

CHAPTER – 6

BINARY LOGIC

In some of the competitive exams, we come across questions which are to be answered based on the truth or falsity of statements given in the question. In these questions we come across three kinds of terms. They are 'Truth-Teller', 'Liar' and 'Alternator'. These terms may or may not be explicitly defined in the question. The following are the definitions of these terms, which can be applied while answering these questions, unless otherwise defined.

Truth-teller: - A person whose each and every statement is true.

Liar: - A person whose each and every statement is false.

Alternator: - If first statement of the person is true, the next statement is false or vice versa.

The question does not specify as to which statement is true or false. It has to be found out by trial and error and by checking for consistency in the given statement. The following illustration helps in understanding the concept.

Example: Among the three persons A, B and C, one is a truth-teller, one is a liar and the other is an alternator. Each of them made the following statements in reply to the question asked about them.

A : I am not the liar. C is the liar.
B : I am the liar. A is the truth-teller.
C : I am the alternator. B is the liar.

Find out who the truth-teller is who the liar is and who the alternator is.

Solution : The statement, 'I am not the liar', could be that of a truth-teller or of a liar or of an alternator. Hence, we cannot find out the nature of A. From the statement of B i.e., 'I am a liar', it can be concluded that B is the alternator, because neither a truth-teller nor a liar would say that he is a liar. Hence the second statement of B, i.e., 'A is the truth-teller' is true. From the above, it can be concluded that the statement of C i.e., I am the alternator is false. Hence, C is the liar. Let us check the truth in each of the statements of A, B and C with the help of the conclusions made.

A : I am not the liar (True). C is the liar (True).
B : I am the liar (False). A is the truth teller (True).
C : I am the alternator (False). B is the liar (False).

From the above, it is clear that the conclusions made i.e., A is the truth teller (both the statements are true), B is the alternator (one statement is true and the other is false) and C is the liar (both the statements are false), are correct. The questions asked may have one, two, three or even four statements made by each person.

Exercise – 6(a)

Directions for questions 1 to 7: Select the correct alternative from the given choices.

1. In 'Saka-misa' city, there are two types of people – Truth-tellers and liars. Truth-tellers always speak the truth and liars always tell lies. One day I met three people Kiran, Lalit and Manish of 'Saka-misa' city and asked them 'Who among you is the truth teller?'
The following were their replies:
Kiran : I am not a liar.
Lalit : Manish is not a liar.
Manish : Lalit is a truth-teller.
If it was known that exactly one person among the three was a truth-teller and the other two were liars, then who among them must be the truth-teller?
(A) Kiran (B) Manish
(C) Lalit (D) Cannot be determined
2. One day I met three persons A, B and C, each of whom belonged to a different tribe amongst Truth-tellers, Liars and Alternators. It is also known that the Truth-tellers always speak the truth, the liars always tell lies and the Alternators alternate between truth and lies, in any order. When asked to introduce themselves, each of them gave two replies, as given below.
A: B is the Liar. I am the Truth-teller.
B: I am not the Liar. C is the Truth-teller.
C: A is not the Truth-teller. I am not the Liar.
Who among the three persons is a Liar?
(A) A (B) B
(C) C (D) Cannot be determined
3. Police arrested three persons – Charles, Raj and Soban - on suspicion, in a theft case. It was found that one among these three was the thief. During the interrogation, their replies were as follows:
Charles: I am not the thief. Raj is the thief.
Raj: I am not the thief. Either Charles or Soban is the thief.
Soban: I am not the thief. Raj is not the thief.
If exactly one person among them always speaks the truth, another always tells lies and the third alternates between the truth and lies, then who is the thief?
(A) Charles
(B) Soban
(C) Raj
(D) Cannot be determined
4. Three friends – Akshay, Sanjay and Sunil were of different heights. When asked "Who among you three is the tallest?", the following were their replies:
Akshay: I am the tallest. Sanjay is not the 2nd tallest.
Sanjay: I am the tallest. Akshay is the shortest.
Sunil: I am the tallest. Sanjay is the shortest.
It is known that one among them always tells the truth, one always tells lies and one alternates between the truth and lies (not necessarily in the same order). Who can never be the 2nd tallest?
(A) Akshay
(B) Sanjay
(C) Sunil
(D) Cannot be determined

5. Three sprinters – Johnson, Bailey and Jones – participated in a 100 m race and each one of them won exactly one medal among Gold, Silver and Bronze. Exactly one among them always speaks the truth, another always tells lies and the last person always alternates between truth and lie (in any order). When asked about the medal each of them won, the following were their replies :
Johnson: Bailey won Gold. I won Bronze.
Bailey: Jones won Silver. Johnson did not win Gold.
Jones: Bailey won Bronze. Johnson did not win Silver.
Who won the Gold, Bronze and Silver respectively?
(A) Johnson, Bailey, Jones
(B) Bailey, Jones, Johnson
(C) Jones, Johnson, Bailey
(D) Johnson, Jones, Bailey
6. In a class, three students – Kashyap, Laxman and Mehar – are the top three rankers, i.e., 1st, 2nd and 3rd, in any order. Each student among them gives two replies to any question, one of which is true and the other is false (in any order). When asked about the ranks they got, the following were their replies.
Laxman: I got the first rank. Kashyap got the second rank.
Mehar: I got the first rank. Laxman got the second rank.
Kashyap: I got the first rank. Laxman got the third rank.

Which among the following is the correct order of the persons who got the first, the second and the third ranks respectively?

- (A) Kashyap, Laxman, Mehar
- (B) Mehar, Laxman, Kashyap
- (C) Mehar, Kashyap, Laxman
- (D) Laxman, Mehar, Kashyap

7. Each of Raman, Pranay and Yashwant is the professor of a different subject among – Physics, Chemistry and Mathematics, not necessarily in the same order. Each professor gives two replies to any question asked to them, at least one of which is true. When asked about their subjects, there is exactly one professor who always speaks the truth. The following were their replies:
Raman: I am a Physics professor. Yashwant is the Chemistry professor.
Yashwant: I am a Mathematics professor. Raman is the Chemistry professor.
Pranay: I am not a Physics professor. Raman is not the Mathematics professor.

Which among the following is the correct order of the professors of Physics, Chemistry and Mathematics respectively?

- (A) Raman, Pranay, Yashwant
- (B) Pranay, Yashwant, Raman
- (C) Raman, Yashwant, Pranay
- (D) Yashwant, Raman, Pranay

Directions for questions 8 to 10: These questions are based on the data given below.

Each of the three players – Kambli, Kumble and Krishnan – plays exactly one game among Cricket, Football and Tennis, not necessarily in the same order. Each player always gives two replies to any question. Out of these three players, exactly one player always speaks the truth, one always tells lies and one always alternates between the truth and lies, in any order.

When each was asked “Which game do you play?” the following were their replies:

Kambli: I am a Cricketer. Kumble is a Football player.
Kumble: I am a Cricketer. Krishnan is a Tennis player.
Krishnan: Kambli is a Football player. Kumble is a Cricket player.

8. Who among the three players is a liar?
(A) Kambli (B) Kumble
(C) Krishnan (D) Cannot be determined
9. Who among the three players must be the Tennis player?
(A) Kambli (B) Kumble
(C) Krishnan (D) Cannot be determined
10. Which game does Kumble play?
(A) Cricket (B) Football
(C) Tennis (D) Cannot be determined

Directions for questions 11 to 13: These questions are based on the data given below.

Each of the three friends – Dinit, Farah and Adarsh – has a different profession among –Doctor, Lawyer and Professor – not necessarily in the same order. It was known that each of them spoke at least one true statement. When asked, “Who belongs to which profession?”, the following were their replies :

Dinit : Adarsh is the Professor. Farah is the Lawyer.
Farah: Dinit is the Doctor. Adarsh is not the Lawyer.
Adarsh: Farah is the Lawyer. I am the Doctor.

11. Who is the Lawyer?
(A) Dinit (B) Farah
(C) Adarsh (D) Cannot be determined
12. What is Dinit's profession?
(A) Doctor (B) Lawyer
(C) Professor (D) Cannot be determined
13. Among the three, who speaks the truth always?
(A) Dinit (B) Farah
(C) Adarsh (D) Cannot be determined

Directions for questions 14 and 15: These questions are based on the data given below.

In a cricket match, the total number of runs scored by Sanjay, Rahul and Sanath together is 60. When asked about the individual runs scored by them, following were their replies.

Sanjay: I scored 20 runs. Sanath is not the least scorer.
Rahul: Sanjay scored the maximum number of runs.
I scored the minimum number of runs.
Sanath: Sanjay scored the minimum number of runs.
Rahul scored 20 runs.

Each player scored at least one run. It was also known that one player among them always spoke the truth, another always told lies and the third player alternated between the truth and lies, in any order.

14. If each of them scored equal number of runs, then who among them always lied?
(A) Sanjay (B) Rahul
(C) Sanath (D) Cannot be determined
15. If the runs scored by the three players are 15, 20 and 25 runs (not necessarily in the same order), then which player did not score 15 runs?
(A) Rahul
(B) Sanjay
(C) Sanath
(D) Cannot be determined

Directions for questions 16 to 18: These questions are based on the data given below.

Four players – Safin, Agassi, Fedarar and Hewitt -each of whom won exactly one Grand Slam amongst Australian Open, French Open, Wimbledon and U.S Open (not necessarily in the same order), in the year X. Each person gives two replies to any questions asked to them. At least one person among them speaks the truth always and at least one person always tells lies. There is at least one person who always alternates between the truth and lies in any order. When asked about the Grand Slams won by them in the year X, following were their replies :

Safin: I won the Australian Open. Fedarar won the Australian Open.
Agassi: I won the U.S Open. Hewitt won the U.S Open.
Fedarar: Safin won the Wimbledon. Agassi won the Australian Open.
Hewitt: Fedarar won the French Open. I won the Australian Open.

It is also known that Hewitt won the U.S Open and a definite arrangement can be obtained from the above statements given by the players.

16. Who won the Australian Open in the year X?
(A) Safin (B) Agassi
(C) Fedarar (D) Cannot be determined
17. Who among the following players always tell lies?
(A) Safin (B) Agassi
(C) Hewitt (D) Fedarar
18. Which Grand Slam did Fedarar win in the year X?
(A) Australian (B) French
(C) Wimbledon (D) U.S.

Directions for questions 19 and 20: These questions are based on the information given below.

One among three students – Anand, Bhargav and Chandu – is the top ranker in the class. Each one of them claims that he got the first rank. It was also known that among them, there is one student who always speaks the truth, one who always tells lies and another whose statement cannot be classified as either true or false. The following are the statements made by them.

Anand : I am not a liar.
 Bhargav : I am a liar.
 Chandu : I neither speak the truth nor do I speak lies.

19. Who got the first rank in the class?

- (A) Anand
 (B) Bhargav
 (C) Chandu
 (D) Cannot be determined

20. Who is the liar?

- (A) Anand
 (B) Bhargav
 (C) Chandu
 (D) Cannot be determined

Directions for questions 21 to 24: These questions are based on the data given below.

Four players Akbar, Birbal, Shahjahan and Humayun played the game of chancer and the score obtained by each of the persons was a whole number. Five spectators Karan, Yudhishta, Duryodhan, Shakuni, and Kunti made the following statements about their scores.

Karan: Exactly three persons together scored 20 points.

Yudhishta: Exactly three persons together scored 30 points.

Duryodhan: Exactly three persons together scored 40 points.

Shakuni: Exactly three persons together scored 50 points.

Kunti: Exactly three persons together scored 60 points.
 It is known that exactly one amongst the five persons is lying.

21. Who is lying?

- (A) Karan (B) Shakuni
 (C) Yudhishta (D) Kunti

22. What is the total score obtained by the four players?

- (A) 60 (B) 70 (C) 80 (D) 50

23. How many players scored 0 points?

- (A) 0 (B) 1 (C) 2 (D) 3

24. What was the highest score obtained by any player?

- (A) 20 (B) 40 (C) 50 (D) 30

Directions for questions 25 to 27: These questions are based on the information given below.

Five persons – Ajay, Vijay, Kumar, Binoy and Sanjay, who are of different ages met at a place. Each of them made two statements, but each person will make at least one false statement. The following are the statements made by them.

Ajay : I am older than Sanjay.
 Binoy is older than Vijay.

Binoy : Vijay is older than Ajay.

I am younger than Kumar.

Kumar: I am younger than Sanjay.

Vijay is older than Binoy.

Vijay : Sanjay is older than Ajay.

I am older than Sanjay.

Sanjay : Kumar is younger than Binoy.

Kumar is older than Ajay.

25. If Binoy is older than Ajay and Vijay is older than Sanjay, then how many persons are younger than Ajay?

- (A) 1 (B) 2 (C) 3 (D) 4

26. If Sanjay is younger than Binoy and Vijay is older than Binoy, then according to the statements made by them, how many such cases are possible?

- (A) 6 (B) 7 (C) 8 (D) 9

27. If they made exactly five true statements in total and B is the youngest, who is the oldest?

- (A) Kumar (B) Vijay
 (C) Sanjay (D) Ajay

Directions for questions 28 to 30: These questions are based on the following information.

Each of the three persons P, Q and R is from a different country among India, Pakistan and China.

It is known that one of them always speaks the truth, one always tells lies and one alternates between truth and lie in any order. They made the following statements.

P: I am a truth teller.

Q is from India.

R is not from China.

Q: I am from Pakistan.

R is a liar.

P is from India.

R: Q is a liar.

I am not a liar.

P is from Pakistan.

28. Who is from India?

- (A) P (B) Q
 (C) R (D) Cannot be determined

29. Who cannot be a liar?

- (A) P (B) Q
 (C) R (D) Cannot be determined

30. Who made at least two false statements?

- (A) P (B) Q
 (C) R (D) Cannot be determined

Exercise – 6(b)

Directions for questions 1 to 3: These questions are based on the information given below.

Four friends – A, B, C and D – sit around a square table not necessarily in the same order. Exactly one person sits on each side and every one is opposite to exactly one person. Each person makes two statements for any question asked to him. It was known that there is exactly

one person who always speaks the truth and exactly one person who alternates between truth and false. When asked about their respective positions around the table, the following were their replies:

A: D sits opposite to me. C sits to the left of D.

B: A sits to my left. D sits to the right of C.

C: B sits to my right. D sits to my left.

D: C sits opposite to me. B sits to my right.

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It was also known that a definite arrangement can be obtained by assessing their statements.

- Who always speaks the truth?
(A) A (B) B (C) C (D) D
- Who among them are liars?
(A) A and B
(B) C and D
(C) A and D
(D) Cannot be determined
- Who sits opposite to D?
(A) A (B) B
(C) C (D) Cannot be determined

Directions for questions 4 to 6: These questions are based on the information given below.

Among the four members of a family - K, L, M and N, there is one couple, their son and their daughter. When asked about their relationships, the following were their replies.

- K: N is my husband.
M is my daughter.
L: K is my mother.
M is my son.
M: K and L are of the same gender.
L is my sister.
N: L is of the same gender as I.
M is my son.

It was also known that only one of them always speaks the truth.

- Among the four, who cannot be the truth-teller?
(A) K
(B) L
(C) M
(D) Cannot be determined
- Among them, if there are two persons who always tell lies, then who always speaks the truth?
(A) K
(B) M
(C) N
(D) Cannot be determined
- Among them, if there are two persons who always alternate between the truth and lies, then who speaks the truth always?
(A) K (B) L
(C) M (D) Cannot be determined

Directions for questions 7 to 10: These questions are based on the information given below.

Four players - Abhinav, Bipash, Chandar and Danny – are from four different cities among Hyderabad, Mumbai, Delhi and Kolkata. Each of them plays a different game among Chess, Badminton, Tennis and Bridge and they are of different heights. Each of them gives three statements to any question such that the three statements given by each person are alternately true and false in any order. The second statement made by exactly two persons is true and Abhinav is one of them. When asked about them, the following were their replies.

- Abhinav : Bipash is from Delhi.
Chandar plays Chess.
Danny is not the tallest.
- Bipash : Abhinav is from Kolkata.
Chandar is not the shortest.
Danny plays Badminton.
- Chandar : Abhinav is the 2nd tallest.
Bipash plays Tennis.
Danny is from Delhi.
- Danny : Abhinav plays Chess.
Bipash is from Mumbai.
Chandar is not from Hyderabad.

- Who is from Delhi?
(A) Abhinav
(B) Bipash
(C) Chandar
(D) Danny
- Who is the Chess player?
(A) Abhinav
(B) Bipash
(C) Chandar
(D) Cannot be determined
- Who is the shortest person?
(A) The Badminton player.
(B) The Chess player.
(C) The person from Delhi.
(D) The person from Kolkata.
- Which two persons' second statements are true?
(A) Abhinav, Bipash
(B) Abhinav, Chandar
(C) Abhinav, Danny
(D) Cannot be determined

Directions for questions 11 to 14: These questions are based on the information given below.

In a class, the five students – Anirudh, Brijesh, Mayank, Nakul and Pavan – are the top five rankers, not necessarily in the same order. Each of these persons always gives three replies to any question asked. Except one person, all the other four tell at least a lie. Except one person, all the other four speak at least one truth. Exactly one person among them alternated between the truth and lies in any order. When I asked them about their respective ranks, the following were their replies:

- Anirudh : Brijesh is the 5th ranker.
Mayank is the 4th ranker.
Pavan is the 3rd ranker.
- Brijesh : Nakul is the 4th ranker.
Anirudh is the 2nd ranker.
Mayank is the 1st ranker.
- Mayank : Anirudh is the 3rd ranker.
Nakul is the 5th ranker.
Brijesh is the 2nd ranker.
- Nakul : Pavan is the 1st ranker.
Anirudh is the 4th ranker.
Mayank is the 2nd ranker.

Pavan : Brijesh is the 3rd ranker.
Mayank is the 4th ranker.
I am the 1st ranker.

Exactly one definite arrangement exists based on their statements.

11. Who among the following always speaks the truth?
(A) Anirudh (B) Brijesh
(C) Mayank (D) Nakul
12. Who is the top ranker in the class?
(A) Brijesh (B) Anirudh
(C) Mayank (D) Pavan
13. What is the rank of the person who always speaks one truth and two lies but does not alternate between the truth and lies?
(A) 3rd (B) 5th (C) 2nd (D) 4th
14. What is the rank of the person who always tells lies?
(A) 5th (B) 4th (C) 3rd (D) 2nd

Directions for question 15: This question is based on the following information.

15. In 'Kya Kya' island, every inhabitant gives two replies to a question. Both the replies could be true (Truth-teller), both could be false (Liar) or one reply is true and the other is false, in any order (Alternator). Once I came across three persons – Truth Kumar, False Bhai and Alti Singh and asked them "Who's who?". Their replies were as follows:

Truth Kumar : I am the truth-teller.
False Bhai is a liar.

False Bhai : I am the liar.
Alti Singh is the truth-teller.

Alti Singh : I am the truth-teller.
Truth Kumar is a liar.

If each of them belongs to a different race (truth-teller or liar or alternator), then who among them is the alternator?

- (A) Truth Kumar
- (B) False Bhai
- (C) Alti Singh
- (D) Cannot be determined

Directions for questions 16 to 20: These questions are based on the following information.

Five persons – Amar, Bharat, Chandu, Dinesh and Eswar are of different heights, weights and ages. It is also known that each of them speaks truth and lie in alternate fashion. Five persons are ranked from 1 to 5 according to the decreasing order of their heights, weights and ages. No person is ranked the same in any two parameters. The following are the statements made by four persons.

Amar:-
Bharat is the 3rd tallest.
Dinesh is the 3rd youngest.
Eswar is the lightest.

Bharath:-
Chandu is the tallest.
Amar is the 3rd oldest.
Eswar is the oldest.

Chandu:-
Bharath is 2nd youngest.
Bharath is the 2nd tallest.
Amar is the 3rd heaviest.

Dinesh:-
Eswar is the shortest.
Bharath is 4th lightest.
Amar is the 2nd tallest.

16. Who among them is the tallest?
(A) Chandu (B) Dinesh
(C) Bharath (D) Amar
17. Who among them is the oldest?
(A) Amar (B) Dinesh
(C) Eswar (D) Chandu
18. Who among them is the lightest?
(A) Eswar (B) Dinesh
(C) Bharath (D) Chandu
19. Who among them is the 2nd shortest?
(A) Dinesh (B) Amar
(C) Bharath (D) Eswar
20. Who among them is the 3rd youngest?
(A) Dinesh (B) Eswar
(C) Chandu (D) Bharath

Directions for questions 21 to 24: These questions are based on the following information.

Three persons Greta, Fischer and Schindler are talking about their heights. It is known that each of them is of a different height. Each of them belongs to one of the three categories, Truth Tellers (who always speak truth), Liars (who always tell lies) and the Alternators (who alternately make a true and a false statement). They made the following statements.

Gretta: I am the tallest.
I always speak truth.
Fischer always lies.

Fischer: I am not the tallest.
Gretta is a liar.
Schindler is the shortest.

Schindler: Greta is a liar.
I am not an alternator.
I am not the shortest.

21. Who is/are truth teller(s)?
(A) Greta or Fischer (B) Schindler
(C) None of them (D) Cannot be determined
22. Who is the tallest?
(A) Fischer (B) Schindler
(C) Greta (D) Cannot be determined
23. How many true statements have they together made?
(A) Four (B) Five
(C) Three (D) Three or four
24. Who is/are alternator(s)?
(A) Schindler and Greta (B) Fisher and Schindler
(C) Fisher (D) Schindler

Directions for questions 25 to 28: These questions are based on the following information.

Four very naughty siblings Pringle, Qusac, Robert and Swank are going to meet their father's childhood friend who is meeting them after 30 years. Their father's friend doesn't have any information about these siblings. Each of them wrote the following two statements on a piece of paper. They mentioned only the first letter of their respective names on the paper so that the friend cannot find out the gender by name.

- P: I have two sisters and a brother.
S is my brother.
Q: Both the statements of S are false.
R is my brother.
R: One statement of P is true and the other one is false.
I am S's sister.
S: I have two brothers and a sister.
Q is my sister.

It is known that exactly one person among them made two true statements, and that person is not R, and exactly one person made both false statements.

25. Who definitely made one true and one false statement?
(A) Pringle (B) Qusac
(C) Robert (D) Swank
26. Who is/are definitely male?
(A) Pringle and Robert (B) Swank
(C) Swank and Pringle (D) Robert and Qusac
27. Who made two false statements?
(A) Pringle (B) Qusac
(C) Robert (D) Qusac or Swank

28. Which of the following is true?
(A) Swank's second statement is false.
(B) Robert's second statement is true.
(C) Qusac's first statement is true.
(D) Pringle's second statement is true.

Directions for questions 29 and 30: These questions are based on the following information.

Karuna and Sharmila are studying in the same class. Their teacher came to know that today is the birthday of either Karuna or Sharmila, but not of both.

The teacher asked them whose birthday is it today? They made the following statements.

- Karuna: Today it is not my birthday.
Today it is Sharmila's birthday.
Sharmila: Both the statements of Karuna are false.
It is not the birthday of any one of us.

It is known that each of their statements is either true or false.

29. If Sharmila's first statement is false, whose birthday is on that day?
(A) Karuna's
(B) Sharmila's
(C) Both of them
(D) Cannot be determined
30. Which of the following is true?
(A) Karuna did not make even one true statement.
(B) Either both the statements of Karuna are true or both are false.
(C) Sharmila's second statement is definitely true.
(D) Neither Karuna nor Sharmila made two false statements.

Key

Exercise – 6(a)

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|------|-------|-------|-------|-------|-------|
| 1. A | 6. C | 11. B | 16. B | 21. A | 26. C |
| 2. B | 7. A | 12. D | 17. A | 22. A | 27. A |
| 3. C | 8. C | 13. D | 18. B | 23. B | 28. B |
| 4. B | 9. C | 14. B | 19. A | 24. D | 29. A |
| 5. A | 10. B | 15. C | 20. C | 25. B | 30. B |

Exercise – 6(b)

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|------|-------|-------|-------|-------|-------|
| 1. B | 6. A | 11. C | 16. A | 21. D | 26. B |
| 2. B | 7. D | 12. D | 17. C | 22. A | 27. D |
| 3. B | 8. C | 13. B | 18. D | 23. D | 28. D |
| 4. B | 9. B | 14. D | 19. B | 24. C | 29. B |
| 5. C | 10. C | 15. B | 20. A | 25. C | 30. B |