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Logical Reasoning

INTRODUCTION

Mathematical Reasoning is a skill that allows us to employ critical thinking. It has a logical approach. It is a type of deductive reasoning, which is the process of reasoning from one or more statements (premises) to reach a logical conclusion. In this chapter, we shall learn Coding-decoding, Blood-relations, Odd man out and Syllogism.

LOGICAL REASONING

Logical reasoning is the process of using systematic series of steps based on sound mathematical procedures and given statements to arrive at a conclusion.

Logical reasoning tests are the part of most of the competitive exams. These tests are designed to assess one's ability at skills such as coding-decoding, interpreting patterns, number sequences or the relationships between the persons etc.

In this chapter you will learn about coding-decoding, blood relations, odd man out and syllogism.

Coding-Decoding

Coding is a rule for converting the information in the form of letters, words or phrases into same or other form of representation.

Decoding is the reverse process of coding. It converts the message sent by a source into the information which can be understood by the receiver.

Some basic methods of coding-decoding are given below.

Letter Coding

In this type of coding, the real alphabets in a word are replaced by certain other alphabets according to a specific rule. For decoding, we have to detect that specific rule.

For this type of coding, the knowledge of English alphabets and their positions is very necessary.

Alphabets and their positions:

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

For fast recalling of alphabets and their positions, we should write the alphabets in a group of 5 as given below:

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

Remember the word

E	J	O	T	Y
5	10	15	20	25

It will help us to recall alphabets and their positions.

For example: For position of alphabet I, we know that I comes just before J, so position of I = 10 – 1 = 9. Similarly, for position of W, we know that W is third alphabet from T, so position of W = 20 + 3 = 23.

In letter coding, we have different patterns given below:

(*i*) **Repetition pattern:** In this type of pattern, same letters in different order are used for coding. For examples,

1. CRICKET is coded as TEKCIRC.

Here, you can see that letters are written in reverse order.

2. CRICKET is coded as EITKCRC.

Here, vowels are written first then consonants, both in reverse order.

3. CRICKET is coded as CCEIKRT.

Here, letters are written in alphabetical order.

4. MULTIPLICATION is coded as LPITLUMNOITACI.

Here, split the word in two equal parts MULTIPL : ICATION, then write each part in reverse order *i.e.* LPITLUM : NOITACI.

(*ii*) **Addition-subtraction pattern:** In this type of pattern, we add or subtract or both to obtain the new position of the letter. For examples,

1. PLAYER is coded as QNDCJX.

Here,	P	L	A	Y	E	R
	+1↓	+2↓	+3↓	+4↓	+5↓	+6↓
	Q	N	D	C	J	X

2. SPHERE is coded as TOIDSD.

Here,	S	P	H	E	R	E
	+1↓	–1↓	+1↓	–1↓	+1↓	–1↓
	T	O	I	D	S	D

3. JAIPUR is coded as MDLSXU.

Here,	J	A	I	P	U	R
	+3↓	+3↓	+3↓	+3↓	+3↓	+3↓
	M	D	L	S	X	U

(*iii*) **Multiplication pattern:** In this type of pattern, we multiply the positions of letters to obtain new positions. For example,

1. PENCIL is coded as FJBFRX.

Here,	P	E	N	C	I	L
	↓	↓	↓	↓	↓	↓
	16	5	14	3	9	12
	× 2	× 2	× 2	× 2	× 2	× 2
	32	10	28	6	18	24
	−26		−26			
	6		2			
	F	J	B	F	R	X

ILLUSTRATIVE EXAMPLES

Example 1. *In a certain language if 'GANGA' is coded as AGNAG, how is 'YAMUNA' coded?*

Solution. Clearly, letters of the word GANGA are written in reverse order to obtain AGNAG.

So, 'YAMUNA' is coded as 'ANUMAY'.

Example 2. *In a certain language if 'PLATINUM' is coded as 'AILMNPTU', how 'DIAMOND' is coded?*

Solution. Clearly, the letters of the word 'PLATINUM' are written in alphabetical order to obtain 'AILMNPTU'.

So, 'DIAMOND' is coded as 'ADDIMNO'.

Example 3. *In a certain language if 'COMPUTER' is coded as 'OUECMPTR' how 'CALCULATOR' is coded?*

Solution. Clearly, the vowels of the word COMPUTER are written first, then all the consonants without changing their order.

So, 'CALCULATOR' is coded as 'AUAOCLCLTR'.

Example 4. *In a certain language if 'LUCKNOW' is coded as 'NWEMPQY', how is 'DELHI' coded?*

Solution. Clearly, each letter of the word LUCKNOW is moved two steps forward to obtain the corresponding code

	L	U	C	K	N	O	W
+2	↓	↓	↓	↓	↓	↓	↓
	N	W	E	M	P	Q	Y

So

	D	E	L	H	I
+2	↓	↓	↓	↓	↓
	F	G	N	J	K

∴ 'DELHI' is coded as 'FGNJK'.

Example 5. *In a certain language if 'INDIA' is coded as 'KMFHC', how 'AMERICA' is coded?*

Solution.

		M		H	
		−1↑		−1↑	
I	N	D	I	A	
+2↓		+2↓		+2↓	
K		F		C	

Clearly, the letters of the word 'INDIA' are moved 2 steps forward and one step backward alternately.

So

	L		Q		B	
	−1↑		−1↑		−1↑	
A	M	E	R	I	C	A
+2↓		+2↓		+2↓		+2↓
C		G		K		C

∴ AMERICA' is coded as 'CLGQKBC'.

Example 6. *In a certain language if 'JOKER' is coded as 'QLPVI', how 'CLOWN' is coded?*

Solution. We divide the alphabets in two equal parts and draw a line of symmetry in between as shown below:

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
13	12	11	10	9	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	9	10	11	12	13

It is clear that J which is fourth left from line is replaced by Q which is fourth right from the line.

Similarly, O is replaced by L, K is replaced by P, E is replaced by V and R is replaced by I.

So 'CLOWN' is coded as 'XOLDM'.

Example 7. *In a certain language if 'SHARPNER' is coded as 'LPBJFBJJ', how 'ERASER' is coded?*

Solution. Clearly, new positions of the letters of word 'SHARPNER' are obtained by multiplying the original position by 2.

Here,

S	H	A	R	P	N	E	R
↓	↓	↓	↓	↓	↓	↓	↓
19	8	1	18	16	14	5	18
× 2	× 2	× 2	× 2	× 2	× 2	× 2	× 2
38	16	2	36	32	28	10	36
−26			−26	−26	−26		−26
12			10	6	2		10
L	P	B	J	F	B	J	J

So,

E	R	A	S	E	R
↓	↓	↓	↓	↓	↓
5	18	1	19	5	18
× 2	× 2	× 2	× 2	× 2	× 2
10	36	2	38	10	36
	−26		−26		−26
	10		12		10
J	J	B	L	J	J

'ERASER' is coded as 'JJBLJJ'.

Number Coding

In this type of coding, the real alphabets in a word are replaced by certain number or digits according to a specific rule.

Example 8. *If 'RAHUL' is coded as 22 – 5 – 12 – 25 – 16, then how will you code 'VIRAT'?*

Solution. Here R is coded as 22 which is its actual positions 18 + 4.

Similarly, A is coded as 1 + 4 *i.e.* 5.

H is coded as 8 + 4 = 12, U is coded as 21 + 4 = 25 and L is coded as 12 + 4 = 16.

∴ V is equivalent to 22 + 4 = 26

I is equivalent to 9 + 4 = 13

R is equivalent to 18 + 4 = 22

A is equivalent to 1 + 4 = 5

and T is equivalent to 20 + 4 = 24

∴ 'VIRAT' will be coded as 26 – 13 – 22 – 5 – 24.

Example 9. *If 'N' is coded as 28, 'X' is coded as 48 and 'CUT' is coded as 88, then how is 'PUT' coded?*

Solution. Here N is coded as 28 which is its actual position 14 × 2. Similarly, X is coded as 24 × 2 = 48 and CUT = 3 × 2 + 21 × 2 + 20 × 2 = 88

∴ PUT = 16 × 2 + 21 × 2 + 20 × 2 = 114

Hence 'PUT' is coded as 114.

Example 10. *If 'GOMTI' is coded as 74521 and 'YAMUNA' is coded as 835963, then how is 'GANGA' coded?*

Solution. Here

G	O	M	T	I		Y	A	M	U	N	A
↓	↓	↓	↓	↓		↓	↓	↓	↓	↓	↓
7	4	5	2	1		8	3	5	9	6	3

G is coded as 7, A as 3 and N as 6

∴ 'GANGA' is coded as 73673

Example 11. *In a certain language PAC is coded as 61, how will NEP be coded?*

Solution. If we arrange the English alphabets in reverse order, then positions of P, A and C are 11, 26 and 24 respectively. When we add these numbers, we get 61. Similarly, the reverse position numbers of N, E and P are 13, 22 and 11 respectively. On adding these numbers, we get 13 + 22 + 11 = 46.

Hence, NEP will be coded as 46.

Symbols for letters

In this type of coding, the real alphabets in a word are replaced by different symbols such as *, #, @, &, ?, %, ∧, ∨ etc according to a specific rule.

Example 12. *If MADAM is coded as * ? # ? * and LOOM is coded as & % % *, then how will you code LAD?*

Solution. Here, we observe that letter M is coded as *, A by ?, D by #, L by & and O by %. So, LAD will be coded as & ? #.

Group Coding

In this type of coding three or more messages are coded in terms of words or numbers according to a specific rule. To decode a particular word, we take two messages containing the same word or number. The common code words will mean that word or number.

Example 13. *In a certain code language 327 means 'Truth is eternal', 7983 means 'Enmity is not eternal' and 9426 means 'Truth does not perish'. What does 'Enmity' mean in this language?*

Solution. In the first and second statements common codes are 3 and 7, and common words are 'is' and 'eternal'.

In the first and third statements, common code is 2 and the common word is 'truth'.

So code 2 means 'truth'

In the second and third statements common code is 9 and the common word is 'not'.

So code 8 stands for word 'Enmity'.

Example 14. *In a certain code language 'She is mother' means 'Rahul told father', 'She teaches Chemistry' means 'Rahul plays football' and 'Mother teaches Science' means 'Father plays cricket'. Which word is coded as Science?*

Solution. In the first and third statements common code is mother and common word is father.

So father is coded as mother.

In the second and third statements common code is teaches and common word is plays.

So plays is coded as teaches.

$\therefore$ Cricket is coded as Science.

Letter for digits

In this type of coding digits are coded as letters in mathematical operations like addition, subtraction, multiplication or division. For decoding, we have to use the basics of mathematical operations.

To decode these type of messages, we follow the rules given below:

1. Each letter must stand for just one digit *i.e.* each digit must be represented by just one letter.
2. The first digit (from left) of a number cannot be zero. For example, we write the number sixty five as 65 not as 065 or 0065.

Example 15. *Find A and B in the addition*

$$\begin{array}{r} 1\ 2\ A \\ +\ 6\ A\ B \\ \hline A\ 0\ 9 \\ \hline \end{array}$$

Solution. Observe the unit column of the addition.

As A + B cannot exceed 18 and the unit digit in the sum is 9, so A + B = 9.

This is possible when

A = 1, B = 8; A = 2, B = 7, ... , A = 8, B = 1.

Now, observe ten's column

As 2 + A cannot exceed 11 and the digit below the sum of ten's column is 0, therefore 2 + A = 10

$\Rightarrow$ A = 8

$\therefore$ A = 8, B = 1

Now check the sum

$$\begin{array}{r} 1\ 2\ \textcircled{8} \\ +\ 6\ \textcircled{8}\ \textcircled{1} \\ \hline \textcircled{8}\ 0\ 9 \\ \hline \end{array}$$

Hence, the required digits are A = 8, B = 1.

Example 16. *Find the digits A, B and C in the multiplication*

$$\begin{array}{r} A\ B \\ \times\ 3 \\ \hline C\ A\ B \\ \hline \end{array}$$

Solution. Observe the unit column.

For B × 3, we get a number whose unit digit is B.

This is possible only when B = 5 or B = 0

When B = 5, then

$$\begin{array}{r} \overset{(1)}{} \\ A\ 5 \\ \times\ 3 \\ \hline C\ A\ 5 \\ \hline \end{array}$$

Now observe the multiplication of 3 by A

$3 \times A + 1 = CA$

It means (multiplication of 3 by A) + 1 is a number whose unit digit is A. So, $A \neq 5$.

Now, if A have values 1, 2, 3, 4, 6, 7, 8, 9, then on checking we find that no value of A will satisfy the equation

$3 \times A + 1 = CA$

$\therefore$ $B \neq 5$.

Now when B = 0, then

$$\begin{array}{r} A\ 0 \\ \times\ 3 \\ \hline C\ A\ 0 \\ \hline \end{array}$$

Observe the multiplication of 3 by A

$3A = CA$

It is possible only when A = 5 $(\because A \neq 0)$

$3 \times 5 = 15 \Rightarrow C = 1$

$\therefore$ $A = 5, B = 0, C = 1.$

EXERCISE 8.1

1. In a certain language 'ORANGE' is coded as 'AEGNOR', how 'PINEAPPLE' is coded?
2. In a certain language 'MIXTURE' is coded as 'ERUTXIM', how 'SOLUTION' is coded?
3. In a certain language 'REGISTRATION' is coded as 'TSIGERNOITAR', how 'PUBLICATIONS' is coded?
4. In a certain language 'START' is coded as UQEMZ and 'EXCEL' is coded as GUGZR. How is 'PANIC' coded?
5. In a certain language 'SACHIN' is coded as RZBGHM. How 'ISHANT' is coded?
6. In a certain language 'QUEEN ' is coded as OVCFL. How is 'KING' coded?
7. In a certain language 'TEACHER' is coded as GVZXSVI. How is 'STUDENT' coded?
8. If 'REPUBLIC' is coded as TGRWDNKE taken what information can be obtained from the message FGOQETCVKE?
9. In a certain language 'AGRA' is coded as 'CUBC', how 'JHANSI' is coded?
10. In a certain language 'TABLE' is coded as 'NBDXJ', how 'CHAIR' is coded?
11. If 'MIRINDA' is coded as 151120111663 then how is THUMSUP coded?
12. In a certain language 'VIOLET' is coded as 196129217. Decode 1215241142.
13. If 'POOR' is coded as 46 and 'BLOWER' is coded as 57 then how is 'TOWER' coded?
14. In a certain language if 'CORONA' is coded as 6 and 'MALARIA' is coded as 5 then how is 'CANCER' coded?

15. If 'PETER' is coded as 64841, 'SERVENT' is coded as 5412478 and 'MASTER' is coded as 935841, then how is 'PERMANENT' coded?
16. In a certain language 458 means "All is well," 876 means "Well done boys" and 689 means "Boys played well". What does 'played' mean in this language?
17. In a certain language 123 means "He is good", 456 means "You are bad" and 472 means "Good and bad". What does 'and' means in this language?
18. In a certain language 'fli cdo vas' means 'Doctors save life', 'erp fli si' means 'life is precious' and 'dgo can cdo' means 'Doctors are god. What word stand for 'Save' in this language?
19. In a certain code 'mte ves rme' means 'Save more time', 'emt rfo two' means 'Wait for me' and 'rme vge emt' means 'Give me more'. What does 'Give' mean in this language?

Find the values of the letters in each of the following and give reasons for the steps involved (20 to 26):

20.
$$\begin{array}{r} 3\ 1\ Q \\ +\ 1\ Q\ 3 \\ \hline 5\ 0\ 1 \\ \hline \end{array}$$

21.
$$\begin{array}{r} 2\ A\ B \\ +\ A\ B\ 1 \\ \hline B\ 1\ 8 \\ \hline \end{array}$$

22.
$$\begin{array}{r} B\ 3\ 4\ 5 \\ +\ C\ 9\ B\ A \\ \hline 8\ B\ A\ 2 \\ \hline \end{array}$$

23.
$$\begin{array}{r} B\ A \\ \times\ B\ 3 \\ \hline 5\ 7\ A \\ \hline \end{array}$$

24.
$$\begin{array}{r} A\ B \\ \times\ 5 \\ \hline C\ A\ B \\ \hline \end{array}$$

25.
$$\begin{array}{r} A\ A\ B \\ \times\ B \\ \hline 8\ 8\ A \\ \hline \end{array}$$

26.
$$\begin{array}{r} A\ B \\ \times\ B\ A \\ \hline B\ C \\ 1\ A\ B\ C \\ \hline 1\ D\ C\ C \\ \hline \end{array}$$

Answers

1. AEEILNPPP **2.** NOITULOS **3.** CILBUPSNOITA
4. RXRDI **5.** HRGZMS **6.** IJLH **7.** HGFWVMG
8. DEMOCRATIC **9.** DXCPEA **10.** FPBRJ **11.** 22102315212318
12. ORANGE **13.** 18 **14.** 4 **15.** 641937478
16. 9 **17.** 7 **18.** vas **19.** vge
20. Q = 8 **21.** A = 4, B = 7 **22.** A = 7, B = 2, C = 5
23. A = 5, B = 2 **24.** A = 5, B = 0, C = 2; A = 2, B = 5, C = 1; A = 7, B = 5, C = 3
25. A = 4, B = 2 **26.** A = 2, B = 5, C = 0, D = 3