and answer the questions given below it. The pie-chart given below shows the spendings of a country on various sports during a particular year.



Previous Year Questions

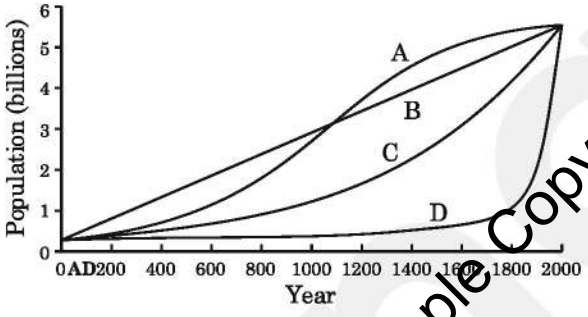
1. Consider the four age pyramids given below namely A, B, C and D representing four different countries.



Which one of them indicates the declining population ?

(a) A (b) B
(c) C (d) D **[CSAT 2011]**

2. The following figure has four curves namely A, B, C and D. Study the figure and answer the item that follows.

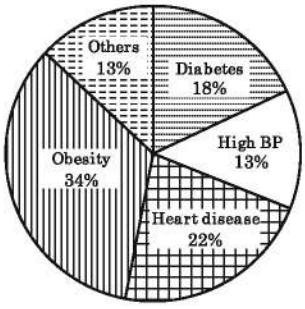


Which curve indicates the exponential growth?

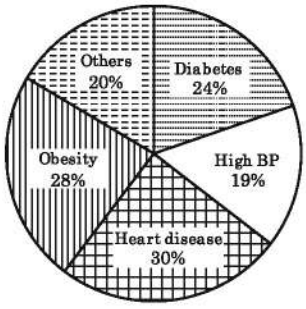
(a) A (b) B
(c) C (d) D **[CSAT 2011]**

Directions for the following 2 (two) items :

The following pie-charts show the break-up of disease categories recorded in the patients from two towns, Town A and Town B. Pie-charts plot the disease categories as percentage of the total number of patients. Based on these, answer the two items that follow the charts.



Distribution of diseases in Town-A



Distribution of diseases in Town-B

3. Which of the two towns has a higher number of persons with Diabetes ?

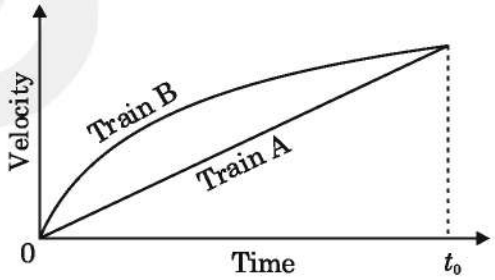
(a) Town A
(b) Town B
(c) Same in Town A and Town B
(d) No inference can be drawn **[CSAT 2011]**

4. What can we say about persons with more than one disease from these graphs ?

(a) There are likely to be persons with more than one disease in Town A.
(b) There are likely to be persons with more than one disease in Town B.
(c) There are likely to be persons with more than one disease in both Towns A and B.
(d) No inference can be drawn.

[CSAT 2011]

5. Consider the following Velocity-Time graph. It shows two trains starting simultaneously on parallel tracks.



With reference to the above graph, which one of the following statements is *not* correct ?

(a) Train B has an initial acceleration greater than that of Train A.
(b) Train B is faster than Train A at all times.
(c) Both trains have the same velocity at time t_0.
(d) Both trains travel the same distance in time t_0 units.

[CSAT 2011]

Logical Reasoning

Chapter 1 Number Series

CONCEPT :

Find the difference between consecutive terms and try to observe the pattern among them.

Types of series :

1. Addition, Subtraction
2. Multiplication, Division
3. Special series
4. Alternate series
5. Miscellaneous series

EXAMPLES

Addition, Subtraction

1. 21, 24, 32, 45, 63, ___

Sol: 21, 24, 32, 45, 63, (86)

+3 +8 +13 +18 +23

2. Find the missing term in the given series: 2, 8, 14, 24, 34, 48, ___

Sol: 2, 8, 14, 24, 34, 48, (62)

+6 +6 +10 +10 +14 +14

Multiplication, Division

3. 15, 30, 60, 120, 240, ___

Sol: 15, 30, 60, 120, 240, (480)

×2 ×2 ×2 ×2 ×2

4. 3, 6, 18, 72, ___

Sol: 3, 6, 18, 72, (360)

×2 ×3 ×4 ×5

5. 240, ___, 120, 40, 10, 2

Sol: 240, (240), 120, 40, 10, 2

×1 ×1/2 ×1/3 ×1/4 ×1/5

38. 2, 12, 36, 80, 150, ___
    (a) 194 (b) 210
    (c) 252 (d) 285

39. 0, 7, 26, ___, 124, 215
    (a) 51 (b) 37
    (c) 63 (d) 16

40. 24, 30, 33, 39, 51, ___
    (a) 57 (b) 69
    (c) 54 (d) 81

41. 1, 11, 21, 1211, 111221, ___
    (a) 312211 (b) 1112221
    (c) 1112222 (d) 1112131

Directions: In the following number series, a wrong term is given. Find out that wrong term.

42. 3, 4, 9, 22.5, 67.5, 202.5, 810
    (a) 4 (b) 9
    (c) 22.5 (d) 67.5

43. 108, 54, 36, 18, 9, 6, 4
    (a) 54 (b) 36
    (c) 18 (d) 9

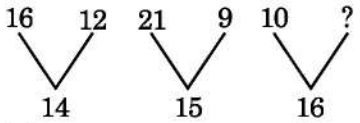
44. 3, 7.5, 15, 37.5, 75, 167.5, 375
    (a) 167.5 (b) 75
    (c) 37.5 (d) 15

ANSWER KEY

1. (b)	7. (c)	13. (d)	19. (c)	25. (a)	31. (a)	37. (c)	43. (d)
2. (d)	8. (c)	14. (b)	20. (c)	26. (d)	32. (a)	38. (c)	44. (a)
3. (a)	9. (b)	15. (c)	21. (a)	27. (b)	33. (c)	39. (c)	
4. (b)	10. (b)	16. (c)	22. (d)	28. (c)	34. (d)	40. (a)	
5. (a)	11. (c)	17. (b)	23. (c)	29. (d)	35. (a)	41. (a)	
6. (d)	12. (d)	18. (b)	24. (b)	30. (b)	36. (d)	42. (a)	

Chapter 2 Missing terms

In the following question, find missing number

1. 

(a) –21 (b) 12
(c) 32 (d) 22

2. 

(a) 60 (b) 68
(c) 55 (d) 65

3.

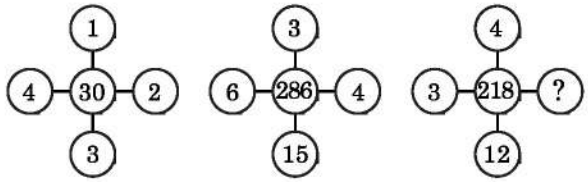
169	64	81	30
625	?	49	50
1296	576	100	70

(a) 324 (b) 289
(c) 441 (d) 361

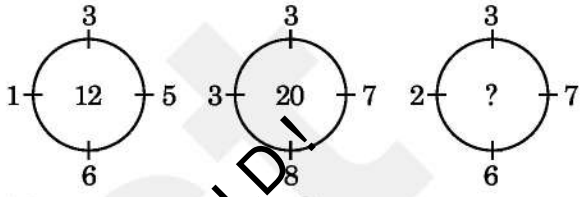
4.

3	4	5
2	3	4
1	2	3
14	29	?

(a) 50 (b) 30
(c) 40 (d) 32

5. 

(a) 6 (b) 7
(c) 9 (d) 12

6. 

(a) 10 (b) 15
(c) 20 (d) 25

7.

5		15
	26	?
49	89	147

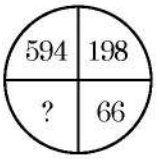
(a) 45 (b) 48
(c) 51 (d) 54

8. $\begin{pmatrix} 2 & 3 & 1 \\ 1 & 2 & -1 \\ 3 & 4 & ? \end{pmatrix}$
(a) 5 (b) 2
(c) 1 (d) 4

9.

3	4	5
4	5	3
4	3	?
48	60	105

(a) 2 (b) 6
(c) 7 (d) 9

10. 

(a) 22 (b) 33
(c) 11 (d) 44

22. 

(a) 10 (b) 11
(c) 12 (d) 13

23.

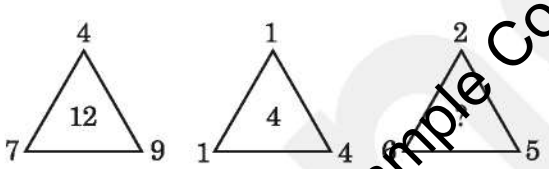
6	15	20
8	4	5
3	5	20
51	65	?

(a) 12 (b) 51
(c) 56 (d) 120

24.

5	4	7	8
6	9	5	10
3	7	2	?

(a) 1 (b) 4
(c) 3 (d) 6

25. 

(a) 9 (b) 28
(c) 13 (d) 3

26.

5	6	7
3	4	5
9	10	11
345	460	?

(a) 535 (b) 577
(c) 755 (d) 775

27. 

(a) U (b) C
(c) M (d) F

28.

3C	27D	9E
7I	28G	3M
4D	?	7J

(a) 28B (b) 28G
(c) 28F (d) 11G

ANSWER KEY

1. (d)	5. (b)	9. (c)	13. (b)	17. (c)	20. (d)	23. (d)	26. (b)
2. (d)	6. (b)	10. (a)	14. (b)	18. (d)	21. (c)	24. (d)	27. (d)
3. (a)	7. (b)	11. (d)	15. (d)	19. (c)	22. (b)	25. (a)	28. (b)
4. (a)	8. (a)	12. (c)	16. (c)				

Previous Year Solved Questions

1. Consider the following figures:

2	6
80	24

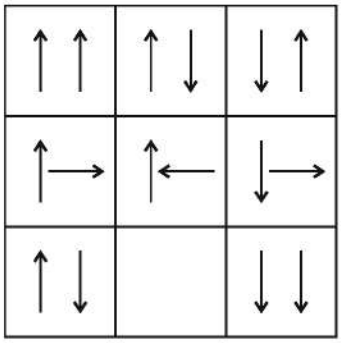
3	?
120	36

What is the missing number ?

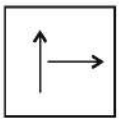
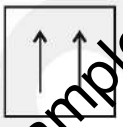
(a) 7 (b) 8

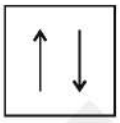
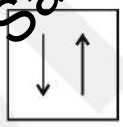
(c) 9 (d) 10 **[CSAT 2011]**

2. Consider the following matrix:



Which one of the following figures fits into the blank part of the above matrix ?

(a)  (b) 

(c)  

[CSAT 2014]

3. Consider the table given below in which the numbers bear certain relationship among themselves along the rows:

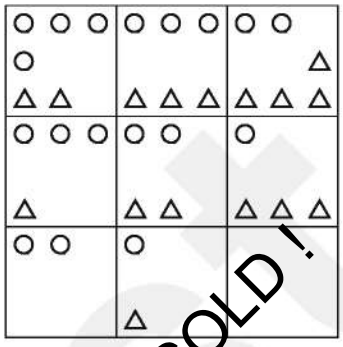
29	13	18
33	X	19
30	27	3

Which one of the following numbers is the missing number indicated above by X?

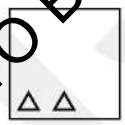
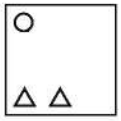
(a) 19 (b) 15

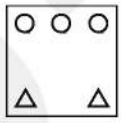
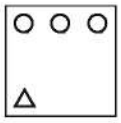
(c) 14 (d) 8 **[CSAT 2014]**

4. Consider the following matrix with one empty block in the lower extreme corner:



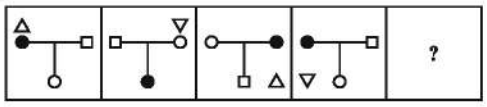
Which of the following figures could fit in the empty block and thus complete the matrix?

(a)  (b) 

(c)  (d) 

[CSAT 2014]

5. Consider the figure given below:



To fit the question mark, the correct answer is

(a)  (b) 

(c)  (d)  **[CSAT 2015]**

6. Consider the following matrix:

3	8	10	2	?	1
6	56	90	2	20	0

What is the missing number at '?' in the matrix?

(a) 5 (b) 0

(c) 7 (d) 3 **[CSAT 2015]**

Chapter 3 Clocks

Key points

- Dial of a clock is divided into 60 equal divisions which are known as minute spaces.
- A clock has two hands, the smaller one is called the hour hand and the larger one is called the minute hand (however, some clocks have second hand also but usually it is not taken into account since it moves all the time).
- There are 60 seconds in 1 minute and there are 60 minutes in 1 hour.
- Minute hand and hour hand coincide once in every 1 hour and 22 times in a day.
- Minute hand and hour hand are in opposite directions once in every 1 hour and 22 times in a day.
- Minute hand and hour hand subtend 90° twice in every 1 hour and 44 times in a day.
- Angle swiped by hour hand in 12 hours = 360° and in 1 hour = 30°.
- Angle swiped by minute hand in 60 minutes = 360° and in 1 minute = 6°.
- At 'n' o'clock, the difference between hour hand and minute hand is $5n$ divisions.
- In 1 hour, minute hand overtakes hour hand by 55 divisions.
- Minute hand overtakes hour hand by 55 divisions in 60 minutes. Hence, 1 division in $\frac{12}{11}$ minutes.

Angle between hour hand and minute hand:

$\left|\frac{11\,M - 60\,H}{2}\right|^{\circ}$; where, M = minute and H = hour.

EXAMPLES

1. Find out the angle swiped by an hour hand from 12 noon to 5:30 pm.

Sol: Angle swiped by hour hand in 1 hour = 30°. So, in 5.5 hours = 5.5 × 30° = 165°.

2. Find the angle between hour and minute hands of the clock at 8:30 ?

Sol: Angle between the hour hand and the minute hand of a clock is given by

$\left|\frac{11\,M - 60\,H}{2}\right|^{\circ}$; where, M = 8 and H = 30.

Substituting the values, we get $\left|\frac{11\times 30 - 60\times 8}{2}\right|^{\circ} = \left|\frac{330 - 480}{2}\right|^{\circ} = \left|\frac{150}{2}\right|^{\circ} = 75°$.

Practice Set

1. A clock is started at noon. By 10 minutes past 5, the hour hand has turned through
   (a) 145° (b) 150°
   (c) 155° (d) 160°

2. An accurate clock shows 8 O'clock in the morning. Through how many degrees will the hour hand rotate when the clock shows 2 O'clock in the afternoon ?
   (a) 144° (b) 150°
   (c) 168° (d) 180°

3. At 3:40, the hour hand and the minute hand of a clock form an angle of
   (a) 120° (b) 125°
   (c) 130° (d) 135°

4. The angle between the minute hand and the hour hand of a clock when the time is 8:30, is
   (a) 80° (b) 75°
   (c) 60° (d) 105°

5. The angle between the minute hand and the hour hand of a clock when the time is 4:20, is
   (a) 0° (b) 10°
   (c) 5° (d) 20°

6. At what angle the hands of a clock are inclined at 15 minutes past 5 ?
   (a) $58\frac{1}{2}°$ (b) 64°
   (c) $67\frac{1}{2}°$ (d) $72\frac{1}{2}°$

7. The reflex angle between the hands of a clock at 10:25 is
   (a) 180° (b) $192\frac{1}{2}°$
   (c) 195° (d) $197\frac{1}{2}°$

8. How many times do the hands of a clock coincide in a day ?
   (a) 20 (b) 21
   (c) 22 (d) 24

9. How many times in a day, the hands of a clock are straight ?
   (a) 22 (b) 24
   (c) 44 (d) 48

10. How many times are the hands of a clock at right angle in a day ?
    (a) 22 (b) 24
    (c) 44 (d) 48

11. How many times in a day, are the hands of a clock in straight line but opposite in direction ?
    (a) 20
    (b) 22
    (c) 24
    (d) 48

12. How much does a watch gains per day, if its hands coincide every 64 minutes ?
    (a) $32\frac{8}{11}$ minutes
    (b) $36\frac{5}{11}$ minutes
    (c) 90 minutes
    (d) 96 minutes

13. At what time, in minutes, between 3 O'clock and 4 O'clock, both the needles will coincide each other ?
    (a) $5\frac{1}{11}$ (b) $12\frac{4}{11}$
    (c) $13\frac{4}{11}$ (d) $16\frac{4}{11}$

14. At what time between 9 and 10 O'clock will the hands of a watch be together ?
    (a) 45 minutes past 9
    (b) 50 minutes past 9
    (c) $49\frac{1}{11}$ minutes past 9
    (d) $48\frac{2}{11}$ minutes past 9

25. The minute hand of a clock overtakes the hour hand at intervals of 65 minutes of the correct time. How much a day does the clock gain or lose ?

(a) $11\frac{10}{143}$ minutes in 24 hours.

(b) $12\frac{10}{143}$ minutes in 24 hours.

(c) $10\frac{10}{143}$ minutes in 24 hours.

(d) None of these

26. A watch which gains uniformly, is 5 minutes slow at 8 O'clock in the morning on Sunday and it is 5 minutes 48 seconds fast at 8 pm on following Sunday. When was it correct ?

(a) 20 minutes past 7 pm on Wednesday

(b) 15 minutes past 7 pm on Thursday

(c) 29 minutes past 8 pm on Wednesday

(d) 20 minutes past 7 pm on Thursday

27. A clock is set right at 5 am. The clock loses 16 minutes in 24 hours. What will be the true time when the clock indicates 10 pm on 4^{th} day ?

(a) 10 pm (b) 01 am

(c) 11 pm (d) 12 noon

28. A clock is set right at 8 am. The clock gains 10 minutes in 24 hours. What will be the true time when the clock indicates 1 pm on the following day ?

(a) 38 minutes past 1

(b) 1:50 pm

(c) 48 minutes past 1

(d) 48 minutes past 12

29. At what time after 4 O'clock, the hour and the minute hands will be lie opposite to each other ?

(a) 4 - 50′ - 31″

(b) 4 - 52′ - 51″

(c) 4 - 53′ - 23″

(d) 4 - 54′ - 33″

30. At one instant, the hour hand and the minute hand of a clock are one over the other in between the markings for 5 and 6 on the dial. At this instant, the tip of the minute hand

(a) is closer to the marking for 6

(b) is equidistant from the markings for 5 and 6

(c) is closer to marking for 5

(d) is equidistant from the markings for 11 and 12

31. What is the angle between the minute and hour hands of a clock at 7:35 ?

(a) 0°

(b) 17.5°

(c) 19.5°

(d) 20°

32. The time gap between the two instants, one before and one after 12.00 noon, when the angle between the hour hand and the minute hand is 66°, is

(a) 12 minutes

(b) 16 minutes

(c) 18 minutes

(d) 24 minutes

ANSWER KEY

1. (c)	5. (b)	9. (c)	13. (d)	17. (b)	21. (c)	25. (c)	29. (d)
2. (d)	6. (c)	10. (c)	14. (c)	18. (b)	22. (d)	26. (a)	30. (c)
3. (c)	7. (d)	11. (b)	15. (d)	19. (b)	23. (d)	27. (c)	31. (b)
4. (b)	8. (c)	12. (a)	16. (d)	20. (b)	24. (d)	28. (d)	32. (d)

Chapter 4 Calendar

Odd days

In a given period, the number of days more than the complete weeks are called *odd days*. Odd days are always between 0 - 6 days. If odd days are more than 7, then divide it by '7', remainder will be considered as number of odd days.

For example:

January has 3 odd days.

Since, January has 31 days *i.e.*, 28 days + 3 days which can be treated as 4 weeks + 3 days.

Or we can say that, the remainder when 31 is divided by 7 is considered as odd days *i.e.*, 3.

Similarly, April has 2 days.

For 100 years = 76 ordinary years + 24 leap years = $(76 \times 1 + 24 \times 2)$ odd days = 124 odd days

= (17 weeks + 5 days) = 5 odd days.

Number of odd days in 100 years = 5

Number of odd days in 200 years = $(5 \times 2) \equiv 3$ odd days.

Number of odd days in 300 years = $(5 \times 3) \equiv 1$ odd day.

Number of odd days in 400 years = $(5 \times 4 + 1) \equiv 0$ odd day.

Similarly, each one of 800 years, 1200 years, 1600 years, 2000 years etc. has 0 odd day.

Normal year

1. Contains 365 days.
2. Contains 52 weeks and 1 odd day (since $52 \times 7 = 364$, hence, 365^{th} day is considered as odd day).
3. An ordinary year starts and ends with the same day of the week.
4. First day of the year occurs '53' times and rest days occur '52' times in the year.

Leap year

1. Contains 366 days.
2. Contains 52 weeks and 2 odd days (since $52 \times 7 = 364$, hence 365^{th} and 366^{th} day are considered as odd days).
3. A leap year ends with the next day of the first day of the year.
4. First 2 days of the year occur '53' times and rest '52' times.
5. If a century year is a multiple of 400, then only it is a leap year else not and if a non-century year is a multiple of 4, then it is a leap year.

19. November 9. 1994 was a Wednesday. Then which of the following is true ?
    (a) November 9, 1965 is a Wednesday and November 9, 1970 is a Wednesday.
    (b) November 9, 1965 is not Wednesday and November 9, 1970 is a Wednesday.
    (c) November 9, 1965 is a Wednesday and November 9, 1970 is not a Wednesday.
    (d) November 9, 1965 is not a Wednesday and November 9, 1970 is not a Wednesday.

20. A certain day, which is x days before 17th August, is such that 50 days prior to that day, it was $4x$ days since March 30th of the same year. What is x ?
    (a) 18
    (b) 30
    (c) 22
    (d) 16

21. Ketan takes casual leave only on first working day of every month. The office has weekly offs on Saturday and Sunday. In a month of 30 days, the first working days happened to be Tuesday. What will be the day for his next casual leave ?
    (a) Wednesday (b) Thursday
    (c) Friday (d) Monday

22. Abhay gave an application for a new ration card to the clerk on Monday afternoon. Next day was a holiday. So the clerk cleared the papers on the next working day on resumption of duty. The senior clerk checked it on the same day but forwarded it to the head clerk on next day. The head clerk decided to dispose the case on the subsequent day. On which of the following day was the case put up to the head clerk by the senior clerk ?
    (a) Wednesday (b) Thursday
    (c) Friday (d) Saturday

ANSWER KEY

1.	(b)	4.	(a)	7.	(d)	10.	(c)	13.	(c)	16.	(c)	19.	(d)	21.	(b)				
2.	(c)	5.	(d)	8.	(a)	11.	(a)	14.	(c)	17.	(a)	20.	(a)	22.	(b)				
3.	(d)	6.	(c)	9.	(b)	12.	(b)	15.	(a)	18.	(a)								

Hints and solutions

1. Fifth day from 21st is 26th day.
   If 3rd is Monday, then after 21 days *i.e.*, 24th is also Monday. So, 26th is Wednesday.
   Hence, option (c) is correct.

2. To find minimum number of possible working days of any month of any year, let us consider February of non-leap year.
   Total number of days = 28 (4 weeks)
   Therefore, there will be 4 Saturdays and 4 Sundays.
   Number of holidays
   = 2 Saturdays + 4 Sundays = 6
   Number of working days = 28 – 6 = 22
   Hence, option (b) is correct.

3. Difference of day according to the dates given in the question = 28 days.
   So, on adding 28 days in the given days,
   4/12/95 + 28 days = 1/1/96
   1/1/96 + 28 days = 29/1/96
   29/1/96 + 28 days = 26/2/96
   26/2/96 + 28 days = 25/3/96
   Thus, the next term of the series = 25/3/96.
   Hence, option (b) is correct.

4. 5th Monday of April is possible only on two dates : 29th April or 30th April.
   Case 1 : 29th April Monday
   Number of days from 30th April to 1st November
   = (1 + 31 + 30 + 31 + 31 + 30 + 31 + 1) = 186 days
   Number of odd days = 186 ÷ 7 = 26 weeks and 4 odd days
   1 November = Friday
   29th November and 30th November are Friday and Saturday respectively.
   So, in this case 5th Thursday is not possible.
   Case 2 : 30th April Monday
   Number of days from 1st May to 1st November
   = (31 + 30 + 31 + 31 + 30 + 31 + 1) = 185 days
   Number of odd days = 185 ÷ 7 = 26 weeks and 3 odd days
   So, 1st November will be Thursday.
   Therefore, 29th November will be 5th Thursday.
   Birthday of second child is on 29th November.
   Thursdays in December = 6th December, 13th December, 20th December, 27th December.
   So, Thursday is the correct answer.
   Hence, option (b) is correct.

5. We know that, calendar of a year which is just after a leap year repeats after 6 years, and that of a year which is just before a leap year, repeats after 11 years provided non-leap century should not come in between.
   So, calendar of 2009 will be repeated in 2015.
   Hence, option (d) is correct.

6. For any leap year the calendar of January and July is exactly same.
   Hence, option (c) is correct.

7. Statement 1:
   The last day of the month is Wednesday.
   From this we cannot determine that the month is of 28 days or 29 or 30 or 31 days.
   So, this statement is not sufficient to answer the question.
   Statement 2:
   The third Saturday of the month was the 17th day. Means, 17th is Saturday.
   Thus, we can find the day 14th *i.e.*, Wednesday.
   So, Statement-2 alone is sufficient to answer the Question.
   Hence, option (b) is correct.

8. We need to find the day on 10th October 2027,
   10.10.2027 = 2026 years + period from 1.1.2027 to 10.10.2027.
   Counting number of odd days :
   The number of odd days in 2000 years
   = 0. (odd days is 0 for every 400 years)

Number of odd days in 26 years = 6 leap years + 20 ordinary years

$= 6 \times 2 + 20 \times 1 = 32$ days = 4 weeks + 4 days

= 4 odd days.

Number of odd days from 1.1.2027 to 10.10.2027 = 31(Jan) + 28(Feb) + 31(March) + 30(April) + 31(May) + 30(June) + 31(July) + 31(Aug) + 30(Sep) + 10(Oct)

= 283 days = 40 weeks + 3 days = 3 odd days

Total number of odd days till 10.10.2027

= 4 + 3 = 0 odd days.

Therefore, the day on 10^{th} October 2027 is Sunday.

Hence, option (a) is correct.

9. LCM (5, 24, 9) = 360

So, all three will meet 360^{th} day.

Now as 1^{st} time they meet is on Sunday which occurs after every 7 days.

$360 = 51 \times 7 + 3$

357^{th} day will be Sunday and hence, 360^{th} day will be on Wednesday.

Hence, option (b) is correct.

10. Lets find the day on 31^{st} May 2099

Number of odd days:

2000 years = 0

98 years = 3

January = 3

February = 0

March = 3

April = 2

May = 3

Total number of odd days

= 3 + 3 + 3 + 2 + 3 = 14

So, 31st May 2099 is Sunday

Thus, 7^{th} June 2099 will be Sunday

Hence, the correct option is (d) *i.e.*, 7.

11. Let $x = 1$

x weeks $= 7 \times 24 \times 60 \times 60$

x days $= 24 \times 60 \times 60$

x hours $= 60 \times 60$

x minutes $= 60$

x seconds $= 1$

$60 \times 60\ [(7 \times 24) + 24 + 1] + 61$

61 unit digit will be 1 so option (a) and (c) eliminated.

Doing calculation $694861x$.

Hence, option (d) is correct.

12. We know that, calendar of a year which is just after a leap year repeats after 6 years, and that of a year which is just before a leap year, repeats after 11 years provided non-leap century should not come in between.

So, calendar of 2025 will be repeated in 2031.

Hence, option (c) is correct.

Chapter 5 Cubes & Dice

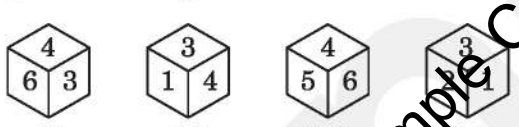
Important facts:

1. A cube has 6 square faces (sides), 8 vertices and 12 edges.
2. Only 3 sides of a cube are visible at a time (known as "Joint Sides") and these sides can never be on the opposite side of each other.
3. Things that are shaped like a cube are often referred to as 'cubic'.
4. Most dice are cube shaped, with the numbers 1 to 6 on the different faces.
5. The adjacent faces of a dice cannot be opposite to each other.
6. A dice where the sum of opposite faces is always 7, known as standard dice / normal dice.

Non-standard Dice:

Case 1: When 4 positions are given.

We need to check the most visible face and we know the adjacent faces of a dice cannot be opposite to each other, with the help this observation we can find which face is opposite to which one.

E.g. 

(i) (ii) (iii) (iv)

Sol. The most visible faces here is 3 and 4.

Corresponding to 3:

According to the position (i): 4 and 6 cannot be opposite to 3.

According to the position (ii): 4 and 1 cannot be opposite to 3.

According to the position (iv): 1 and 2 cannot be opposite to 3.

Hence, 5 will be opposite to 3.

Corresponding to 4:

According to the position (i): 6 and 3 cannot be opposite to 4.

According to the position (ii): 1 and 3 cannot be opposite to 4.

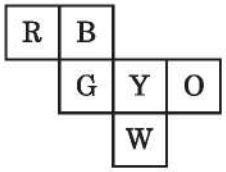
According to the position (iii): 5 and 6 cannot be opposite to 4.

Hence, 2 will be opposite to 5.

And the rest 2 faces will be opposite to each other *i.e.*, 1 is opposite to 6.

Previous Year Solved Questions

1. Six squares are coloured, front and back, red (R), blue (B), yellow (Y), green (G), white (W) orange (O) and are hinged together as shown in the figure below. If they were folded to form a cube, what would be the face opposite to white face ?

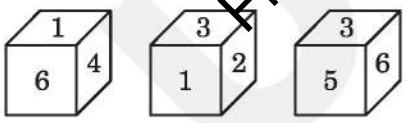


(a) R (b) G
(c) B (d) O **[CSAT 2012]**

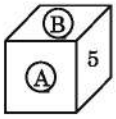
2. The views of a cube following a particular motion are given below:

What is the letter opposite to A ?
(a) H
(b) P
(c) B
(d) M **[CSAT 2012]**

3. A cube has six numbers marked 1, 2, 3, 4, 5 and 6 on its faces. Three views of the cube are shown below:



What possible number can exist on the two faces marked Ⓐ and Ⓑ, respectively on the cube ?



(a) 2 and 3
(b) 6 and 1
(c) 1 and 4
(d) 3 and 1 **[CSAT 2013]**

4. Each of the six different faces of a cube has been coated with a different colour *i.e.*, V, I, B, G, Y and O. Following information is given:
   1. Colours Y, O and B are on adjacent faces.
   2. Colours I, G and Y are on adjacent faces.
   3. Colours B, G and Y are on adjacent faces

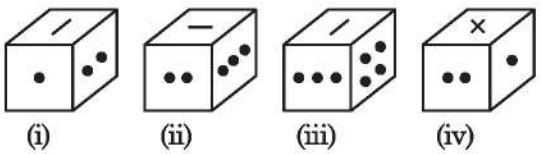
Which is the colour of the face opposite to the face coloured with O ?
(a) B (b) V
(c) G (d) I **[CSAT 2015]**

5. A cube has all its faces painted with different colours. It is cut into smaller cubes of equal sizes such that the side of the small cube is one-fourth the big cube. The number of small cubes with only one of the sides painted is
(a) 32 (b) 24
(c) 16 (d) 8 **[CSAT 2016]**

6. The outer surface of a 4 cm × 4 cm × 4 cm cube is painted completely in red. It is sliced parallel to the faces to yield sixty four 1 cm × 1 cm × 1 cm small cubes. How many small cubes do not have painted faces ?
(a) 8 (b) 16
(c) 24 (d) 36 **[CSAT 2017]**

Directions for the following 3 (three) items:

Rotated positions of a single solid are shown below. The various faces of the solid are marked with different symbols like dots, cross and line. Answer the three items that follow the given figures.

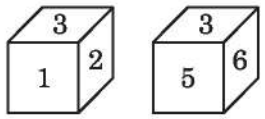


7. What is the symbol on the face opposite to that containing a single dot ?
(a) Four dots
(b) Three dots
(c) Two dots
(d) Cross **[CSAT 2018]**

Hints and solutions

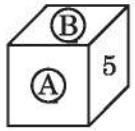
1. Here, Yellow (Y) is adjacent to B, G, O and W.
So, Y is opposite to Red (R) and Green (G) is opposite to Orange (O).
Thus, Blue (B) would be the face opposite the White (W) face.
Hence, option (c) is correct.

2. From figure (1) and (2):
A, B, M and H are adjacent to K.
So, P will be opposite K.
From figure (1) and (3):
A, K, P and H are adjacent to B.
So, M will be opposite B.
From figure (2) and (3):
P, M, B and K are adjacent to H.
So, A will be opposite H.
Thus, H is opposite A
Hence, option (a) is correct.

3. 

(ii) (iii)

From the two cubes shown above, it is clear that,
1 is opposite to 5,
2 is opposite to 6,
3 is opposite to 4.



Only option (a) does not have number 1, while other options have number 1.
So, it is very clear that option (a), *i.e.*, 2 and 3 are the possible numbers that can exist on the two faces marked on the cube.
Hence, option (a) is correct.

4. The dice positions based on the given data:

(i) (ii) (iii) (iv)

In the first and the second figure O and G both are adjacent to B and Y. Implies, both O and G must be on opposite faces.
So, G is opposite O.
Hence, option (c) is correct.

5. Here, $n = 4$, we know that
Cubes with 2 side painting = $6(n-2)^2$.
$= 6(4-2)^2 = 6(2)^2 = 6 \times 4 = 24$
Hence, option (b) is correct.

6. Here, $n = 4$, we know that
Cubes with no side painted = $(n-2)^3$.
$= (4-2)^3 = (2)^3 = 8$
Hence, option (a) is correct.

7. According to the given figures, we can conclude
2 dots are opposite to 4 dots.
1 dot is opposite to 3 dots.
(×) is opposite to (–)
Hence, option (b) is correct.

8. Here, option (c) is correct.

9. Here, option (c) is correct.

10. Here, $n = 3$, we know that
Cubes with 2 sides painting = $12(n-2)$.
$= 12(3-2) = 12(1) = 12$
Hence, option (a) is correct.

11. Let each side of the original cube be 12 units.
According to the question,
The cube is cut into 36 cubes such that 32 cubes are small and 4 cubes are big.
Each of 32 small cubes will have sides of 3 units.
Each of 4 big cubes will have sides of 6 units each.

Chapter 6 Blood relation

EXAMPLES

1. Pointing to a photograph X said to Y, "she is the only daughter of the father of my mother". How X is related to the person of the photograph ?

Sol: 'The only daughter of the father of X's mother' means the mother of X.
Hence, X is the child of the lady in the photograph.
But we do not know about the gender of X. He could be the son or the daughter.

2. Pointing towards a girl, Abhishek says, "This girl is the daughter of only child of my father." What is the relation of Abhishek's wife to that girl ?

Sol: The girl is Abhishek's daughter. So, Abhishek's wife is mother to that girl.

3. Pointing to a person, Deepak said, "His only brother is the father of my daughter's father". How is the person related to Deepak ?

Sol: Father of Deepak's daughter's father is Deepak's father.
Hence, the person is the brother of Deepak's father. So, the person is the uncle of Deepak.

4. If A is brother of B; B is sister of C; C is father of D, how D is related to A ?

Sol: If D is Male, the answer is Nephew. If D is Female, the answer is Niece.
As the gender of D is not known, hence, the relation between D and A cannot be determined.

5. If D is Brother of B, how B is related to C? To answer this question, which of the statements is/are necessary ?
1. The son of D is the grandson of C.
2. B is the sister of D.

Sol: Given that, D is the brother of B.
From statement-1, we can say that D is son of C (son of D is the grandson of C).
From statement-2, we can say that B is 'Female' (sister of D). Thus, B is the daughter of C.

6. If Sangeeta's daughter is my daughter's mother, then how am I related to Sangeeta ?

Sol: Here 'I' can be male as well as female. If we consider 'I' as male, then the relation is Son-in-law and if we consider 'I' as female the relation is daughter. So, it can be a son in law or daughter.

Practice Set

1. Pointing to a photograph of a boy Suresh said, "He is the son of the only son of my mother." How is Suresh related to that boy ?
   (a) Brother (b) Uncle
   (c) Cousin (d) Father

2. If A is the brother of B; B is the sister of C; and C is the father of D, how D is related to A ?
   (a) Brother
   (b) Sister
   (c) Nephew
   (d) Cannot be determined

3. Introducing a boy, a girl said, "He is the son of the daughter of the father of my uncle." How is the boy related to the girl ?
   (a) Brother (b) Nephew
   (c) Uncle (d) Son-in-law

4. Deepak said to Nitin, "That boy playing with the football is the younger of the two brothers of the daughter of my father's wife." How is the boy playing football related to Deepak ?
   (a) Son
   (b) Brother
   (c) Cousin
   (d) Brother-in-law

5. Veena who is the sister-in-law of Ashok, is the daughter-in-law of Kalyani. Dheeraj is the father of Sudeep who is the only brother of Ashok. How Kalyani is related to Ashok ?
   (a) Mother-in-law
   (b) Aunt
   (c) Wife
   (d) None of these

6. Pointing to a woman, Abhijit said, "Her granddaughter is the only daughter of my brother." How is the woman related to Abhijit ?
   (a) Sister
   (b) Grandmother
   (c) Mother-in-law
   (d) Mother

7. A and B are children of D. Who is the father of A? To answer this question, which of the statements 1 and 2 is necessary ?
   1. C is the brother of A and the son of E.
   2. F is the mother B.
   (a) Only 1 (b) Only 2
   (c) Either 1 or 2 (d) Both 1 and 2

8. Anil, introducing a girl in a party, said, she is the wife of the grandson of my mother. How is Anil related to the girl ?
   (a) Father (b) Grandfather
   (c) Husband (d) Father-in-law

9. Introducing Rajesh, Neha said, "His brother's father is the only son of my grandfather." How Neha is related to Rajesh ?
   (a) Sister (b) Daughter
   (c) Mother (d) Niece

10. A man said to a woman, "Your brother's only sister is my mother." What is the relation of the woman with the maternal grandmother of that man ?
    (a) Mother (b) Sister
    (c) Niece (d) Daughter

11. Pointing to a photograph, a lady tells Pramod, "I am the only daughter of this lady and her son is your maternal uncle." How is the speaker related to Pramod's father ?
    (a) Sister-in-law
    (b) Wife
    (c) Neither (a) nor (b)
    (d) Aunt

12. Deepak said to Nitin, "That boy playing with the football is the younger of the two brothers of the daughter of my father's wife." How is the boy playing football related to Deepak ?
    (a) Son
    (b) Brother
    (c) Cousin
    (d) Nephew

Previous Year Solved Questions

Read the following passage and answer the **3 (three)** items that follow:

A, B, C, D and E are members of the same family. There are two fathers, two sons, two wives, three males and two females. The teacher was the wife of a lawyer who was the son of a doctor. E is not a male, neither also a wife of a professional. C is the youngest person in the family and D is the eldest. B is a male.

1. How is D related to E ?
   (a) Husband
   (b) Son
   (c) Father
   (d) Wife **[CSAT 2011]**

2. Who are the females in the group ?
   (a) C and E
   (b) C and D
   (c) E and A
   (d) D and E **[CSAT 2011]**

3. Whose wife is the teacher ?
   (a) C
   (b) D
   (c) A
   (d) B **[CSAT 2011]**

4. Given that,
   1. A is the brother of B.
   2. C is the father of A.
   3. D is the brother of E.
   4. E is the daughter of B.

   Then the uncle of D is
   (a) A
   (b) B
   (c) C
   (d) E **[CSAT 2012]**

5. Four persons A, B, C and D consisting of two married couples are in a group. Both the women are shorter than their respective husbands. A is the tallest among the four. C is taller than B. D is B's brother. In this context, which one of the following statements is ***not*** correct ?
   (a) All four have family ties.
   (b) B is the shortest among the four.
   (c) C is taller than D.
   (d) A is B's husband. **[CSAT 2015]**

6. Consider the following:
   A + B means A is the son of B.
   A – B means A is the wife of B.
   What does the expression P + R – Q mean ?
   (a) Q is the son of P.
   (b) Q is the wife of P.
   (c) Q is the father of P.
   (d) None of the above **[CSAT 2017]**

7. Consider the following relationships among members of a family of six persons A, B, C, D, E and F:
   1. The number of males equals that of females.
   2. A and E are sons of F.
   3. D is the mother of two, one boy and one girl.
   4. B is the son of A.
   5. There is only one married couple in the family at present.

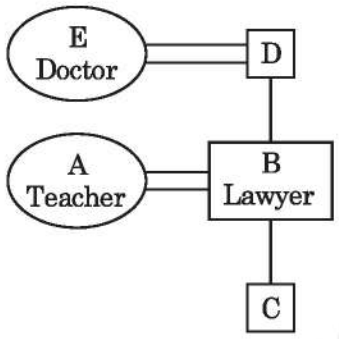
   Which one of the following inferences can be drawn from the above ?
   (a) A, B and C are all females.
   (b) A is the husband of D.
   (c) E and F are children of D.
   (d) D is the daughter of F. **[CSAT 2017]**

Hints and solutions

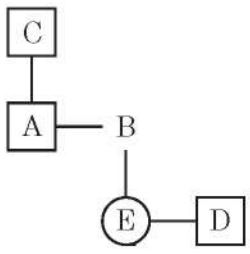
Family tree and their symbols:

Diagram	Meaning
◯	Female
□	Male
=	Married couple
—	Siblings
|	Difference of a generation

Diagram for solutions 1 to 3:



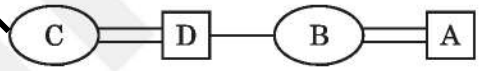
1. Hence, option (a) is correct.
2. Hence, option (c) is correct.
3. So, B's wife is teacher.
   Hence, option (d) is correct.
4. By using the symbols in the table given below, we can draw the following family tree:
   According to the given information:
   1. A is the brother of B.
   2. C is the father of A.
   3. D is the brother of E.
   4. E is the daughter of B.



From the family tree it is clear that A is the Uncle of D.

Hence, option (a) is correct.

5. 1. A is the tallest among the four.
      Implies, A is a male.
   2. D is B's brother. Implies, D is also a male.
   3. Both the women are shorter than their respective husbands.
      It further implies that D is married to C as B and C are the two females. Hence, A is married to B.
   4. C is taller than B.
      Also, as D is the husband of C. Implies, D is taller than C who is taller than B.
      A > D > C > B



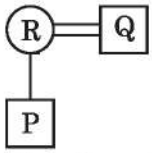
All four have family ties, B is the wife of A and B is the shortest of all.

So, C is not taller than D.

Thus, C being taller than D is the wrong statement.

Hence, option (c) is correct.

6. According to the given information we can have the following family tree.



Therefore, Q is the father of P.

Hence, option (c) is correct.

7. Since the number of males equals that of females. So, there are 3 males and 3 females.
   A and E are sons of F. B is the son of A. This means that A, B and E are males and C, D and F are females.
   Also, it is given that there is only one married couple in the family at present. It will be A and D.

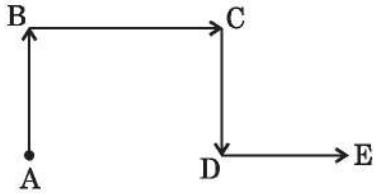
Chapter 7 Direction sense

EXAMPLES

1. If someone goes north, turns right then turns right again and then goes to the left. In which direction is the person now ?

Sol: The movements indicated are as shown in the figure (A to B, B to C, C to D and D to E).

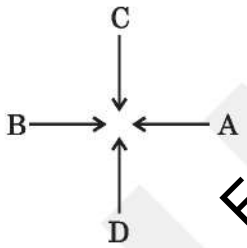
Thus, E lies to the east of A.



So, person is the east direction now.

2. A, B, C and D are playing cards. A and B are partners. D faces towards North. If A faces towards the West, then in which direction C is facing (Assume that partners are facing each other) ?

Sol: As per the data D faces North, A faces towards west. So, its partner B will face towards A and hence towards East. So, C who will face D will face towards south.



3. If at 4:30 pm, the minute hand of a clock points towards East, in which direction the hour hand points ?

Sol:

At 4:30 pm, the minute hand is pointing South in the diagram. But according to the question, it is pointing East. It means the clock has been rotated through 90° clockwise.

So, hour hand will point North-East.

Practice Set

1. Q travels towards East. M travels towards North. S and T travel in opposite directions. T travels towards right of Q. Which of the following is definitely true ?
   (a) M and S travel in the opposite directions.
   (b) S travels towards West.
   (c) T travels towards North.
   (d) M and S travel in the same direction.

2. P, Q, R, S and T are sitting around a circular table. R is to the immediate right of P and is second to the left of S. T is not between P and S. Who is second to the left of R ?
   (a) S (b) T
   (c) Q (d) Data inadequate

3. Of the five villages P, Q, R, S and T situated close to each other, P is to west of Q, R is to the south of P, T is to the north of Q, and S is to the east of T. Then, R is in which direction with respect to S ?
   (a) North-West (b) South-East
   (c) South-West (d) Data inadequate

4. M is to the East of D, F is to the South of D and K is to the West of F. M is in which direction with respect ot K ?
   (a) South-West
   (b) North-West
   (c) North-East
   (d) South-East

5. After 4 pm on a sunny day when Ramesh was returning from his school, he saw his uncle coming in the opposite direction. His uncle talked to him for some time. Ramesh saw that the shadow of his uncle was to his right side. Which direction was his uncle facing during their talk ?
   (a) North
   (b) South
   (c) East
   (d) Data inadequate

6. Alok walked 30 metres towards east and took a right turn and walked 40 metres. He again took a right turn and walked 50 metres. Towards which direction is he from his starting point ?
   (a) South (b) West
   (c) South-West (d) South-East

7. Ruchi's house is to the right of Vani's house at a distance of 20 metres in the same row facing North. Shabana's house is in the North-East direction of Vani's house at a distance of 25 metres. Determine that Ruchi's house is in which direction with respect of Shabana's house.
   (a) North-East (b) East
   (c) South (d) West

8. Y is to the East of X, which is to the North of Z. If P is to the South of Z, then P is in which direction with respect to Y ?
   (a) North (b) South
   (c) South-East (d) None of these

9. One afternoon, Manisha and Madhuri were talking to each other face to face in Bhopal on M.G. Road. If Manisha's shadow was exactly to the left of Madhuri, which direction was Manisha facing ?
   (a) North
   (b) South
   (c) East
   (d) Data inadequate

10. 'X' started walking straight towards South. He walked a distance of 5 metres and then took a left turn and walked a distance of 3 metres. Then he took a right turn and walked a distance of 5 metres again. 'X' is facing which direction now ?
    (a) North-East
    (b) South
    (c) North
    (d) South-West

Previous Year Solved Questions

1. The houses of A and B face each other on a road going north-south, A's being on the western side. A comes out of his house, turns left, travels 5 km, turns right, travels 5 km to the front of D's house. B does exactly the same and reaches the front of C's house. In this context, which one of the following statements is *correct* ?
   (a) C and D live on the same street.
   (b) C's house faces south.
   (c) The houses of C and D are less than 20 km apart.
   (d) None of the above **[CSAT 2011]**

2. Consider the following statements:
   There are six villages A, B, C, D, E and F.
   F is 1 km to the west of D.
   B is 1 km to the east of E.
   A is 2 km to the north of E.
   C is 1 km to the east of A.
   D is 1 km to the south of A.
   Which three villages are in a line ?
   (a) A, C, B (b) A, D, E
   (c) C, B, F (d) E, B, D **[CSAT 2014]**

3. Location of B is north of A and location of C is east of A. The distances AB and AC are 5 km and 12 km respectively. The shortest distance (in km) between the locations B and C is
   (a) 60 (b) 13
   (c) 17 (d) 7 **[CSAT 2014]**

4. Shahid and Rohit start from the same point in opposite directions. After each 1 km, Shahid always turns left and Rohit always turns right. Which of the following statements is correct ?
   (a) After both have travelled 2 km, the distance between them is 4 km.
   (b) They meet after each has travelled 3 km.
   (c) They meet for the first time after each has travelled 4 km.
   (d) They go on without ever meeting again. **[CSAT 2015]**

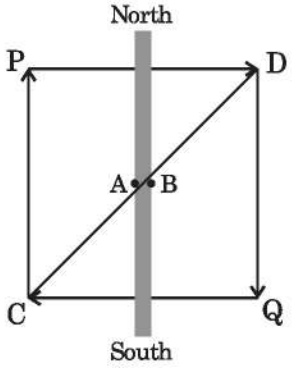
5. A person X was driving in a place where all roads ran either north-south or east-west, forming a grid. Roads are at a distance of 1 km from each other in a parallel. He started at the intersection of two roads, drove 3 km north, 3 west and 4 km south. Which further route could bring him back to his starting point, if the same route is not repeated ?
   (a) 3 km east, then 2 km south
   (b) 3 km east, then 1 km north
   (c) 1 km north, then 2 km west
   (d) 3 km south, then 1 km north **[CSAT 2016]**

6. A person walks 12 km due north, then 15 km due east, after that 19 km due west and then 15 km due south. How far is the from the starting point ?
   (a) 5 km (b) 9 km
   (c) 37 km (d) 61 km **[CSAT 2016]**

7. P, Q and R are three towns. The distance between P and Q is 60 km, whereas the distance between P and R is 80 km. Q is in the West of P and R is in the South of P. What is the distance between Q and R ?
   (a) 140 km
   (b) 130 km
   (c) 110 km
   (d) 100 km **[CSAT 2019]**

8. 'A' started from his house and walked 20 m towards East, where his friend 'B' joined him. They together walked 10 m in the same direction. Then 'A' turned left while 'B' turned right and travelled 2 m and 8 m respectively. Again 'B' turned left to travel 4 m followed by 5 m to his right to reach his office. 'A' turned right and travelled 12 m to reach his office. What is the shortest distance between the two offices ?
   (a) 15 m
   (b) 17 m
   (c) 19 m
   (d) 20 m **[CSAT 2019]**

Hints and solutions

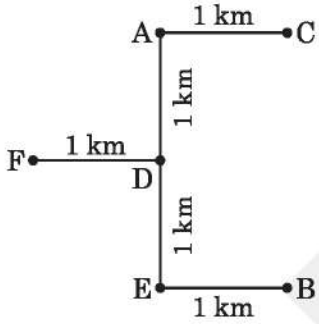
1. 

PCQD is a square with the sides 10 km each.

CD = diagonal of square PCQD

$$= \sqrt{10^2 + 10^2} = 10\sqrt{2} < 20 \text{ km}$$

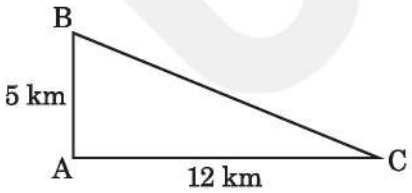
Hence, option (c) is correct.

2. 

So, A, D and E are in a line.

Hence, option (b) is correct.

3. The direction distance diagram is given below:



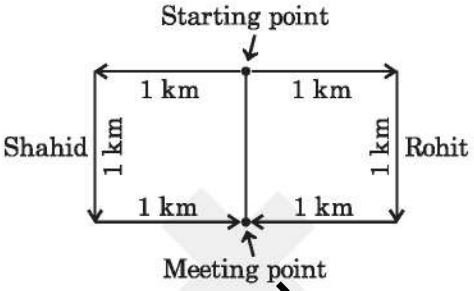
Using the Pythagoras Theorem, we get

$$BC = \sqrt{AB^2 + AC^2}$$

$$BC = \sqrt{5^2 + 12^2} = \sqrt{25 + 144} = \sqrt{169} = 13 \text{ km}$$

So, the shortest distance between the locations B and C is 13 km.

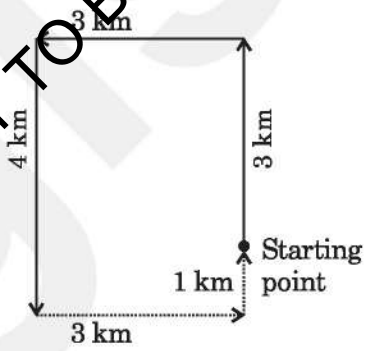
Hence, option (b) is correct.

4. 

So, they would meet each other after travelling 3 km each.

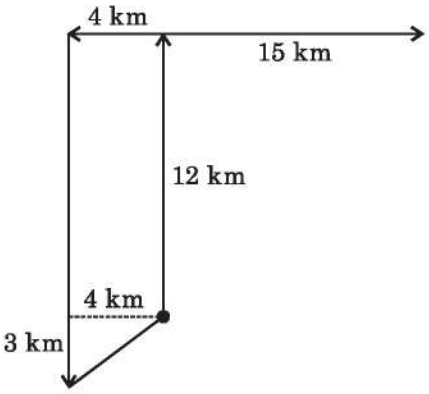
Hence, option (b) is correct.

5. The direction distance diagram is given below:



So, the person will have to go 3 km towards the east, then 1 km towards the north to reach his starting point. Hence, option (b) is correct.

6. The direction distance diagram is given below:



Using the Pythagoras Theorem, the distance between the initial and final point

$$= \sqrt{3^2 + 4^2} = \sqrt{25} = 5 \text{ km}$$

Hence, option (a) is correct.

Chapter 8 Coding Decoding

1. If, in a code, MIND becomes KGLB and ARGUE becomes YPESC, then what will DIAGRAM be in that code ?
   (a) BGYEPYK (b) BGYPYEK
   (c) GLPEYKB (d) LKBGYPK

2. If GOLD is coded as HOME, COME is coded as DONE and CORD is coded as DOSE, how would you code SONS ?
   (a) TPOT (b) TOOT
   (c) TOOS (d) TONT

3. In a certain code, KAVERI is written as VAKIRE. How is MYSORE written in that code ?
   (a) EROSYM (b) SYMROE
   (c) SYMEOR (d) None of these

4. In a certain code language, GERMINATION is written as IMGRENNOAIT. How is ESTABLISHED written in that code ?
   (a) BEATSLADEIHS
   (b) BAETSLEDISH
   (c) BATESLADEIHS
   (d) BAETSLDEIHS

5. In a certain code language, BOARD is written as EQBNC. How will the word CLIMB be written in that language ?
   (a) CLJKH (b) DKJLF
   (c) DNHMB (d) FNJRO

6. In a certain code, the words COME AT ONCE were written as XLNVZGLMXV. In the same code, which of the following could code OK ?
   (a) KL (b) LM
   (c) KM (d) LP

7. If EHFNRQ is the code for BECKON, which word has the code QDFWXULQ ?
   (a) NCQUTIRN (b) NACUTIRN
   (c) NATCRIUN (d) NACTURIN

8. If in a certain language, TRIANGLE is coded as SQHZMFKD, which word would be coded as DWZLOKD ?
   (a) EXAMPLE (b) FIGMENT
   (c) DISMISS (d) DISJOIN

9. If fulfnhw is the code for cricket, then eulgh is the code for which word ?
   (a) PRIDE (b) BRIDE
   (c) BLADE (d) BLIND

10. If in a certain language, itnietam is the code for intimate, which word has the code trevnietarbi ?
    (a) INVRETIBRATE
    (b) INVERTIBARTE
    (c) INVERTIBRETA
    (d) INVERTIBRATE

11. If in a certain language, MACHINE is coded as LBBIHOD, which word would be coded as SLTMFNB ?
    (a) RKSLEMA (b) RKULGMC
    (c) RMSNEOA (d) TMUNGOC

12. If DEER = 12215 and HIGH = 5645, how will you code HEEL ?
    (a) 2328 (b) 3449
    (c) 4337 (d) 5229

13. If B is coded as 8, F is coded as 6, Q is coded as 4, D is coded as 7, T is coded as 2, M is coded as 3 and K is coded as 5, then what is the coded from of QKTBFM ?
    (a) 425783 (b) 452683
    (c) 452783 (d) None of these

14. In a certain code, BRAIN is written as *%+#× and TIER is written as $#+%. How is RENT written in that code ?
    (a) %×#$ (b) %#×$
    (c) %+×$ (d) +×%$

Previous Year Solved Questions

1. A military code writes SYSTEM as SYSMET and NEARER as AENRER. Using the same code, FRACTION can be written as
   (a) CARFTION
   (b) FRACNOIT
   (c) NOITCARF
   (d) CARFNOIT **[CSAT 2016]**

2. In a certain code, '256' means 'red colour chalk', '589' means 'green colour flower' and '254' means 'white colour chalk'. The digit in the code that indicates 'white' is
   (a) 2
   (b) 4
   (c) 5
   (d) 8 **[CSAT 2017]**

3. If LSJXVC is the code for MUMBAI, the code for DELHI is
   (a) CCIDD
   (b) CDKGH
   (c) CCJFG
   (d) CCIFE **[CSAT 2018]**

4. If RAMON is written as 12345 and DINESH as 675849, then HAMAM will be written as
   (a) 92233
   (b) 92323
   (c) 93322
   (d) 93232 **[CSAT 2018]**

5. If every alternative letter of the English alphabet from B onwards (including B) is written in lower case (small letters) and the remaining letters are capitalized, then how is the first month of the second half of the year written ?
   (a) JuLY
   (b) jULy
   (c) jUly
   (d) jUlY **[CSAT 2019]**

6. In the English alphabet, the first 4 letters are written in opposite order; and the next 4 letters are written in opposite order and so on; and at the end Y and Z are interchanged. Which will be the fourth letter to the right of the 13th letter?
   (a) N (b) T
   (c) H (d) I **[CSAT 2021]**

7. In a code language 'MATHEMATICS' is as 'LBSIDNZUHDR'. How is 'CHEMISTRY' written in that code language ?
   (a) DIDLHRSSX
   (b) BIDNHTSSX
   (c) BIDLHTSSX
   (d) DGILIRUQZ **[CSAT 2021]**

8. If the order of the letters in the English alphabet is reversed and each letter represents the letter whose position it occupies, then which one of the following represents 'LUCKNOW' ?
   (a) OGXPMLD
   (b) OGXQMLE
   (c) OFXPMLE
   (d) OFXPMLD **[CSAT 2022]**

9. If 'ZERO' is written as 'CHUR', then how is 'PLAYER' written ?
   (a) SOCAGT
   (b) SODBGT
   (c) SODBHT
   (d) SODBHU **[CSAT 2023]**

10. If in a certain code, 'ABCD' is written as 24 and 'EFGH' is written as 1680, then how is 'IJKL' written in that code ?
    (a) 11880
    (b) 11240
    (c) 7920
    (d) 5940 **[CSAT 2024]**

Hints and solutions

1. Divide the word equally into two parts and reverse them.

   So, FRAC TION can be written as CARFNOIT.

   Hence, option (d) is correct.

2. Red colour chalk ⇒ 2 5 6

   Green colour flower ⇒ 5 8 9

   White colour chalk ⇒ 2 5 4

   Therefore, the word and code combination is :

Word	Colour	Chalk	White	Red
Code	5	2	4	6

   So, the code that indicates 'white' is '4'.

   Hence, option (b) is correct.

3. The pattern followed here is :

   M U M B A I
   −1 −2 −3 −4 −5 −6
   L S J X V C

   Similarly,

   D E L H I
   −1 −2 −3 −4 −5
   C C I D D

   Hence, option (a) is correct.

4.

R	A	M	O	N
1	2	3	4	5

D	I	N	E	S	H
6	7	5	8	4	9

H	A	M	A	M
9	2	3	2	3

   Hence, option (b) is correct.

5. jUIY

   Hence, option (d) is correct.

6. The English alphabet is:

   ABCD EFGH IJKL MNOP QRST UVWX YZ

   As per the question, the letters are arranged as follows:

   DCBA HGFE LKJI PONM TSRQ XWVIJ ZY

   13th letter in this arrangement is P.

   So, the fourth letter to the right of the 13th letter is T.

   Hence, option (b) is correct.

7. The pattern followed here is :

   M A T H E M A T I C S
   −1 +1 −1 +1 −1 +1 −1 +1 −1 +1 −1
   L B S I D N Z U H D R

   Similarly,

   C H E M I S T R Y
   −1 +1 −1 +1 −1 +1 −1 +1 −1
   B I D N H T S S X

   Hence, option (b) is correct.

8. The English alphabet has 26 letters. If we assign a numerical value to each letter based on its position in the alphabet (A = 1, B = 2, C = 3 and so on), then we can find the reverse of each letter by subtracting its value from 27.

   This is because when the order of the alphabet is reversed, the first letter (A) becomes the last (Z), the second letter (B) becomes the second last (Y) and so on.

   For example: L is the 12th letter in the alphabet.

   To find its reverse, we subtract its value from 27: 27 − 12 = 15.

   The 15th letter in the alphabet is O.

   So, L becomes O when reversed.

Practice Set

1. Mohan and Suresh study in the same class. Mohan has secured more marks than Suresh in the terminal examination. Suresh's rank is seventh from top among all the students in the class. Which of the following is definitely true ?
   (a) Mohan stood first in the terminal examination.
   (b) There is at least one student between Mohan and Suresh in the rank list.
   (c) There are at the most five students between Mohan and Suresh in the rank list.
   (d) Suresh is five ranks lower than Mohan in the rank list.

2. Fifteen children are standing in a row facing north. Ravi is to the immediate left of Prabha and is eighth from the left end. Arjun is second from the right end. Which of the following statements is not true ?
   (a) Prabha is 7^{th} from right end.
   (b) There are four children between Ravi and Arjun.
   (c) There are five children between Ravi and Arjun.
   (d) Arjun is 14^{th} from the left end.

3. If the positions of the first and the fifth digits of the number 83721569 are interchanged, similarly, the positions of the second and the sixth digits are interchanged, and so on, which of the following will be the third from the right end after the rearrangement ?
   (a) 6 (b) 3
   (c) 2 (d) 7

4. If the positions of the first and the sixth digits of the group of digits 5904627813 are interchanged, similarly, the positions of the second and the seventh are interchanged, and so on, which of the following will be the fourth from the right end after the rearrangement ?
   (a) 4 (b) 9
   (c) 1 (d) 0

5. In a row of boys Akash is fifth from the left and Nikhil is eleventh from the right. If Akash is twenty-fifth from the right then how many boys are there between Akash and Nikhil ?
   (a) 14 (b) 13
   (c) 15 (d) 12

6. The positions of the first and the sixth digits in the number 3597280164 are interchanged. Similarly, the positions of the second and the seventh digits are interchanged, and so on. Which of the following will be the fourth digit from the right end after the rearrangement ?
   (a) 5 (b) 3
   (c) 9 (d) 4

7. In a shop, there were 4 dolls of different heights M, N, O and P. 'P' is neither as tall as 'M' nor as short as 'O'. 'N' is shorter than 'P' but taller than 'O'. If Anvi wants to purchase the tallest doll, which one should she purchase ?
   (a) Either M or P (b) Either P or N
   (c) Only P (d) Only M

8. A, B, C, D and E, when arranged in descending order of their weight from top, A becomes third, E is between D and A, C and D are not at the top. Who among them is the second ?
   (a) C (b) B
   (c) E (d) Data inadequate

9. Vijay's position is 14^{th} from upwards in a class of 43 students. What will be his position from downwards ?
   (a) 30^{th} (b) 28^{th}
   (c) 29^{th} (d) 31^{st}

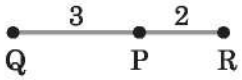
10. Rakesh is on 9^{th} position from upwards and on 38^{th} position from downwards in a class. How many students are in class ?
    (a) 47
    (b) 45
    (c) 46
    (d) 48

8. Given that, PQ : QR = 3 : 5

Case 1:

PQ : PR = 3 : 8

Case 2:



PQ : PR = 3 : 2

So, we have 2 possible values of n.

Hence, option (b) is correct.

9. Three persons A, B and C are standing in a queue not necessarily in the same order. There are 4 persons between A and B, and 7 persons between B and C. If there are 11 persons ahead of C and 13 behind A, what could be the minimum number of persons in the queue.

3 + B - - - - A - - C + 10

Minimum possible number of people in the queue = 22

Hence, option (a) is correct.

Chapter 10 Mathematical operation

EXAMPLES

1. If '+' means 'minus' '–' means 'multiplied by' '÷' means 'plus' and '×' means 'divided by', then $10 \times 5 \div 3 - 2 + 3 = ?$

Sol: After substituting the given symbols, the new expression will be:

$10 \div 5 + 3 \times 2 - 3 = 2 + 3 \times 2 - 3 = 2 + 6 - 3 = 5.$

2. If '–' stands for division, '+' for multiplication, '÷' for subtraction and '×' for addition, then what is the value of $6 \div 20 \times 12 + 7 - 1$.

Sol: After substituting the given symbols, the new expression will be:

$6 - 20 + 12 \times 7 \div 1 = 6 - 20 + 12 \times 7$

$= 6 - 20 + 84 = 90 - 20 = 70.$

3. If L stands for +, M stands for –, N stands for ×, P stands for ÷, then 14 N 10 L 42 P 2 M 8 = ?

Sol: After substituting the given symbols, the new expression will be:

LHS = $14 \times 10 + 42 \div 2 - 8$

Using the BODMAS rule we can solve the expression.

$= 14 \times 10 + 21 - 8 = 140 + 21 - 8 = 153.$

4. If P denotes +, Q denotes –, R denotes × and S denotes ÷, then what is the value of 8 R 8 P 8 S 8 Q 8.

Sol: After substituting the given symbols, the new expression will be:

$8 \times 8 + 8 \div 8 - 8 = 8 \times 8 + 1 - 8 = 64 - 7 = 57.$

5. Which one of the following is correct ?

6 * 4 * 9 * 15

(a) ×, =, –
(b) ×, –, =
(c) =, ×, –
(d) –, ×, =

Sol: $6 \times 4 - 9 = 15$

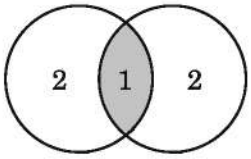
$15 = 15$

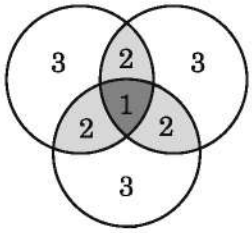
Hence, option (b) is correct.

Chapter 11 Venn Diagrams

Concept

- All the data should be similar.
- Fill the common area (intersection) first.

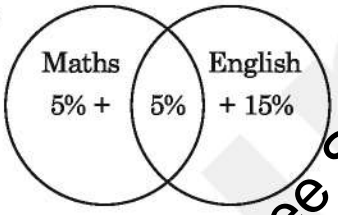




EXAMPLES

1. In an examination, 10% of the students failed in Maths, 20% failed in English and 5% failed in both. Find the percentage of students who passed in both the subjects.

Sol:

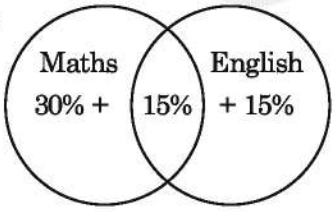


= 25% failed students

Hence, the percentage of students who passed in both the subjects = 100 – 25 = 75%.

2. In an examination, 45% of the students failed in Maths, 30% failed in English and 15% failed in both. Find the percentage of students who passed in both the subjects.

Sol:



= 60% failed students

Hence, the percentage of students who passed in both the subjects = 100 – 60 = 40%.

Practice Set

1. In an examination, 35% of total students failed in Hindi, 45% failed in English and 20% in both. Find the percentage of those who passed in both the subjects.
   (a) 40% (b) 35%
   (c) 45% (d) 50%

2. In an examination, 80% of the students passed in English, 85% in Mathematics and 75% in both English and Mathematics. If 40 students failed in both the subjects, find the total number of students.
   (a) 350 (b) 200
   (c) 450 (d) 400

3. In an examination, 65% students passed in Civics and 60% in History, 40% passed in both of these subjects. If 90 students failed in History and Civics both, then what is the total number of students ?
   (a) 600 (b) 650
   (c) 700 (d) 750

4. In an examination, 35% candidates failed in one subject and 42% failed in another subject while 15% failed in both the subjects. If 2500 candidates appeared at the examination, how many passed in either subject but not in both ?
   (a) 325 (b) 1175
   (c) 2125 (d) None of these

5. In an examination, 34% of the students failed in Mathematics and 42% failed in English. If 20% of the students failed in both the subjects, then the percentage of students who passed in both the subjects was
   (a) 44 (b) 50
   (c) 54 (d) 56

6. 40% of the people read newspaper X, 50% read newspaper Y and 10% read both the papers. What percentage of the people read neither newspaper ?
   (a) 10% (b) 15%
   (c) 20% (d) 25%

7. Out of 450 students of a school, 325 play football, 175 play cricket and 50 neither play football nor cricket. How many students play both football and cricket ?
   (a) 50 (b) 75
   (c) 100 (d) 225

8. In a hotel, 60% had vegetarian lunch while 30% had non-vegetarian lunch and 15% had both types of lunch. If 96 people were present, how many did not eat either type of lunch ?
   (a) 20 (b) 24
   (c) 26 (d) 28

9. There are 600 boys in a hostel. Each plays either hockey or football or both. If 75% play hockey and 45% play football, how many play both ?
   (a) 48
   (b) 60
   (c) 80
   (d) 120

10. In a certain office, 72% of the workers prefer tea and 44% prefer coffee. If each of them prefers tea or coffee and 40 like both, the total number of workers in the office is
    (a) 200
    (b) 240
    (c) 250
    (d) 320

11. In a class some students play cricket only, some other students play football only and remaining $\frac{1}{6}$ th students play both cricket and football. Which of the following statements is definitely true ?
    (a) Two-thirds of the students play cricket.
    (b) Three-fourths of the students play football only.
    (c) One-thirds of the students play football only.
    (d) None of these

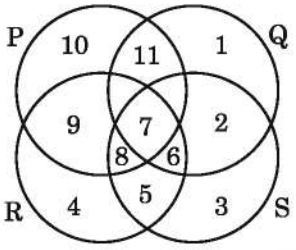
Previous Year Solved Questions

1. There are 100 students in a particular class. 60% students play cricket, 30% student play football and 10% students play both the games. What is the number of students who play neither cricket nor football ?

   (a) 25 (b) 20

   (c) 18 (d) 15 **[CSAT 2011]**

2. In the below figure, circle P represents hardworking people, circle Q represents intelligent people, circle R represents truthful people, and circle S represents honest people. Which region represents the people who are intelligent, honest and truthful but not hard working ?



   (a) 6 (b) 7

   (c) 8 (d) 11 **[CSAT 2012]**

3. Out of 120 applications for a post, 70 are male and 80 have a driver's license. What is the ratio between the minimum to maximum number of males having driver's license ?

   (a) 1 to 2 (b) 2 to 3

   (c) 3 to 7 (d) 5 to 7 **[CSAT 2013]**

4. There are 50 students admitted to a nursery class. Some students can speak only English and some can speak only Hind. 10 student can speak both English and Hindi. If the number of students who can speak English 21, then how many students can speak Hindi how many can speak only Hindi and how many can speak English ?

   (a) 21, 11 and 29 respectively.

   (b) 28, 18 and 22 respectively.

   (c) 37, 27 and 13 respectively.

   (d) 39, 29 and 11 respectively. **[CSAT 2014]**

5. In a town, 45% population read magazine A, 55% read magazine B, 40% read magazine C, 30% read magazines A and B, 15% read magazines B and C, 25% read magazines A and C; and 10% read all the three magazines. What percentage do ***not*** read any magazine ?

   (a) 10%

   (b) 15%

   (c) 20%

   (d) 25% **[CSAT 2015]**

6. Out of 130 students appearing in an examination, 82 failed in English, 52 failed in Mathematics, whereas 24 failed in both English and Mathematics. The number of students who passed finally is

   (a) 40

   (b) 50

   (c) 55

   (d) 60 **[CSAT 2015]**

7. In a group of persons travelling in a bus, 6 persons can speak Tamil, 15 can speak Hindi and 6 can speak Gujarati. In that group none can speak any other language. If 2 persons in the group can speak two languages only and one person can speak all the three languages, then how many persons are there in the group ?

   (a) 21

   (b) 22

   (c) 23

   (d) 24 **[CSAT 2015]**

8. 19 boys turn out for playing hockey. Of these, 11 are wearing hockey shirts and 14 are wearing hockey pants. There are no boys without shirts and/or pants. What is the number of boys wearing full uniform ?

   (a) 3

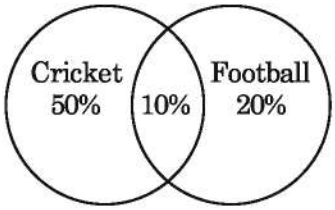
   (b) 5

   (c) 6

   (d) 8 **[CSAT 2018]**

Hints and solutions

1. According to the question,



So, the number of students who play neither cricket nor football

= 100% – (50% + 10% + 20%) = 20%.

20% of 100 = 20

Hence, option (b) is correct.

2. Number of people who are intelligent, honest and truthful but not hardworking will be the area of intersection of Q, S, R *i.e.*, common figure to the circle Q, R and S.

Hence, option (a) is correct.

3. According to the question,

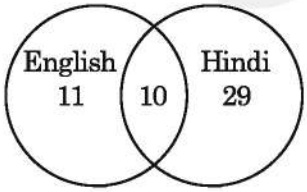
	Male = 70	Female = 50
Case 1	70 (DL)	10 (DL)
Case 2	30 (DL)	50 (DL)

The minimum to the maximum number of males having driver's license = 30 : 70.

So, the ratio between the minimum to maximum number of males having driver's license = 3 to 7.

Hence, option (c) is correct.

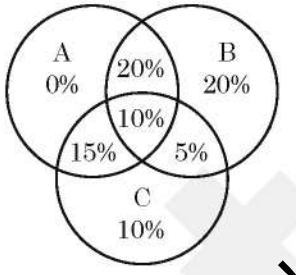
4. According to the given information, we can have the following venn diagram,



So, students who can speak Hindi, who can speak only Hindi, and who can speak only English are 39, 29 and 11 respectively.

Hence, option (d) is correct.

5. According to the question,

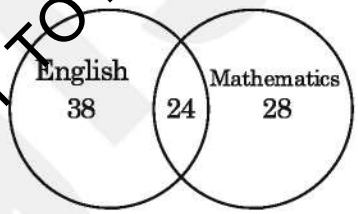


Total percentage of people who read at least one magazine = 80%.

So, 20% do not read any magazine.

Hence, option (c) is correct.

6. According to the question,



Number of students failed in at least one subject

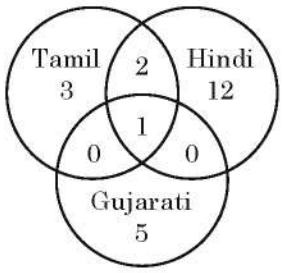
= 38 + 24 + 28 = 90

So, the number of students who passed finally

= 130 – 90 = 40.

Hence, option (a) is correct.

7. According to the question,



Given that, 2 people speak only two languages.

Let us assume that those two people speak Tamil and Hindi.

So, the number of people in the group

= 3 + 2 + 12 + 1 + 5 = 23

Hence, option (c) is correct.

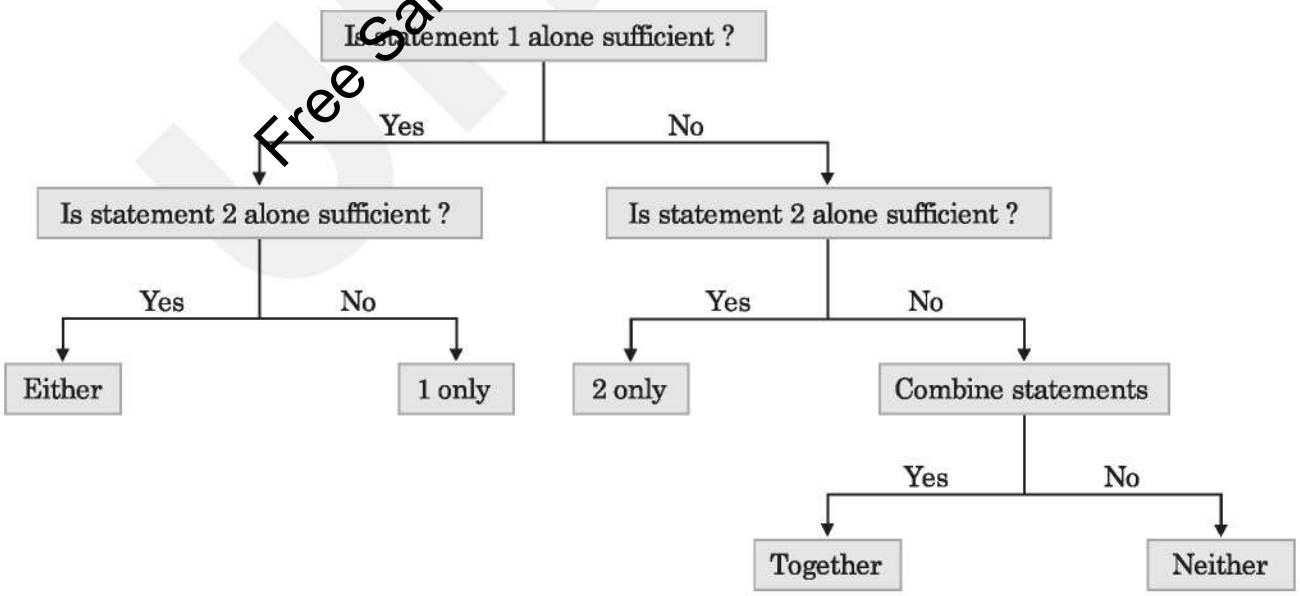
Chapter 12 Data sufficiency

Concept

Data sufficient means a unique answer.

1. Read the question statement first.
2. Come to statement-1 alone and try to find the answer, if we can find a unique answer, then statement-1 alone would be sufficient to find the answer.
3. If statement-1 alone is not sufficient, move to statement-2 and read that statement alone (forget about statement-1) and try to find the answer, if it can be obtained uniquely, statement-2 alone would be sufficient to find the answer.
4. If from statement-2, we cannot find a unique answer, try to find the answer using both the statements together, in that case both the statements together would be sufficient to find the answer. Else answer cannot be obtained even after using both the statements together.
5. Sometimes questions can be uniquely answered either from statement-1 alone or from statement-2 alone, in that case either one of the two statements alone would be sufficient to find the answer.
6. If a question can be answered using any one statement alone and using both the statements together, in that situation the answer from the single statement would be preferred.

Flowchart



Practice Set

1. How is GREEN written in a code language ?
   1. GREEN AND BLACK is coded as '#@7' and ORANGE AND PINK is coded as '$%#'.
   2. PINK AND RED is coded as '#$8' and YELLOW AND GREEN is coded as '6@#'.
   (a) Statement 1 alone is sufficient.
   (b) Statement 2 alone is sufficient.
   (c) Both statements 1 and 2 together are not sufficient.
   (d) Both statements 1 and 2 together are necessary.

2. In which month did Rahul go to Kanpur for business ?
   1. Rahul's son remembers that he went after 20th August but before 10th September.
   2. Varun, friend of Rahul remembers that he went Kanpur in the 3rd quarter of the fiscal year.
   (a) Statement 1 alone is sufficient to answer the question.
   (b) Statement 2 alone is sufficient to answer the question.
   (c) Both statements 1 and 2 together are not sufficient to answer the question.
   (d) Both statements 1 and 2 together are necessary to answer the question.

3. Madan's flat is on which floor of 5 floor apartments ?
   1. Harish flat, which is exactly above to Madan, is exactly below Karan's flat which is on fifth floor.
   2. Madan's flat is exactly above Gopal's flat, whose flat is exactly above Nitin's first floor flat.
   (a) Statement 1 alone is sufficient to answer the question.
   (b) Statement 2 alone is sufficient to answer the question.
   (c) Both statements 1 and 2 together are not sufficient to answer the question.
   (d) Either statement 1 or 2 alone is sufficient to answer the question.

4. How many pencils does the shopkeeper sells on Sunday ?
   1. On Sunday he sold 12 more pencils than he sold the previous day.
   2. He sold 28 pencils each on Thursday and Saturday.
   (a) Statement 1 alone is sufficient to answer the question.
   (b) Statement 2 alone is sufficient to answer the question.
   (c) Both statements 1 and 2 together are not sufficient to answer the question.
   (d) Both statements 1 and 2 together are necessary to answer the question.

5. How many boys students are there in the class ?
   1. 65% girls students are there in the class.
   2. The number of boys students is half that of girls.
   (a) Statement 1 alone is sufficient to answer the question.
   (b) Statement 2 alone is sufficient to answer the question.
   (c) Both statements 1 and 2 together are not sufficient to answer the question.
   (d) Both statements 1 and 2 together are necessary to answer the question.

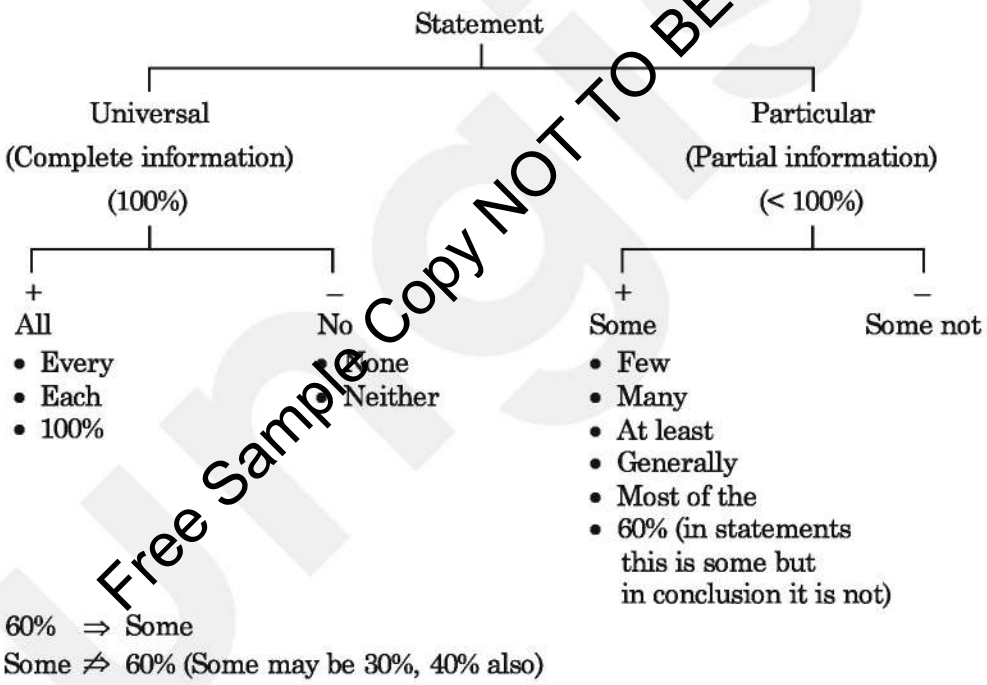
6. Which of the five trains A, B, C, D and E is the best ?
   1. Train D is better than train E, A and C but not as good as train B.
   2. Train D is better than train C but not as good as train B which is better than train E.
   (a) Statement 1 alone is sufficient to answer the question.
   (b) Statement 2 alone is sufficient to answer the question.
   (c) Both statements 1 and 2 together are not sufficient to answer the question.
   (d) Both statements 1 and 2 together are necessary to answer the question.

Chapter 13 Syllogism

Syllogism

Introduction

The word syllogism comes from the Greek word syllogismos, which means "conclusion, inference". Aristotle devised syllogisms as the simplest sequence of logical premises and conclusions. They are a logical argument of statements that use deductive reasoning to arrive at a conclusion. Here the conclusion means an "always true" logical result.



NOTE: In case of contrary conclusions '*Either*' will follow.

Rules :

1. Positive statement always gives positive conclusion. (+ ⇒ +)
2. Negative statement always gives negative conclusion. (– ⇒ –)
3. 'All' can be concluded as 'Some' but converse is not true.
   'No' can be concluded as 'Some not' but converse is not true.
   - All ⇒ Some
   - Some ⇏ All
   - No ⇒ Some not

Which one of the following is correct ?

(a) Only Conclusion 1

(b) Only Conclusion 2

(c) Both Conclusion 3 and Conclusion 4

(d) None of the Conclusions follows.

[CSAT 2022]

12. Three Statements followed by three Conclusions are given below. You have to take the Statements to be true even if they seem to be at variance from the commonly known facts. Read all the Conclusions and then decide which of the given Conclusions logically follows/follow from the Statements, disregarding the commonly, known facts:

Statements: Some doctors are teachers.
All teachers are engineers.
All engineers are scientists.

Conclusions: 1. Some scientists are doctors.
2. All engineers are doctors.
3. Some engineers are doctors.

Which one of the following is correct ?

(a) Only Conclusion 1

(b) Only Conclusion 2

(c) Both Conclusion 1 and Conclusion 3

(d) Both Conclusion 1 and Conclusion 2

[CSAT 2022]

ANSWER KEY

1.	(a)	3.	(b)	5.	(d)	7.	(c)	9.	(c)	10.	(d)	11.	(d)	12.	(c)
2.	(c)	4.	(d)	6.	(c)	8.	(d)								

Hints and Solutions

1. Statement 1 and 3 cannot both be true, but both can be false.
   Hence, option (a) is correct.

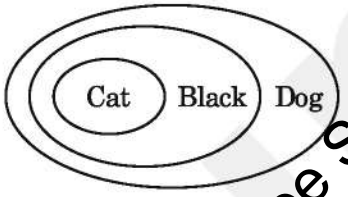
2. Statement 1 and 3 cannot both be true, but both can be false.
   Hence, option (c) is correct.

3. Based on statements 1 and 2 we can say Some artists are drug addicts.
   Hence, option (b) is correct.

4. We have "Some" before the common term "men". So, there is no conclusion.
   Hence, option (d) is correct.

5. If statement 4 is true, then statement 1 has to be false.
   Hence, option (d) is correct.

6. From statement 1 we can say "Some cats are rats" and no other conclusion follows.
   Hence, option (c) is correct.

7. 

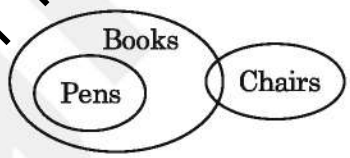
   From the above diagram we cannot say "All dogs are black" and with two positive statements we cannot have a negative conclusion.
   So, neither conclusion 1 nor 2.
   Hence, option (c) is correct.

8. We cannot have a certain relation between radios and watches and between mobiles and watches.
   So, neither conclusion 1 nor 2.
   Hence, option (d) is correct.

9. From statements 2 and 3 we can say "Certainly, some almirahs are tables." and though we cannot find the exact relation between cat and chair, but they can be connected with the word "may".
   Hence, option (c) is correct.

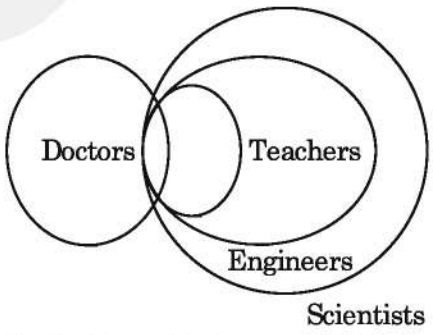
10. We have "Some" before the common term "blues". Hence there is no conclusion.
    Hence, option (d) is correct.

11. Here we have one positive statement and one negative statement. So, we cannot have a positive conclusion. Hence, conclusions 1, 2 and 3 are not correct. and with the help of the diagram given below we can say, conclusion 4 is also not correct.



    Hence, option (d) is correct.

12. The required diagram is shown below:



    So, both conclusions 1 and 3.
    Hence, option (c) is correct.

Chapter 14 Puzzles

Directions for the following 3 (three) items:

Read the following information and answer the items that follow:

There are 4 persons A, B, C, D. They are going to Hyderabad, Kanpur, Bhopal and Yamuna Nagar. They have 4 bikes *i.e.*, Kinetic, Yamaha, Honda and Bajaj but not in the given order.

- No two initials match.
- A has Yamaha. B goes to Hyderabad. D has Bajaj.
- A person who has Honda going to Kanpur.

1. Who is going to Bhopal ?
   (a) A (b) B
   (c) C (d) D

2. Bajaj is owned by
   (a) A (b) B
   (c) C (d) D

3. A person who has Kinetic going to
   (a) Kanpur
   (b) Hyderabad
   (c) Bhopal
   (d) Yamuna Nagar

4. During an evening party, when Ms. Black, Ms. Brown and Ms. White met, Ms. Brown remarked, "It is interesting that our dresses are white, black or brown, but for each of us the name does not match the colour of the dress!" Ms. White replied, "But your white dress does not suit you!". Pick the correct answer.
   (a) Ms. White's dress was brown.
   (b) Ms. Black's dress was white.
   (c) Ms. White's dress was black.
   (d) Ms. Black's dress was black.

Directions for the following 4 (four) items:

Read the following information and answer the items that follow:

Four young men Raj, Prem, Ved and Ashok are friendly with four girls Sushma, Kusum, Vimla and Poonam. Sushma and Vimla are friends. Ved's girl friend does not like Sushma and Vimla. Kusum does not care for Ved. Prem's girl friend is friendly with Sushma. Sushma does not like Raj.

5. Who is Raj's girl friend ?
   (a) Sushma (b) Kusum
   (c) Vimla (d) Poonam

6. With whom is Sushma friendly ?
   (a) Raj (b) Prem
   (c) Ved (d) Ashok

7. Who is Poonam's boy friend ?
   (a) Ashok (b) Ved
   (c) Prem (d) Raj

8. Who does not like Sushma and Vimla ?
   (a) Poonam (b) Raj
   (c) Ashok (d) Ved

9. Three persons A, B and C wore shirts of black, blue and orange colours (not necessarily in that order) and pants of green, yellow and orange colours (not necessarily in that order). No person wore pant and shirt of the same colour. Further, it is given that
   1. A did not wear shirt of black colour.
   2. B did not wear shirt of blue colour.
   3. C did not wear shirt of orange colour.
   4. A did not wear pant of green colour.
   5. B wore pant of orange colour.

   What were the colours of pant and shirt worn by C, respectively ?
   (a) Yellow and Black (b) Yellow and Blue
   (c) Green and Blue (d) Orange and Black

33. If A's income be Rs. 80,000 per annum and the difference between the incomes of B and D be the same as A's income, B's income is
(a) Rs. 40,000 (b) Rs. 60,000
(c) Rs. 80,000 (d) Rs. 1,20,000

34. Suppose in a box there are 20 red, 30 black, 40 blue and 50 white balls. What is the minimum number of balls to be drawn, without replacement, so that you are certain about getting 4 red, 5 black, 6 blue and 7 white balls?
(a) 140 (b) 97
(c) 104 (d) 124

35. The minimum number of weights needed to measure any integer weight from 1 to 63 grams.
(a) 6 (b) 7
(c) 8 (d) None of these

36. There are nine identical balls, one of which is heavier than the other eight. What is the least number of weighings, using a two-pan balance, needed for definitely identifying the heavier ball?
(a) One (b) Two
(c) Three (d) Four

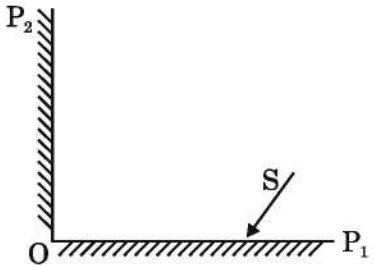
37. A chocolate salesman is travelling with 3 boxes with 30 chocolates in each box. During his journey he encounters 30 toll booths. Each toll booth inspector takes one chocolate per box that contains chocolate(s), as tax. What is the largest number of chocolates he can be left with after passing through all toll booths ?
(a) 0 (b) 30
(c) 25 (d) 20

ANSWER KEY

1. (a)	6. (d)	11. (c)	16. (a)	21. (b)	26. (b)	31. (b)	36. (b)
2. (d)	7. (b)	12. (c)	17. (d)	22. (d)	27. (d)	32. (a)	37. (c)
3. (b)	8. (a)	13. (b)	18. (a)	23. (b)	28. (a)	33. (d)	
4. (c)	9. (c)	14. (a)	19. (a)	24. (b)	29. (d)	34. (d)	
5. (b)	10. (c)	15. (b)	20. (d)	25. (d)	30. (b)	35. (a)	

Previous Year Questions

1. Consider the figure given below and answer the item that follows:



In the figure shown above, OP_1 and OP_2 are two plane mirrors kept perpendicular to each other. S is the direction of a beam of light falling on the mirror OP_1. The direction of the reflected beam of light from the mirror OP_2 will be

(a) Perpendicular to the direction S.

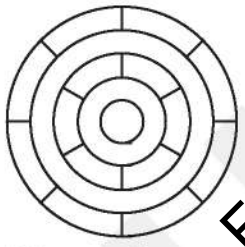
(b) At 45° to the direction S.

(c) Opposite and parallel to the direction S.

(d) At 60° to the direction S.

[CSAT 2011]

2. Consider the following figure and answer the item that follows:



What is the minimum number of different colours required to paint the figure given above such that no two adjacent regions have the same colour ?

(a) 3 (b) 4

(c) 5 (d) 6 **[CSAT 2011]**

Read the following passage and answer the 3 (three) items that follow:

In a survey regarding a proposed measure to be introduced, 2878 persons took part of which 1652 were males. 1226 persons voted against the proposal of which 796 were males. 1425 persons voted for the proposal. 196 females were undecided.

3. How many females voted for the proposal ?

(a) 430 (b) 600

(c) 624 (d) 640 **[CSAT 2011]**

4. How many males were undecided ?

(a) 31 (b) 227

(c) 426 (d) 581 **[CSAT 2011]**

5. How many females were not in favour of the proposal ?

(a) 430 (b) 496

(c) 586 (d) 1226 **[CSAT 2011]**

6. Three persons A, B and C wore shirts of black, blue and orange colours (not necessarily in that order) and pants of green, yellow and orange (not necessarily in that order). No person wore shirt and pants of the same colour. Further, it is given that

1. A did not wear shirt of black colour.
2. B did not wear shirt of blue colour.
3. C did not wear shirt of orange colour.
4. A did not wear pants of green colour.
5. B wore pants of orange colour.

What were the colours of the pants and shirt worn by C, respectively ?

(a) Orange and black

(b) Green and blue

(c) Yellow and blue

(d) Yellow and black **[CSAT 2012]**

7. Ten new TV shows started in January — 5 sitcoms, 3 drama and 2 news magazines. By April, only seven of the new shows were still on, five of them being sitcoms.

Based on the above information, four conclusions, as given below, have been made. Which one of these logically follows from the information given above ?

(a) Only one news magazine show is still going on.

(b) Only one of the drama shows is still on.

(c) At least one discontinued show was a drama.

(d) Viewers prefer sitcoms over drama.

[CSAT 2012]

ANSWER KEY

1. (c)	12. (c)	23. (c)	34. (b)	45. (b)	56. (a)	67. (b)	78. (c)
2. (a)	13. (c)	24. (d)	35. (d)	46. (a)	57. (b)	68. (b)	79. (d)
3. (b)	14. (a)	25. (a)	36. (d)	47. (c)	58. (a)	69. (d)	80. (b)
4. (a)	15. (d)	26. (b)	37. (a)	48. (b)	59. (c)	70. (c)	81. (b)
5. (a)	16. (a)	27. (d)	38. (c)	49. (b)	60. (b)	71. (b)	82. (c)
6. (b)	17. (b)	28. (c)	39. (b)	50. (c)	61. (c)	72. (a)	83. (c)
7. (c)	18. (d)	29. (b)	40. (b)	51. (a)	62. (b)	73. (b)	84. (d)
8. (c)	19. (a)	30. (c)	41. (b)	52. (a)	63. (c)	74. (a)	85. (d)
9. (b)	20. (b)	31. (c)	42. (c)	53. (b)	64. (a)	75. (d)	86. (c)
10. (d)	21. (c)	32. (b)	43. (d)	54. (b)	65. (b)	76. (a)	87. (c)
11. (b)	22. (b)	33. (a)	44. (b)	55. (c)	66. (b)	77. (a)	88. (d)

Chapter 15 Inequality

1. **Introduction**

   Inequality questions test your ability to interpret and compare relationships between elements, usually expressed through symbols like >, <, =, ≥ and ≤.

   In UPSC CSAT, these questions are often simple in concept but tricky in execution, especially when presented in **Data Sufficiency** or **Mixed Reasoning** format.

2. **Common Symbols and Meanings**

Symbol	Meaning
A > B	A is greater than B
A < B	A is less than B
A = B	A is equal to B
A ≥ B	A is greater than or equal to B
A ≤ B	A is less than or equal to B

3. **Reversal and Opposite**

   If A > B, then B < A.

   If A ≤ B, then B ≥ A.

4. **Combining Statements**

   Think of this as "connecting the dots"

   - If A > B and B > C, then A > C.
   - If A ≥ B and B ≥ C, then A ≥ C.
   - If there's a mixture (like > and ≥), the result takes the **weaker sign**:
     - A > B and B ≥ C ⇒ A > C (since '>' is stronger than '≥').
     - A ≥ B and B > C ⇒ A > C.

5. **Break in the Chain** (No Conclusion)

   If no direct link is possible, conclusion **cannot be drawn**.

   For example: A > B and C > B ⇒ No conclusion between A and C.

6. **Equalities Mixed with Inequalities**

   When = appears, treat both variables as the same entity.

   For example: A = B and B > C ⇒ A > C.

Practice Set

1. What is the relationship between P and R ?
   Statement-1: $Q \geq R$
   Statement-2: $P > Q$
   (a) $P > R$ (b) $P < R$
   (c) $P \geq R$ (d) $P \geq R$

2. What is the relationship between M and O ?
   Statement-1: $M \geq N$
   Statement-2: $N > O$
   (a) $M < O$ (b) $M > O$
   (c) $M \geq O$ (d) $M \geq O$

3. What is the relationship between X and Z ?
   Statement-1: $X \geq Y$
   Statement-2: $Z > Y$
   (a) $X > Z$ (b) $X < Z$
   (c) $X \geq Z$ (d) No conclusion

4. What is the relationship between S and V ?
   Statement-1: $S = T$
   Statement-2: $T \geq U$
   Statement-3: $U < V$
   (a) $S > V$ (b) $S < V$
   (c) $S \geq V$ (d) No conclusion

5. Find A % B $ C if
   Statement-1: X % Y means $X > Y$
   Statement-2: X $ Y means $X \leq Y$
   (a) $A > C$ (b) $A < C$
   (c) $A \geq C$ (d) No conclusion

6. Find X & Y * Z if
   Statement-1: P @ Q means $P \geq Q$
   Statement-2: P & Q means $P < Q$
   Statement-3: P * Q means $P = Q$
   (a) $X > Z$ (b) $X < Z$
   (c) $X \geq Z$ (d) $X \geq Z$

7. What is the relationship between K and O ?
   Statement-1: $K > L \geq M$
   Statement-2: $M \geq N = O$
   (a) $K > O$ (b) $K < O$
   (c) $K \geq O$ (d) $K \geq O$

8. What is the relationship between M and Q ?
   Statement-1: $M \geq N$ and $N \geq Q$
   Statement-2: $Q \leq P$ and $P \leq M$
   Which one of the following is correct with respect to the above Question and the Statements ?
   (a) The Question can be answered by using one of the Statements alone, but cannot be answered using the other Statement alone.
   (b) The Question can be answered by using either Statement alone.
   (c) The Question can be answered by using both the Statements together, but cannot be answered using either Statement alone.
   (d) The Question cannot be answered even by using both the Statements together.

Directions for the following 5 (five) items :
Read the following information and answer the items that follow:

Six persons A, B, C, D, E and F were playing a game of cards. A's father, mother and uncle were in the group. There were two women. B, the mother of A, got more points than her husband. D got more points than E but less than F. Niece of E got lowest points. Father of A got more points than F but could not win the game.

9. Who won the game ?
   (a) A (b) B
   (c) D (d) F

10. Who got the lowest points ?
    (a) A (b) B
    (c) C (d) E

11. Who is the husband of B ?
    (a) C (b) D
    (c) E (d) F

12. B was one of the ladies. Who was the other lady?
    (a) A (b) C
    (c) D (d) E

13. Who stood second in the game ?
    (a) A (b) B
    (c) C (d) D

Previous Year Solved Questions

1. Consider the following statements :
   1. A is older than B.
   2. C and D are of the same age.
   3. E is the youngest.
   4. F is younger than D.
   5. F is older than A.

   How many statements given above are required to determine the oldest person/persons ?

   (a) Only two (b) Only three
   (c) Only four (d) All five

   [CSAT 2023]

2. Consider the following :
   i. A + B means A is neither smaller nor equal to B.
   ii. A – B means A is not greater than B.
   iii. A × B means A is not smaller than B.
   iv. A ÷ B means A is neither greater nor equal to B.
   v. A ± B means A is neither smaller nor greater than B.

   Statement: P × Q, P – T, T ÷ R, R ± S

   Conclusion-1: Q ± T

   Conclusion-2: S + Q

   Which one of the following is correct in respect of the above Statement and the Conclusions ?

   (a) Only Conclusion-1 follows from the Statement.
   (b) Only Conclusion-2 follows from the Statement.
   (c) Both Conclusion-1 and Conclusion-2 follow from the Statement.
   (d) Neither Conclusion-1 nor Conclusion-2 follows from the Statement.

   [CSAT 2023]

3. A Question is given followed by two Statements 1 and 2. Consider the Question and the Statements.

   P, Q, R and S appeared in a test.

   Question: Has P scored more marks than Q ?

   Statement-1: The sum of the marks scored by P and Q is equal to the sum of the marks scored by R and S.

   Statement-2: The sum of the marks scored by P and S is more than the sum of the marks scored by Q and R.

   Which one of the following is correct in respect of the above Question and the Statements ?

   (a) The Question can be answered by using one of the Statements alone, but cannot be answered using the other Statement alone.
   (b) The Question can be answered by using either Statement alone.
   (c) The Question can be answered by using both the Statements together, but cannot be answered using either Statement alone.
   (d) The Question cannot be answered even by using both the Statements together.

   [CSAT 2024]

4. If P means 'greater than (>)'; Q means 'less than (<)'; R means 'not greater than (≯)'; S means 'not less than (≮)' and T means 'equal to (=)', then consider the following statements:
   1. If 2x(S)3y and 3x(T)4z, then 9y(P)8z.
   2. If x(Q)2y and y(R)z, then x(R)z.

   Which of the statements given above isare correct ?

   (a) 1 only (b) 2 only
   (c) Both 1 and 2 (d) Neither 1 nor 2

   [CSAT 2024]

5. Consider the following statements :
   I. If $A \leq B > C < D > E > F \geq G = H$; then B is always greater than E.
   II. If $P > Q = R \geq S = T \leq U = V > W$; then S is always less than V.

   Which of the statements given above is/are correct ?

   (a) I only (b) II only
   (c) Both I and II (d) Neither I nor II

   [CSAT 2025]

Reading comprehension

Chapter 1 Reading Comprehension Solved PYQs 2016

Directions for the following 6 (six) items:
*Read the following **two** passages and answer the items that follow each passage. Your answers to these items should be based on the passages only.*

Passage - 1

Accountability, or the lack of it, in governance generally, and civil services, in particular, is a major factor underlying the deficiencies in governance and public administration. Designing an effective framework for accountability has been a key element of the reform agenda. A fundamental issue is whether civil services should be accountable to the political executive of the day or to society at large. In other words, how should internal and external accountability be reconciled? Internal accountability is sought to be achieved by internal performance monitoring, official supervision by bodies like the Central Vigilance Commission and Comptroller and Auditor General, and judicial review of executive decisions. Articles 311 and 312 of the Indian Constitution provide job security and safeguards to the civil services, especially the All India Services. The framers of the Constitution had envisaged that provision of these safeguards would result in a civil service that is not totally subservient to the political executive but will have the strength to function in larger public interest. The need to balance internal and external accountability is thus built into the Constitution. The issue is where to draw the line. Over the years, the emphasis seems to have tilted in favour of greater internal accountability of the civil services at large through the electron process. This system for seeking accountability to society has not worked out, and has led to several adverse consequences for governance.

Some special measures can be considered for improving accountability in civil services. Provisions of articles 311 and 312 should be reviewed and laws and regulations framed to ensure external accountability of civil services. The proposed Civil Services Bill seeks to address some of these requirements. The respective roles of professional Civil Services and the political executive should be defined so that professional managerial functions and management of civil services are depoliticized. For this purpose, effective statutory civil service boards should be created at the centre and in the states. Decentralization and devolution of authority to bring government and decision making closer to the people also helps to enhance accountability.

1. According to the passage, which of the following factor/factors led to the adverse consequences for governance/public administration?
   1. Inability of civil services strike a balance between internal and external accountabilities.
   2. Lack of sufficient professional training to the officers of All India Services.
   3. Lack of proper service benefits in civil services.
   4. Lack of constitutional provisions to define the respective roles of professional civil services vis-a-vis political executive in this context.

   Select the correct answer using the code given below:

   (a) 1 only (b) 2 and 3 only
   (c) 1 and 4 only (d) 2, 3 and 4

ANSWER KEY

1. (c)	5. (a)	9. (c)	13. (d)	16. (b)	19. (b)	22. (b)	25. (d)
2. (a)	6. (c)	10. (a)	14. (a)	17. (d)	20. (a)	23. (d)	26. (c)
3. (d)	7. (d)	11. (d)	15. (d)	18. (b)	21. (b)	24. (b)	27. (b)
4. (d)	8. (b)	12. (c)					

Hints and solutions

1. **Statement 1: Correct.**

The passage explicitly highlights that the "**emphasis seems to have tilted in favour of greater internal accountability**... This system for seeking accountability to society has not worked out, and has led to several adverse consequences for governance."

Thus, the inability to reconcile internal and external accountability is identified as a cause of adverse consequences.

Statement 2: Incorrect.

Nowhere in the passage is **"lack of training"** mentioned as a cause of governance problems. The text focuses instead on accountability structures and constitutional safeguards.

Statement 3: Incorrect.

The passage makes no mention of service benefits or conditions of service being inadequate. In fact, Articles 311 and 312 are said to provide "job security and safeguards."

Statement 4: Correct.

The passage states: "The respective roles of professional Civil Services and the political executive should be defined so that... management of civil services are depoliticized."

This shows that the lack of clarity in defining these roles is one of the causes of governance issues.

Therefore, only **Statements 1 and 4 are correct**, making option **(c)** the right answer.

Hence, option (c) is correct.

2. **Assumption 1: Valid.**

The passage highlights the **"fundamental issue – whether civil services should be accountable to the political executive of the day or to society at large"** and further says "the emphasis seems to have tilted in favour of greater internal accountability... This system for seeking accountability to society has not worked out, and has led to several adverse consequences for governance."

This implies that subordination to the political executive has weakened direct accountability to society, making the political executive an obstacle in that sense.

Assumption 2: Not valid.

The passage **never claims** that **the political executive has ceased to be accountable**. It only discusses the **imbalance of accountability mechanisms** for civil services.

Hence, option (a) is correct.

3. **Option (a): Incorrect.**

The passage **does not claim** that civil services are entirely unaccountable. Instead, it says the system for seeking accountability to society **"has not worked out"**, meaning it is ineffective, not absent.

Option (b): Incorrect.

The passage **never refers to political leadership** or **the educational quality of leaders**. Its scope is strictly limited to civil service accountability.

Chapter 2 Reading Comprehension Solved PYQs 2017

Directions for the following 8 (eight) items:
*Read the following **eight** passages and answer the items that follow each passage. Your answers to these items should be based on the passages only.*

Passage - 1

What climate change will undeniably do is cause or amplify events that hasten the reduction of resources. Competition over these diminishing resources would ensue in the form of political or even violent conflict. Resource-based conflicts have rarely been overt and are thus difficult to isolate. Instead they take on veneers that appear more politically palatable. Conflicts over resources like water are often cloaked in the guise of identity or ideology.

1. What does the above passage imply?
   (a) Resource-based conflicts are always politically motivated.
   (b) There are no political solutions to resolve environmental and resource-based conflicts.
   (c) Environmental issues contribute to resource stresses and political conflict.
   (d) Political conflicts based on identity or ideology cannot be resolved.

Passage - 2

The man who is perpetually hesitating which of the two things he will do first, will do neither. The man who resolves, but suffers his resolution to be changed by the first counter-suggestion of a friend— who fluctuates from opinion to opinion and veers from plan to plan—can never accomplish anything. He will at best be stationary and probably retrograde in all. It is only the man who first consults wisely, then resolves firmly and then executes his purpose with inflexible perseverance, undismayed by those petty difficulties which daunt a weaker spirit—that can advance to eminence in any line.

2. The keynote that seems to be emerging from the passage is that
   (a) We should first consult wisely and then resolve firmly.
   (b) We should reject suggestions of friends and remain unchanged.
   (c) We should always remain broad-minded.
   (d) We should be resolute and achievement-oriented.

Passage - 3

During the summer in the Arctic Ocean, sea ice has been melting earlier and faster, and the winter freeze has been coming later. In the last three decades, the extent of summer ice has declined by about 30 per cent. The lengthening period of summer melt threatens to undermine the whole Arctic food web, atop which stand polar bears.

3. Which among the following is the ***most crucial message*** conveyed by the above passage?
   (a) Climate change has caused Arctic summer to be short but temperature to be high.
   (b) Polar bears can be shifted to South Pole to ensure their survival.
   (c) Without the presence of polar bears, the food chains in Arctic region will disappear.
   (d) Climate change poses a threat to the survival of polar bears.

Passage - 4

Why do people prefer open defecation and not want toilets or, if they have them, only use them sometimes? Recent research has shown two critical elements : ideas of purity and pollution, and not wanting pits or septic tanks to fill because they have to be emptied. These are the issues that nobody wants to talk about, but if we want to eradicate the practice of open defecation, they have to be confronted and dealt properly.

ANSWER KEY

1. (c)	5. (b)	9. (c)	13. (a)	17. (a)	21. (c)	25. (c)	29. (a)
2. (a)	6. (b)	10. (d)	14. (d)	18. (c)	22. (d)	26. (c)	30. (b)
3. (d)	7. (a)	11. (c)	15. (b)	19. (b)	23. (b)	27. (a)	31. (b)
4. (b)	8. (c)	12. (d)	16. (d)	20. (a)	24. (a)	28. (c)	

Hints and solutions

1. **Option (a): Incorrect.**

Passage states conflicts are **"cloaked in the guise of identity or ideology."** This shows political or ideological motives often mask the real cause, but not that they are **always** politically motivated.

Option (b): Incorrect.

Nowhere does the passage claim the impossibility of solutions. It emphasizes conflicts are **"difficult to isolate,"** not that solutions are futile.

Option (c): Correct.

Passage clearly notes: **"Climate change... hasten(s) the reduction of resources. Competition... would ensue in the form of political or violent conflict."** This establishes the link between **environment, scarcity and conflict.**

Option (d): Incorrect.

The passage never claims such conflicts are irreconcilable; it only says they are **"cloaked"** in these forms.

Hence, option (c) is correct.

2. **Option (a): Correct.**

The core message is summed up in the line: **"It is only the man who first consults wisely, then resolves firmly..."** This stresses that careful judgment **before** decision-making is essential, followed by firmness in resolution. The entire passage builds toward this idea.

Option (b): Incorrect.

The author criticizes the person who **"suffers his resolution to be changed by the first counter-suggestion,"** but does not advocate outright rejection of all advice. The emphasis is not on ignoring friends, but on not being easily swayed.

Option (c): Incorrect.

There is no reference to **broad-mindedness**. The focus is on decision-making and perseverance, not on openness to all views.

Option (d): Incorrect. The passage indeed praises perseverance, but achievement orientation is the outcome, not the keynote.

Hence, option (a) is correct.

3. **Option (a): Incorrect.** The passage clearly says summers are getting **longer** because the freeze is coming later and ice is melting earlier.

Option (b): Incorrect.

The passage makes no mention of shifting polar bears or any remedial step. It only highlights the **threat to their survival**.

Option (c): Incorrect.

While polar bears are said to stand "atop the Arctic food web," the passage **does not state that the entire food web will collapse without them. This overstates the case.**

Option (d): Correct. The passage explicitly notes: **"The lengthening period of summer melt threatens to undermine the whole Arctic food web, atop which stand polar bears."** This makes it clear that polar bears' survival is directly endangered by climate change.

Hence, option (d) is correct.

Chapter 3 Reading Comprehension Solved PYQs 2018

Directions for the following 4 (four) items:
Read the following ***four*** *passages and answer the items that follow each passage. Your answers to these items should be based on the passages only.*

Passage - 1

Global population was around 1.6 billion in 1990—today it is around 7.2 billion and growing. Recent estimates on population growth predict a global population of 9.6 billion in 2050 and 10.9 billion in 2100. Unlike Europe and North America, where only three to four percent of population is engaged in agriculture, around 47 percent of India's population is dependent upon agriculture. Even if India continues to do well in the service sector and the manufacturing sector picks up, it is expected that around 2030 when India overtakes China as the world's most populous country, nearly 42 percent of India's population will still be predominantly dependent on agriculture.

1. Which of the following is the ***most logical and rational inference*** that can be made from the above passage?
   (a) Prosperity of agriculture sector is of critical importance to India.
   (b) Indian economy greatly depends on its agriculture.
   (c) India should take strict measures to control its rapid population growth.
   (d) India's farming communities should switch over to other occupations to improve their economic conditions.

Passage - 2

Many pathogens that cause foodborne illnesses are unknown. Food contamination can occur at any stage from farm to plate. Since most cases of food poisoning go unreported, the true extent of global foodborne illnesses is unknown. Improvements in international monitoring have led to greater public awareness, yet the rapid globalization of food production increases consumers' vulnerability by making food harder to regulate and trace. "We have the world on our plates", says an official of WHO.

2. Which of the following is the ***most logical corollary*** to the above passage?
   (a) With more options for food come more risks.
   (b) Food processing is the source of all foodborne illnesses.
   (c) We should depend on locally produced food only.
   (d) Globalization of food production should be curtailed.

Passage - 3

I am a scientist, privileged to be somebody who tries to understand nature using the tools of science. But it is also clear that there are some really important questions that science cannot really answer, such as: Why is there something instead of nothing? Why are we here? In those domains, I have found that faith provides a better path to answers. 1 find it oddly anachronistic that in today's culture there seems to be a widespread presumption that scientific and spiritual views are incompatible.

3. Which of the following is the ***most logical and rational inference*** that can be made from the above passage?
   (a) It is the faith and not science that can finally solve all the problems of mankind.
   (b) Science and faith can be mutually complementary if their proper domains are understood.
   (c) There are some very fundamental questions which cannot be answered by either science or faith.
   (d) In today's culture, scientific views are given more importance than spiritual views.

ANSWER KEY

1. (a)	5. (c)	9. (d)	12. (b)	15. (b)	18. (a)	21. (b)	24. (d)
2. (a)	6. (a)	10. (a)	13. (c)	16. (c)	19. (b)	22. (d)	25. (b)
3. (b)	7. (d)	11. (d)	14. (c)	17. (d)	20. (c)	23. (a)	26. (a)
4. (d)	8. (c)						

Hints and solutions

1. **Option (a): Correct.** Passage highlights that "around 47% of India's population is dependent upon agriculture" and even by 2030, "nearly 42% will still be predominantly dependent." This shows that almost half of India's population relies on agriculture, making its prosperity essential for India's overall progress and social stability.

Option (b): Incorrect. The passage does not discuss India's *entire economy* being dependent on agriculture; it focuses on the *proportion of population* engaged in it. Hence, the inference about the economy as a whole extends beyond the passage's scope.

Option (c): Incorrect.

The mention of population growth ("expected 9.6 billion in 2050") is used only to emphasize agricultural dependence, not to suggest population control as a solution. The passage is descriptive, not prescriptive.

Option (d): Incorrect.

The passage predicts continued dependence on agriculture but nowhere recommends a shift away from it. It explains the situation, not advises action.

Hence, option (a) is correct.

2. **Option (a): Correct.**

Passage states that "rapid globalization of food production increases consumers' vulnerability by making food harder to regulate and trace." The phrase "We have the world on our plates" implies that while globalization brings variety and options, it also heightens the risk of contamination.

Option (b): Incorrect.

The passage never blames food processing specifically. It says "contamination can occur at any stage from farm to plate," meaning multiple points in the supply chain can cause illness.

Option (c): Incorrect. The passage warns about vulnerabilities but does not recommend restricting consumption to local foods. Such an absolute conclusion is not supported.

Option (d): Incorrect.

The passage discusses *risks* arising from globalization but does not advocate curtailing it. The tone is cautionary, not prescriptive.

Hence, option (a) is correct.

3. **Option (a): Incorrect.** The passage never says that faith can *solve all problems*. It only says that certain questions—like "Why are we here?"—lie beyond science's reach, where faith offers meaning.

Option (b): Correct. The author, being a scientist, respects both science and faith. He finds it "anachronistic" to think they are incompatible. This clearly suggests that both can coexist, addressing different kinds of questions.

Option (c): Incorrect. The author explicitly says that *faith provides a better path to answers* for such questions. He does not claim both are inadequate.

Option (d): Incorrect. The passage mentions a "presumption" that science and faith are incompatible, but it doesn't say that science is considered more important than faith. The tone is about questioning the divide, not about ranking the two.

Hence, option (b) is correct.

Chapter 4

Reading Comprehension
Solved PYQs 2019

Directions for the following 8 (eight) items:
*Read the following **seven** passages and answer the items that follow each passage. Your answers to these items should be based on the passages only.*

Passage - 1

Political theorists no doubt have to take history of injustice, for example, untouchability, seriously. The concept of historical injustice takes note of a variety of historical wrongs that continue into the present in some form or the other and tend to resist repair. Two reasons might account for resistance to repair. One, not only are the roots of injustice buried deep in history, injustice itself constitutes economic structures of exploitation, ideologies of discrimination and modes of representation. Two, the category of historical injustice generally extends across a number of wrongs such as economic deprivation, social discrimination and lack of recognition. This category is complex not only because of the overlap between a number of wrongs, but because one or the other wrong, generally discrimination, tends to acquire partial autonomy from others. This is borne out by the history of repair in India.

1. What is the ***main idea*** that we can infer from the passage?
   (a) Untouchability in India has not been taken seriously by political theorists.
   (b) Historical injustice is inevitable in any society and is always beyond repair.
   (c) Social discrimination and deprivation have their roots in bad economies.
   (d) It is difficult, if not impossible, to repair every manifestation of historical injustice.

2. On the basis of the above passage, the following assumptions have been made:
   1. Removal of economic discrimination leads to removal of social discrimination.
   2. Democratic polity is the best way to repair historical wrongs.

   Which of the above assumptions is/are valid?
   (a) 1 only (b) 2 only
   (c) Both 1 and 2 (d) Neither 1 nor 2

Passage - 2

Education plays a great transformatory role in life, particularly so in this rapidly changing and globalizing world. Universities are the custodians of the intellectual capital and promoters of culture and specialized knowledge. Culture is an activity of thought, and receptiveness to beauty and human feelings. A merely well informed man is only a bore on God's earth. What we should aim at is producing men who possess both culture and expert knowledge. Their expert knowledge will give them a firm ground to start from and their culture will lead them as deep as philosophy and as high as art. Together it will impart meaning to human existence.

3. On the basis of the above passage, the following assumptions have been made:
   1. A society without well educated people cannot be transformed into a modern society.
   2. Without acquiring culture, a person's education is not complete.

   Which of the above assumptions is/are valid?
   (a) 1 only (b) 2 only
   (c) Both 1 and 2 (d) Neither 1 nor 2

Passage - 3

Soil, in which nearly all our food grows, is a living resource that takes years to form. Yet it can vanish in minutes. Each year 75 billion tonnes of fertile soil is lost to erosion. That is alarming — and not just for food producers. Soil can trap huge quantities of carbon dioxide in the form of organic carbon and prevent it from escaping into the atmosphere.

ANSWER KEY

1. (d)	5. (b)	9. (d)	13. (c)	17. (a)	21. (d)	25. (d)	29. (b)
2. (d)	6. (a)	10. (b)	14. (c)	18. (a)	22. (c)	26. (d)	30. (b)
3. (b)	7. (d)	11. (a)	15. (b)	19. (c)	23. (c)	27. (b)	
4. (b)	8. (c)	12. (a)	16. (b)	20. (a)	24. (b)	28. (c)	

Hints and solutions

1. **Option (a): Incorrect.** The question asks for the **main idea** of the passage, not a specific example. The reference to *untouchability* is only **illustrative**, used to explain the broader concept of *historical injustice*. The passage mainly discusses why such injustices are difficult to repair — not whether political theorists take untouchability seriously. Hence, this option focuses on a minor detail and misses the central theme.

   Option (b): Incorrect. The passage does not say that historical injustice is *inevitable* or *always* beyond repair. It only mentions that such injustice *"tends to resist repair,"* meaning it is **difficult but not impossible**. So, this option exaggerates what the passage actually says.

   Option (c): Incorrect. The author says injustice "constitutes economic structures of exploitation, ideologies of discrimination and modes of representation." This shows that economic factors are *one part* of the larger web of injustice, not the sole root cause. Hence, this statement oversimplifies a complex idea.

   Option (d): Correct. The passage says that historical wrongs *"continue into the present and tend to resist repair."* This means that repairing such injustices is **very difficult**, as they are deeply rooted in economic, social, and ideological structures. However, it does **not** suggest that repair is impossible — only that it is challenging and complex. Hence, this statement correctly reflects the idea that while complete repair is hard, it is still possible to attempt it.

   Hence, option (d) is correct.

2. **Statement 1: Invalid.**

   The passage mentions that historical injustice involves *"economic deprivation, social discrimination and lack of recognition"* and that these wrongs often *overlap*, with *"one or the other wrong, generally discrimination, tending to acquire partial autonomy from others."* This means that social discrimination can continue **independently** of economic inequality. Hence, removing economic discrimination alone will **not necessarily remove social discrimination.**

   Statement 2: Invalid.

   The passage does not discuss democracy or political systems at all. It only explains the **complex and deep-rooted nature** of historical injustice and why it resists repair. Therefore, this assumption goes beyond what is stated or implied.

   Hence, option (d) is correct.

3. **Statement 1: Invalid.** The passage says education plays a "**great transformatory role**," but it nowhere makes it a **necessary** or **sole** condition for societal transformation. The claim "cannot be transformed" overstates what is said.

   Statement 2: Valid. The passage contrasts a "**merely well-informed**" person with the aim of producing people with **both culture and expert knowledge**, and adds that together they "impart meaning to human existence." This clearly implies education without culture is incomplete.

   Hence, option (b) is correct.

Chapter 5 Reading Comprehension Solved PYQs 2020

Directions for the following 6 (six) items:
*Read the following **five** passages and answer the items that follow each passage. Your answers to these items should be based on the passages only.*

Passage - 1

In India, over the last decade or so, labour has been departing agriculture, but is only going to construction and unregistered manufacturing which are not markedly better jobs. Services, where labour tends to be most productive, are not generating the additional jobs the country needs. India will need 24 million or so jobs over the next decade. The new sector, e-commerce, can at best close only half the jobs gap. Only those sectors that drive domestic demand such as health and education can comfortably fill the other half.

1. Which one of the following is ***best implied*** in the passage?
   (a) Strong measures need to be taken to reduce the rural to urban migration of labour.
   (b) The working condition in construction and unregistered manufacturing needs to be improved.
   (c) Service sector has been reducing the problem of unemployment.
   (d) Increased social sector spending is imperative for large-scale job creation.

Passage - 2

In India, the current focus on the right to privacy is based on some new realities of the digital age. A right is a substantive right only if it works in all situations, and for everyone. A right to free expression for an individual about her exploitation, for instance, is meaningless without actual availability of security that guarantees that private force cannot be used to thwart this right. The role of the State, therefore, is not just to abstain from preventing rightful free expression, but also to actively ensure that private parties are not able to block it.

2. On the basis of the above passage, the following assumptions have been made
   1. State should have some institutions to ensure its appropriate role in a digital society.
   2. State should ensure that private parties do not violate the citizens' right to privacy.
   3. Digital economy is not compatible with the idea of not violating the citizens' privacy.

   Which of the above assumptions is/are valid?
   (a) 1 and 2 (b) 3 only
   (c) 1 and 3 (d) 2 only

Passage - 3

One of the biggest ironies around water is that it comes from rivers and other wetlands. Yet it is seen as divorced from them. While water is used as a resource, public policy does not always grasp that it is a part of the natural ecosystem. Efforts at engineering water systems are thus efforts at augmenting water supply rather than strengthening the capacities of ecological systems.

3. Which one of the following is the ***most logical and rational inference*** that can be made from the above passage?
   (a) Rivers and other wetlands should be protected under Ramsar Convention.
   (b) Engineering water systems should be modernized and further augmented.
   (c) Wetlands need to be reinforced as more than just open sources of water.
   (d) Water supply should not be free of cost so as to prevent its misuse or overuse.

ANSWER KEY

1. (d)	5. (b)	9. (c)	12. (c)	15. (b)	18. (c)	21. (c)	24. (c)
2. (a)	6. (c)	10. (a)	13. (d)	16. (c)	19. (d)	22. (a)	25. (b)
3. (c)	7. (b)	11. (b)	14. (d)	17. (d)	20. (c)	23. (c)	
4. (a)	8. (a)						

Hints and solutions

1. **Option (a): Incorrect.** The passage does not suggest that **rural-to-urban migration** must be reduced. In fact, it describes **how labour is already moving out of agriculture**. The issue is not migration but the kind of jobs being created in the new sectors.

   Option (b): Incorrect. While working conditions in construction and unregistered manufacturing may indeed be poor, the passage **does not focus on improving these jobs**. It highlights that such sectors are not generating enough quality employment, not that conditions need improvement.

   Option (c): Incorrect. The service sector is described as *not generating sufficient jobs*, even though it is the most productive sector. Hence, it is not reducing unemployment.

   Option (d): Correct. The author mentions that only sectors that drive **domestic demand**, such as **health and education**, can fill the remaining half of the job gap. These are part of the **social sector**, implying that higher spending and focus on these areas are essential for large-scale employment generation.

   Hence, option (d) is correct.

2. **Statement 1: Correct.** The passage emphasizes that a right becomes **"substantive" only when it *works for everyone in all situations***. It argues that the State's duty is not just to remain passive but to ***actively ensure* rights are protected from private interference.** This clearly implies that the State must create **institutional mechanisms or frameworks** to safeguard rights like privacy in the digital age.

   Statement 2: Correct. The passage explicitly says that the role of the State is to "actively ensure that private parties are not able to block" an individual's right (originally in the context of expression, but equally applicable to privacy). Thus, protecting citizens from private violations is part of the State's responsibility.

   Statement 3: Incorrect. The passage does not criticize the digital economy or suggest incompatibility. It only acknowledges **new challenges** to privacy in the digital age, not that digital progress and privacy are mutually exclusive. The focus remains on the **State's role**, not on opposing digital growth.

   Hence, option (a) is correct.

3. **Option (a): Incorrect**. Although protecting wetlands under international conventions like Ramsar is important, the passage does not mention any treaty or legal framework. It discusses our *misunderstanding* of water as separate from ecosystems, not the need for legal protection.

   Option (b): Incorrect. The author criticizes the idea of merely engineering or augmenting water systems. The passage argues that we focus too much on water supply engineering instead of strengthening natural ecosystems like rivers and wetlands.

   Option (c): Correct. The passage clearly implies that **wetlands and rivers are not just sources of water** but integral parts of the natural ecosystem. Hence, they should be treated and strengthened as living ecological systems, not just as storage or supply units.

Chapter 6

Reading Comprehension
Solved PYQs 2021

Directions for the following 4 (four) items :
*Read the following **four** passages and answer the items that follow. Your answers to these items should be based on the passages only.*

Passage - 1

Researchers simulated street lighting on artificial grassland plots containing pea-aphids, sap-sucking insects, at night. These were exposed to two different types of light - a white light similar to newer commercial LED lights and an amber light similar to sodium street lamps. The low intensity amber light was shown to inhibit, rather than induce, flowering in a wild plant of the pea family which is a source of food for the pea-aphids in grasslands. The number of aphids was also significantly suppressed under the light treatment due to the limited amount of food available.

1. Which one of the following statements best reflects the most critical inference that can be made from the passage given above?
   (a) Low intensity light has more adverse effect on the plants as compared to high intensity light.
   (b) Light pollution can have a permanent adverse impact on an ecosystem.
   (c) White light is better for the flowering of plants as compared to the light of other colours.
   (d) Proper intensity of light in an ecosystem is important not only for plants but for animals too.

Passage - 2

Approximately 80 percent of all flowering plant species are pollinated by animals, including. birds and mammals, but the main pollinators are insects. Pollination is responsible for providing us with a wide variety of food, as well as many plant-derived medicines. At least one-third of the world's agricultural crops depend upon pollination. Bees are the most dominant taxa when it comes to pollination and they are crucial to more than four hundred crops. Pollination is an essential service that is the result of intricate relationships between plants and animals, and the reduction or loss of either affects the survival of both. Effective pollination requires resources, such as refuges of pristine natural vegetation.

2. On the basis of the passage given above, the following assumptions have been made:
   1. Sustainable production of India's cereal food grains is impossible without the diversity of pollinating animals.
   2. Monoculture of horticultural crops hampers the survival of insects.
   3. Pollinators become scarce in cultivated areas devoid of natural vegetation.
   4. Diversity in insects induces diversity of plants.

   Which of the above assumptions is/are valid?
   (a) 1 only (b) 2, 3 and 4 only
   (c) 1 and 2 only (d) 3 and 4 only

Passage - 3

A study conducted on the impacts of climate change over the Cauvery basin of Tamil Nadu using regional climate models showed an increasing trend for maximum and minimum temperatures, and a decrease in the number of rainy days. These climatic shifts will have an impact on the hydrological cycles in the region, lead to more run-off and less recharge, and affect the groundwater tables. Further, there has been an increase in the frequency of droughts in the State. This has driven farmers to increase dependency on groundwater resources to secure their crops.

ANSWER KEY

1. (b)	5. (d)	9. (a)	13. (c)	16. (b)	19. (d)	22. (c)	25. (c)
2. (d)	6. (a)	10. (d)	14. (c)	17. (a)	20. (a)	23. (b)	26. (d)
3. (c)	7. (a)	11. (d)	15. (c)	18. (c)	21. (b)	24. (d)	27. (b)
4. (c)	8. (c)	12. (d)					

Hints and solutions

1. **Option (a): Incorrect.**

The passage does not compare **low-intensity** and **high-intensity** light. It only says that low-intensity amber light inhibited flowering; there is no reference to what high-intensity light would do.

Option (b): Correct.

The experiment shows that **artificial lighting (light pollution)** at night affects both plants and insects. Amber light **inhibited flowering** of the pea plant, and since that plant is a **food source for aphids**, the number of aphids declined too. This demonstrates that **artificial light can disturb natural ecological processes** and lead to long-term disruptions in food chains — an adverse and possibly **lasting impact on the ecosystem.**

Option (c): Incorrect.

The passage never states that white light improves flowering. It only mentions that amber light inhibits it, without drawing a comparative conclusion about white light being better.

Option (d): Incorrect.

While the passage does show that light affects both plants and animals, the **core inference** goes beyond this — it's about the **broader ecological harm** caused by artificial light (light pollution), not just its importance for living organisms.

Hence, option (b) is correct.

2. **Statement 1: Incorrect.**

The passage says **"at least one-third of the world's agricultural crops depend upon pollination"**, but it doesn't claim that *cereal grains* specifically depend on it. Many cereals (like rice, wheat, maize) are **wind-pollinated**, not animal-pollinated. Hence, this assumption goes beyond the passage.

Statement 2: Incorrect.

The passage does not mention **monoculture** or crop diversity. While monoculture can indeed harm insect populations, that idea is not discussed or implied in the text.

Statement 3: Correct.

The passage clearly says that **"effective pollination requires resources, such as refuges of pristine natural vegetation."** This means that where such vegetation is missing (as in intensively cultivated areas), pollinators decline. Hence, this assumption directly follows from the passage.

Statement 4:

Correct.

The passage states that **"pollination is the result of intricate relationships between plants and animals, and the reduction or loss of either affects the survival of both."** This means that a diverse insect population helps maintain a diverse plant community, since they depend on each other for survival.

Hence, option (d) is correct.

Chapter 7

Reading Comprehension
Solved PYQs 2022

Directions for the following 3 (three) items :
Read the following ***two*** *passages and answer the items that follow. Your answers to these items should be based on the passages only.*

Passage - 1

The main threat to maintaining progress in human development comes from the increasingly evident unsustainability of production and consumption patterns. Current production models rely heavily on fossil fuels. We now know that this is unsustainable because the resources are finite. The close link between economic growth and greenhouse gas emissions needs to be severed for human development to become truly sustainable. Some developed countries have begun to alleviate the worst effects by expanding recycling and investing in public transport and infrastructure. But most developing countries are hampered by the high costs and low availability of clean energy sources. Developed countries need to support developing countries' transition to sustainable human development.

1. Unsustainability in production pattern is due to which of the following?
   1. Heavy dependence on fossil fuels
   2. Limited availability of resources
   3. Expansion of recycling

   Select the correct answer using the code given below.
   (a) 1 and 2 only (b) 2 only
   (c) 1 and 3 only (d) 1, 2 and 3

2. Consider the following statements :
   Developed countries can support developing countries' transition to sustainable human development by
   1. making clean energy sources available at low cost
   2. providing loans for improving their public transport at nominal interest rates
   3. encouraging them to change their production and consumption patterns

   Which of the statements given above is/are correct?
   (a) 1 only (b) 1 and 2 only
   (c) 2 and 3 only (d) 1, 2 and 3

Passage - 2

Unless the forces and tendencies which are responsible for destroying the country's environment are checked in the near future and afforestation of denuded areas is taken up on a massive scale, the harshness of the climatic conditions and soil erosion by wind and water will increase to such an extent that agriculture, which is the mainstay of our people, will gradually become impossible. The desert countries of the world and our own desert areas in Rajasthan are a grim reminder of the consequences of large-scale deforestation. Pockets of desert-like landscape are now appearing in other parts of the country including the Sutlej-Ganga Plains and the Deccan Plateau. Where only a few decades back there used to be lush green forests with perennial streams and springs, there is only brown earth, bare of vegetation, without any water in the streams and springs except in the rainy season.

3. According to the passage given above, deforestation and denudation will ultimately lead to which of the following?
   1. Depletion of soil resource
   2. Shortage of land for the common man
   3. Lack of water for cultivation

   Select the correct answer using the code given below.
   (a) 1 and 2 only (b) 2 and 3 only
   (c) 1 and 3 only (d) 1, 2 and 3

ANSWER KEY

1. (a)	5. (d)	9. (a)	13. (a)	16. (d)	19. (a)	22. (c)	25. (c)
2. (b)	6. (a)	10. (a)	14. (d)	17. (b)	20. (b)	23. (a)	26. (c)
3. (c)	7. (a)	11. (c)	15. (b)	18. (d)	21. (a)	24. (c)	27. (d)
4. (c)	8. (d)	12. (b)					

Hints and solutions

1. **Statement 1: Correct.**

The passage clearly says: *"Current production models rely heavily on fossil fuels. We now know that this is unsustainable because the resources are finite."*

Hence, dependence on fossil fuels is one of the **main reasons** for unsustainable production patterns.

Statement 2: Correct.

The passage directly mentions that fossil fuels are **finite**, meaning they are limited and exhaustible. Therefore, **limited resource availability** also makes current production models unsustainable.

Statement 3: Incorrect.

Expansion of recycling is actually described as a **positive measure** being taken by developed countries to alleviate environmental problems. It is not a cause of unsustainability but part of the **solution**.

Hence, option (a) is correct.

2. **Statement 1: Correct.**

The passage says that developing countries face "high costs and low availability of clean energy sources." This directly implies that developed countries can support them by making such energy affordable and accessible.

Statement 2: Correct.

Developed countries have "invested in public transport and infrastructure" to mitigate environmental effects. Extending low-interest loans for similar projects in developing countries aligns with the passage's idea of providing material and financial support.

Statement 3:

Incorrect.

While the passage mentions that current production and consumption models are unsustainable, it does not say that developed countries should actively *encourage* developing nations to change them. The focus is on tangible assistance, not on directing policy choices.

Hence, option (b) is correct.

3. **Statement 1:** Correct.

The passage clearly mentions "soil erosion by wind and water will increase," which directly means the loss or depletion of soil resources. This is one of the major effects of deforestation and denudation.

Statement 2: Incorrect.

There is no mention of shortage of land for people. The passage focuses on environmental degradation and decline in agricultural viability, not on lack of available land for habitation or ownership.

Statement 3: Correct.

The passage says that areas which once had "perennial streams and springs" now have "no water... except in the rainy season." This clearly points to water scarcity for cultivation.

Therefore, the correct answer is (c) 1 and 3 only.

Hence, option (c) is correct.

Chapter 8 Reading Comprehension Solved PYQs 2023

Directions for the following 3 (three) items : *Read the following* ***three*** *passages and answer the items that follow. Your answers to these items should be based on the passages only.*

Passage - 1

We often hear about conflicts among different States in India over river waters. Of the 20 major river systems, 14 are already water-stressed; 75% of the population lives in water-stressed regions, a third of whom live in water-scarce areas. Climate change, the demands of rising population and the need for agriculture to keep pace, and increased rate of urbanization and industrialization will exacerbate water stress. According to the Constitution of India, water is a State subject and not that of the Union, except for regulation of inter-State rivers. Key to ensuring balance between competing demands of various stakeholders is a basin-based approach to allocate water amongst constituent regions and States. Allocating fair share of water to them requires assessments based on objective criteria, such as specificities of the river basin, size of dependent population, existing water use and demand, efficiency of use, projected future use, etc. while ensuring the environmental needs of the river and aquifers.

1. Which one of the following statements best reflects the most rational, practical and immediate action required to ensure fair and equitable allocation of water to different stakeholders?
   (a) A national, pragmatic, legal and policy framework for water allocation should be made.
   (b) All river systems of the country should be linked and huge aquifers created.
   (c) Water channels between regions of water surplus and regions of water deficit should be created.
   (d) To mitigate water crisis, water demand of sectors such as agriculture and industry should be reduced.

Passage - 2

More than half of Indian women and almost a quarter of Indian men of working age suffer from anaemia. According to studies, they are anywhere from 5 — 15% less productive than they could be, as a result thereof. India also has the largest tuberculosis burden in the world, costing 170 million workdays to the country annually. But what is just as important as lost productivity now is lost potential in the future. It is becoming increasingly clear that on many measures of cognitive ability, malnourished Indian children perform two or three times worse than their adequately nourished peers. For an economy that will be more dependent on highly skilled workers, this poses a significant challenge. And it is one that really should be addressed given India's demographic outlook.

2. Which one of the following statements best reflects what is implied by the passage ?
   (a) Education system must be strengthened in rural areas.
   (b) Large scale and effective implementation of skill development programme is the need of the hour.
   (c) For economic development, health and nutrition of only skilled workers needs special attention.
   (d) For rapid economic growth as envisaged by us, attention should be paid to health and nutrition of the people.

Passage - 3

In India, a majority of farmers are marginal and small, less educated and possess low adaptive capabilities to climate change, perhaps because of credit and other constraints. So, one cannot expect autonomous adaptation to climate change. Even if

ANSWER KEY

1. (a)	5. (a)	9. (b)	13. (c)	16. (a)	19. (a)	22. (d)	25. (b)
2. (d)	6. (b)	10. (d)	14. (b)	17. (a)	20. (a)	23. (b)	26. (b)
3. (c)	7. (b)	11. (c)	15. (a)	18. (d)	21. (d)	24. (c)	27. (d)
4. (c)	8. (b)	12. (b)					

Hints and solutions

1. **Option (a): Correct.** The passage emphasizes the **need for a fair and equitable water allocation system** through a **basin-based approach** that accounts for factors like **river basin specifics, population size, water use, efficiency**, and **environmental needs**. A **national legal and policy framework** is essential to ensure the **objective and balanced allocation** of water across different regions and stakeholders, addressing the pressing water stress issues.

   Option (b): Incorrect. Linking **all river systems** and creating **huge aquifers** might help distribute water, but it does not directly **address the need for a structured, fair allocation system** based on the criteria mentioned in the passage. This is more of a long-term infrastructural solution rather than a **practical, immediate action**.

   Option (c): Incorrect. Creating **water channels** between surplus and deficit regions is a practical idea, but it is not the most **immediate and effective solution** in the context of the passage. The focus here is on **policy frameworks** to manage water allocation, not just physical infrastructure.

   Option (d): Incorrect. Reducing **water demand** in sectors like agriculture and industry might be a **part of the solution**, but the primary need in the passage is to **allocate water fairly** using a comprehensive **legal and policy framework**. This is not about merely reducing demand, but about **managing water distribution** efficiently.

   Hence, option (a) is correct.

2. **Option (a): Incorrect.**

   The passage does not focus specifically on the **education system** or its strengthening in rural areas. The primary concern is the **impact of malnutrition and health issues** on cognitive abilities and productivity, which ultimately affects the nation's **economic growth**. Education is indirectly related, but the emphasis is on health and nutrition, not just education.

   Option (b): Incorrect.

   While **skill development programs** are important, the passage emphasizes that **malnutrition** and **health issues** are the main barriers to cognitive ability and productivity. The issue is not only about developing skills but ensuring a **healthy population** capable of performing at their best.

   Option (c): Incorrect.

   The passage is not focused only on **skilled workers** but on the general population, especially **children** who suffer from **malnutrition**, which impacts **cognitive ability** and future economic productivity. It stresses the **health and nutrition** of **everyone**, not just skilled workers.

   Option (d): Correct.

   The passage discusses how **malnutrition and poor health** are significant challenges for India's **economic development**, especially as the country moves toward **a more skilled workforce**. **Improving health and nutrition** across the population is necessary for **economic growth** in the long term.

   Hence, option (d) is correct.

Chapter 9 Reading Comprehension Solved PYQs 2024

Directions for the following 4 (four) items :
*Read the following **two** passages and answer the items that follow. Your answers to these items should be based on the passages only.*

Passage - 1

According to the Food and Agriculture Organization, one-third of food produced for human consumption is lost or wasted globally. Food is lost or wasted throughout the supply chain, from initial agricultural production to final household consumption. The increasing wastage also results in land degradation by about 45%, mainly due to deforestation, unsustainable agricultural practices, and excessive groundwater extraction. The energy spent over wasted food results in about 3.5 billion tonnes of carbon dioxide production every year. Decay also leads to harmful emissions of other gases in the atmosphere. Addressing the loss and wastage of food in all forms is critical to complete the cycle of food sufficiency and food sustainability.

1. Which of the following statements best reflect the most logical and rational inferences that can be made from the passage ?
   1. The current methods of food distribution are solely responsible for the loss and wastage of food.
   2. Land productivity is adversely affected by the prevailing trend of food loss and wastage.
   3. Reduction in the loss and wastage of food results in lesser carbon footprint.
   4. Post-harvest technologies to prevent or reduce the loss and wastage of food are not available.

   Select the correct answer using the code given below.
   (a) 1, 2 and 3 (b) 2 and 3 only
   (c) 1, 3 and 4 (d) 1, 2 and 4

2. Based on the above passage, the following assumptions have been made:
   1. The food distribution mechanism needs to be reimagined and made effective to reduce the loss and wastage of food.
   2. Ensuring the reduction of wastage and loss of food is a social and moral responsibility of an citizens.

   Which of the assumptions given above is/are valid ?
   (a) 1 only (b) 2 only
   (c) Both 1 and 2 (d) Neither 1 nor 2

Passage - 2

As inflation rises, even governments previously committed to budget discipline are spending freely to help households. Higher interest rates announced by central banks are to supposed to help produce modest fiscal austerity, because to maintain stable debts while paying more to borrow, governments must cut spending or raise taxes. Without the fiscal backup, monetary policy eventually loses traction. Higher interest rates become inflationary, not disinflationary, because they simply lead governments to borrow more to pay rising debt-service costs. The risk of monetary unmooring is greater when public debt rises, because interest rates become more important to budget deficits.

3. Which of the following statements best reflects/ reflect the most logical and rational inference/ inferences that can be made from the passage?
   1. Central banks cannot bring down inflation without budgetary backing.
   2. The effects of monetary policy depend on the fiscal policies pursued by the government.

   Select the correct answer using the code given below.
   (a) 1 only (b) 2 only
   (c) Both 1 and 2 (d) Neither 1 nor 2

ANSWER KEY

1. (b)	5. (a)	9. (d)	13. (b)	16. (c)	19. (a)	22. (c)	25. (c)
2. (c)	6. (a)	10. (c)	14. (c)	17. (d)	20. (b)	23. (a)	26. (d)
3. (c)	7. (b)	11. (d)	15. (a)	18. (a)	21. (c)	24. (d)	27. (d)
4. (d)	8. (c)	12. (d)					

Hints and solutions

1. **Statement 1: Incorrect.** The passage **does not state that the current methods of food distribution** are solely responsible for food loss and wastage. While **food** is wasted throughout the supply chain, the passage focuses more on factors like unsustainable agricultural practices, deforestation, and excessive groundwater extraction.

   Statement 2: Correct. The passage discusses how food loss and wastage contribute to land degradation, which adversely affects land productivity. This aligns with the inference that food wastage negatively impacts land productivity.

   Statement 3: Correct. The passage explicitly mentions that food waste leads to harmful emissions, including carbon dioxide, contributing to a larger carbon footprint. This supports the idea that reducing food loss and wastage would result in a smaller carbon footprint.

   Statement 4: Incorrect. The passage does not indicate that post-harvest technologies are unavailable. It doesn't mention any specific lack of technologies but rather focuses on the need to address food loss and wastage more effectively.

   Hence, option (b) is correct.

2. **Assumption 1: Correct.** The passage highlights the **need to address food wastage** through better management, implying that an **effective food distribution mechanism is necessary**. This supports the assumption that the distribution system needs rethinking to reduce wastage.

   Assumption 2: Correct. The passage suggests that **reducing food wastage is critical for sustainability and environmental health**, which can be interpreted as a moral and social responsibility. It implies that citizens must take responsibility for addressing food loss and wastage.

   Hence, option (c) is correct.

   Statement 1: Correct. The passage indicates that without fiscal backup, monetary policy loses its effectiveness, implying central banks cannot reduce inflation without budgetary support. This makes assumption 1 valid.

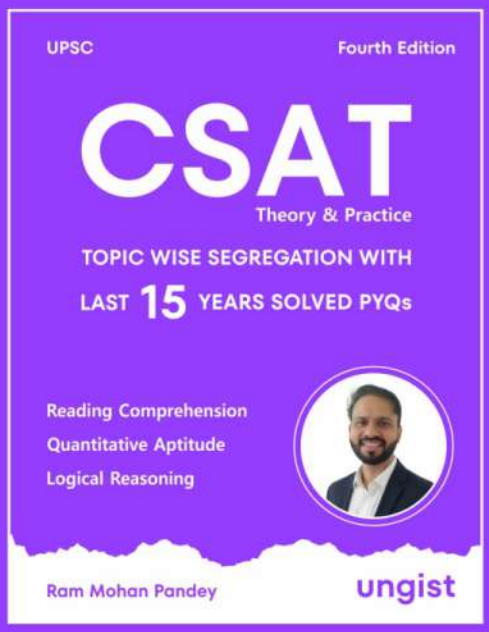
   Statement 2: Correct. The passage highlights that the impact of monetary policy is influenced by government fiscal policies, especially in terms of borrowing and debt service costs. This supports assumption 2.

   Hence, option (c) is correct.

4. **Assumption 1: Incorrect.** The passage **does not state that fiscal policies alone** are responsible for higher prices; it focuses on the interaction between fiscal policies, monetary policies, and debt, suggesting a more complex relationship.

   Assumption 2: Incorrect. The passage **does not mention that higher prices do not affect long-term government bonds**. It discusses the impact of higher interest rates and debt-service costs on government spending, indirectly linking fiscal policies to market conditions.

   Hence, option (d) is correct.



The journey of the CSAT paper has changed dramatically in the last few years. What was once seen as a qualifying hurdle has now become a test of clarity, patience, and true analytical ability. With UPSC steadily shifting toward logic based and application oriented questions since 2021, aspirants from every background, including mathematics and engineering, have felt the increasing weight of this paper.

As a teacher, my greatest joy has been watching students discover that CSAT is not about memorizing formulas, it is about understanding how we think, decide and apply logic in everyday situations. Some of the most beautiful moments in the classroom happen when a concept suddenly "clicks" and a student's confidence rises. Yet, I also see the uncertainty many aspirants feel because they struggle to find high-quality practice questions that truly reflect the UPSC standard. It is that concern, repeated year after year, that inspired the creation of this book.

With every edition, I have tried to stay true to one purpose to give students a resource that builds clarity, confidence and genuine competence.

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