CHAPTER
3

# Logical Links

## LEARNING OBJECTIVES

- What is logical link?
- Different types of logical links and their meanings
- Inclusive vs exclusive meaning of logical links
- Different types of questions
- Approach to solve the questions

While discussing Logic in Chapter 1, we understood how Logic helps us in understanding and examining every proposition/statement. However, in order to construct the formal rules of inference we need to take care of some of the very common 'words', which we define as Logical Links. It is to be understood very clearly that these words alone cannot work as Logical Links.

These Logical Links help us in examining the reversibility of logic, too.

## WHAT DO WE UNDERSTAND BY LOGICAL LINKS?

Before we move ahead, let us consider some statements which will help us in getting a clear picture of Logical Links in our mind:

- If it rains, then the farmers will be happy.
- Either my party will secure majority in the parliament or my government will resign.
- If India does not win a gold medal in chess in the Doha Asian Games, then Indians will not be happy.
- If America mobilizes or Britain protests to the UN, then China will call for a meeting of all the Asian countries.

In all the given statements, there are one or two key words playing the maximum role in deciding the direction and nature of the statement like, if the statement has a negative connotation or it brings an element of uncertainty or causes a concern or brings some conditionality.

In the first example, the combination "If – then" is working like a conditional clause. In the second example, the combination "either – or"; in the third example, the combination "If not – then" and similarly in the fourth statement, the combination "If – then" works as a Logical Link.

## HOW DO WE DEFINE A LOGICAL LINK?

Statements like "I will go to watch a movie" or "She will go to a picnic" are known as simple statements. Now we can join these two simple statements in a number of ways:

- Either I will go to watch a movie or she will go to a picnic.
- If I go to watch a movie, then she will go to a picnic.
- If I go to watch a movie, only then will she go to a picnic.

Or, if we allow a bit of change in the nature of statements then statements could be seen as follows too:

- If I go to watch a movie, then she will not go to a picnic.
- If I do not go to watch a movie, then she will go to a picnic.
- If I do not go to watch a movie, then she will not go to a picnic.
- If I do not go to watch a movie, only then will she not go to a picnic.
- If I go to watch a movie, only then will she not go to a picnic.

After we have joined the simple statements, we call these statements Compound Statements. And the words which we use to join two simple statements are known as Logical Links.

## SOME STANDARD LOGICAL LINKS AND THEIR USAGES

### A. If – then

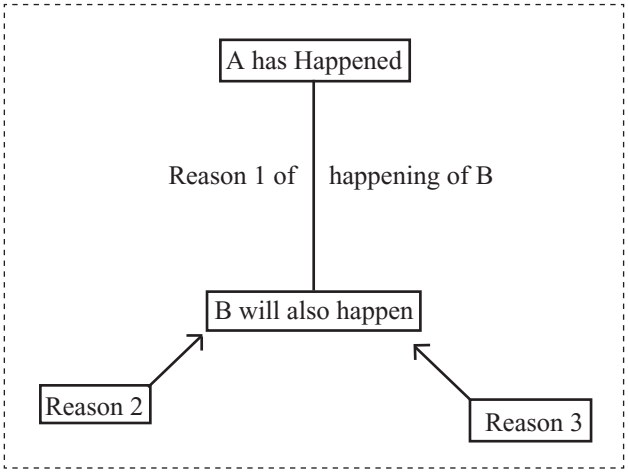
"If – then" is one of the most important Logical Links. Its usage includes the affirmative as well as the negative state-

ment. Following are some of the structured applications of this logical link:

### *If A happens then B happens*

Given – A has happened.
Conclusion – B will happen.
This is a valid conclusion.

See this through the following diagram:




**Example 1**

**1.** If the terrorists' demands are met, then lawlessness will prevail.

Given – The terrorist's demands have been met.

Conclusion – Lawlessness will prevail.

### *If A happens then B happens*

Given – A has not happened.
Conclusion – B will not happen.
This is an invalid conclusion.

Using the diagram given above, despite A has not happened, B might happen owing to the occurrence of either reason 2 or reason 3 etc.

**Example 2**

**2.** If the terrorists' demands are met, then lawlessness will prevail.

Given – The terrorist's demands have not been met.

Conclusion – Lawlessness will not prevail.

This is an invalid conclusion.

**Example 3**

**3.** If you fall down from the roof, then your legs will get fractured.

Given – You have not fallen down the roof.

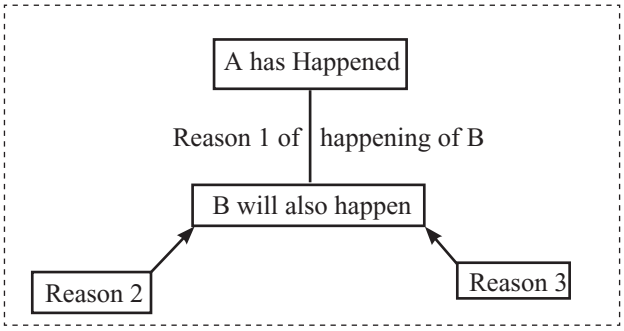
Conclusion – Your legs will not get fractured.

This is an invalid conclusion. What we should understand here is the fact that falling down the roof is just one of the ways by which the legs can get fractured and there can be other ways also of the legs getting fractured e.g., meeting with an accident or getting beaten up etc. And just because you have not fallen down the roof, we cannot be sure that the legs have not got fractured.

### *If A happens then B happens*

Given – B has happened.
Conclusion – A would also have happened.
This is an invalid conclusion.

Once again go through the same diagram:




Obviously, B can happen due to reason 2 or reason 3 also and is not dependent on 'reason 1 only'.

**Example 4**

**4.** If you fall down from the roof, then your legs will get fractured.

Given – Your legs have got fractured.

Conclusion – You have fallen down the roof.

This is an invalid conclusion.

Again, going through the explanation given above, we know that falling down the roof is not the only reason for the legs getting fractured. So just because the legs have got fractured, we cannot conclude that a person has fallen down the roof.

**Example 5**

**5.** If it rains, then farmers become happy.

Given – Farmers are happy.

Conclusion – It must have rained.

This is an invalid conclusion.

We do understand that farmers can have more than one reason for being happy, and having rain is just one of them. So, if farmers are happy we cannot definitely conclude that it must have rained.

### *If A happens then B happens*

Given – B has not happened.
Conclusion – A would also not have happened.
This is a valid conclusion.

**Example 6**

**6.** If you fall down from the roof, then your legs will get fractured.

Given – Your legs have not got fractured.

Conclusion – You have not fallen down from the roof.

This is a valid conclusion.

Understand this—You give a contract to a goon to make Mr A fall down from the roof tonight and as a result Mr A's legs will automatically get fractured. But the next morning you see Mr A walking and looking perfectly all right. He can walk like this because his legs are not fractured, so the direct response will be—The goon has not done his job of making Mr A fall down from the roof. With this, a lot many accidents might not have happened with Mr A, but he must not have fallen down the roof too.

## B. Only if – then

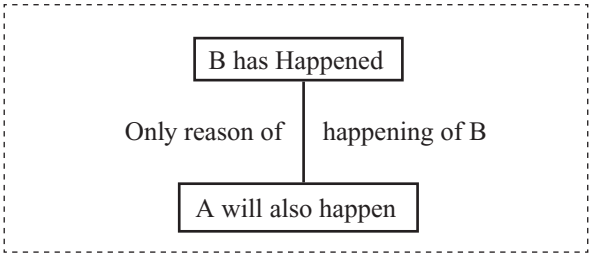
### *Only if A happens then B happens*

Given – B has happened.

Conclusion – A would also have happened.

This is a valid conclusion.

See the diagram for this:




**Example 7**

**7.** If you die, only then you go to heaven.

Given – You have gone to heaven.

Conclusion – You have died.

This is a valid conclusion.

Here, the only way in which a person can go to heaven is to die. So, if a person has gone to heaven, he must have died too.

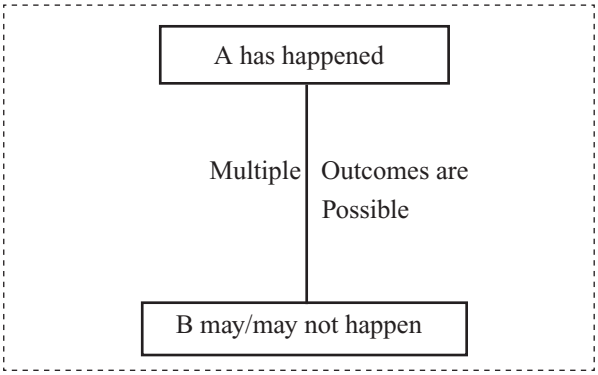
### *Only if A happens then B happens*

Given – A has happened.

Conclusion – B will also happen.

This is an invalid conclusion.

See the diagram for this:




**Example 8**

**8.** If you die only then you go to heaven.

Given – You have not died.

Conclusion – You will not go to heaven.

This is a valid conclusion.

**Example 9**

**9.** If you die only then you go to heaven.

Given – You have died.

Conclusion – You will go to heaven.

This is an invalid conclusion. However, the conclusion "You may go to heaven" is valid.

Sometimes we can even see that two compound statements have been joined with multiple Logical Links. One such statement can be:

If A happens, then B happens. If A does not happen then C happens. So what will be the impact on C if A has happened/A has not happened?

Let us understand this situation with an example:

**Example 10**

**10.** If the terrorists' demands are met, then lawlessness will prevail. And if the terrorists' demands are not met, then the hostages will be murdered.

Consider the statements given below:

(i) Lawlessness has not prevailed.

(ii) The hostages have been murdered.

(iii) The terrorists' demands have been met.

(iv) The terrorists' demands have not been met.

Which of the following options does not show a proper cause-effect relationship?

(a) i-ii (b) iv-ii

(c) iii-ii (d) ii-iv

Let us take the options one by one:

**Option (a) i-ii**

Since lawlessness has not prevailed (i), it means that the terrorists' demands have not been met. And if the terrorists' demands have not been met, then the hostages will be murdered (ii).So, this option shows a valid relationship.

**Option (b) iv-ii**

Since the terrorists' demands have not been met, the hostages will be murdered. This is a direct conclusion. So, it is a valid relationship.

**Option (c) iii-ii**

Since the terrorists' demands have been met, lawlessness will prevail. Now, from here we cannot deduce that the hostages will be murdered. So, it is not a valid relationship.

**Option (d) ii-iv**

Since the hostages have been murdered, the terrorists' demands must not have been met. So, this is also a valid relationship.

Hence option (c) is not a valid cause-effect relationship.

## B. Either – or

We use a lot many statements involving "Either– or" as a logical link in our day-to-day life too. In case of reasoning questions also, we see very similar statements with very similar interpretations. However, for a proper understanding, we should be very clear with the structure of these statements. Some of these structured statements are given here under.

There are two situations possible here:

- **Inclusive** It means 'and/or' where at least one term must be true or they can both be true simultaneously. This is the case of set A ∪ B, where any member of this set (A union B) should be present in at least one of the sets.
- **Exclusive** It means one must be true and the other must be false. Both terms cannot be true and both cannot be false.

The popular English language concept of or is often ambiguous between these two meanings, but the difference is pivotal in evaluating the Logical Link questions asked in the CAT.

Understand this argument:

Either P or Q.
Not P.
Therefore, Q is valid and indifferent between both inclusive and exclusive meanings. However, only in the 'exclusive' meaning is the following form valid:

Either P or Q (exclusive).
P.
Therefore, not Q.

With the 'inclusive' meaning, we cannot draw a definitely true conclusion from the situation given above.

Remember, for the purpose of CAT we have to consider the statements in their 'exclusive' sense.

### Either A will happen or B will happen

Given – A will happen.
Conclusion – B will not happen
This is a valid conclusion.

### Either A will happen or B will happen

Given – A will not happen.
Conclusion – B will happen
This is a valid conclusion.

### Either A will happen or B will happen

Given – B will happen.
Conclusion – A will not happen
This is a valid conclusion.

### Either A will happen or B will happen

Given – B will not happen.
Conclusion – A will happen
This is a valid conclusion.

Understandably, in case of 'Either A will happen or B will happen', not happening of one part ensures the happening of the other part because one of the parts has to be true. Similarly, we should remember that happening of one part ensures 'not happening' of the other part.

Summarizing the above discussion,

| Either A will happen or B will happen | | Validity | Truth-metre |
|---|---|---|---|
| A has happened | B will not happen | Valid | Definitely True |
| A has not happened | B will happen | Valid | Definitely True |
| B has happened | A will not happen | Valid | Definitely True |
| B has not happened | A will happen | Valid | Definitely True |

Further, it should be understood that the statement 'Either A will happen or B will happen' and statement 'A will happen or B will happen' are one and the same.

**Example 11**

**11.** Either A is 200 m from B and B is 100 m from C or A is 300 m from C.
(i) A is 200 m from B and B is 100 m from C.
(ii) A is 300 m from C.
(iii) A is not 200 m from B and B is not 100 m from C.
(iv) A is not 300 m from C.
Which of the following is an incorrect ordered relationship?
(a) ii-iii (b) i-iv
(c) iii-ii (d) i-iii

***Solution***

Go through the options.

**Option (a) ii-iii**

A being 300 m from C ensures that A is not 200 m from B and B is not 100 m from C. So, ii-iii is a correct relationship.

**Option (b) i-iv**

We definitely have a true pair here as well.

**Option (c) iii-ii**

Since one of the two statements given in the example has to be true; and in this case one statement is given to be wrong; so, the other statement has to be true.

Hence, if A is not 200 m from B and B is not 100 m from C then the statement A is 300 m from C has to be true.

So, this is a valid conclusion.

**Option (d) i-iii**

Obviously, this is not true.

## PRACTICE EXERCISES

**Q.1** I will buy the airplane only if it is the costliest and the fastest.
(a) I did not buy the airplane and it is neither the fastest nor the costliest.
(b) I bought the airplane and it is not the costliest nor is it the fastest.
(c) The airplane is the fastest and the costliest and I did not buy it.
(d) I bought the airplane and it is the fastest and the costliest.

**Q.2** I work very hard whenever there is a need.
(a) I work very hard and there is a need.
(b) I did work hard and there is no need.
(c) I did not work hard and there is no need.
(d) Both (b) and (c)

**Q.3** I wear a pad every time I bat.
(i) I batted.
(ii) I didn't bat.
(iii) I wore a pad.
(iv) I didn't wear a pad.
(a) ii-iv (b) iii-i
(c) iv-ii (d) i-iv

**Q.4** I get cold feet whenever I see a lion.
(i) I saw a lion.
(ii) I didn't see a lion.
(iii) I got cold feet.
(iv) I didn't get cold feet.
(a) iii-i (b) ii-iv
(c) iv-ii (d) i-ii

**Q.5** Whenever Devdas comes, Umrao Jaan sings.
(i) Umrao Jaan is singing.
(ii) Devdas has come.
(iii) Devdas hasn't come.
(iv) Umrao Jaan is not singing.
(a) iii-i (b) ii-iv
(c) iv-ii (d) i-ii

**Q.6** I can see the star only if I go to the planetarium.
(i) I went to the planetarium.
(ii) I didn't see the star.
(iii) I saw the star.
(iv) I didn't go to the planetarium.
(a) ii-iv (b) iv-ii
(c) i-ii (d) iii-iv

**Q.7** I can find Chinese toys only if I go to the fair.
(i) I didn't find Chinese toys.
(ii) I found Chinese toys.
(iii) I went to the fair.
(iv) I didn't go to the fair.
(a) iii-iv (b) iii-ii
(c) iii-i (d) i-iv

**Q.8** I will befriend Som only if he returns my book.
(i) I befriended Som.
(ii) Som returned my book.
(iii) I won't befriend Som.
(iv) Som didn't return my book.
(a) ii-i (b) ii-iii
(c) iv-iii (d) iii-iv

**Q.9** Only in Bengal, you can see the Bengal Tiger.
(i) You went to Bengal.
(ii) You didn't go to Bengal.
(iii) You saw the Bengal Tiger.
(iv) You didn't see the Bengal Tiger.
(a) i-iii (b) iv-ii
(c) i-iv (d) ii-iv

**Q.10** You cannot clear the CAT unless you are hard working.
(i) You are hard working.
(ii) You can clear the CAT.
(iii) You are not hard working.
(iv) You cannot clear the CAT.
(a) ii-iv (b) i-iii
(c) iii-iv (d) i-ii

**Q.11** Amit Kumar is either an engineer or a doctor.
(i) Amit Kumar is an engineer.
(ii) Amit Kumar is not a doctor
(iii) Amit Kumar is not an engineer.
(iv) Amit Kumar is a doctor.
(a) i-ii (b) i-iv
(c) iv-i (d) ii-iii

**Q.12** Either Raghav is sick or he is stoned.
(i) Raghav is sick.
(ii) Raghav is not sick.
(iii) Raghav is stoned.
(iv) Raghav is not stoned.
(a) i-ii (b) iv-i
(c) i-iii (d) iii-iv

**Q.13** When I see an RGV movie I have a bad dream.
(i) I saw an RGV movie.
(ii) I did not see an RGV movie.
(iii) I did not have an bad dream.
(iv) I had a bad dream.
(a) iii-ii (b) iv-i
(c) ii-iii (d) i-iii

**Q.14** Raju gets a mild flu whenever he eats an ice cream.
(i) Raju gets a mild flu.
(ii) Raju does not eat an ice cream.
(iii) Raju does not get a mild flu.
(iv) Raju ate an ice cream.
(a) i-ii (b) iv-iii
(c) i-iii (d) iii-ii

**Q.15** Either SRK is angry or he shows mock anger.
(i) SRK shows mock anger.
(ii) SRK is angry.
(iii) SRK does not show mock anger.
(iv) SRK is not angry.
(a) iii-ii (b) iv-i
(c) ii-i (d) iii-ii and iv-i

**Q.16** Whenever my mother scolds me, I either hide behind my father or complain to my grandma.
(a) If I complain to my grandma or I hide behind my father, then my mother must have scolded me.
(b) If I did not complain to my grandma and I did not hide behind my father, then my mother must not have scolded me.
(c) If my mother does not scold me, I will neither hide behind my father nor complain to my grandma.
(d) None of these

**Q.17** Either the paper is big or the pencil is small.
(i) The paper is big.
(ii) The paper is not big.
(iii) The pencil is small.
(iv) The pencil is not small.
(a) i-iii (b) iv-ii
(c) ii-iii (d) iii-i

**Q.18** Either is lion is not big or the fox is cruel.
(i) The lion is big.
(ii) The lion is not big.
(iii) The fox is cruel.
(iv) The fox is not cruel.
(a) ii-iii (b) i-iii
(c) iii-ii (d) i-iv

**Q.19** If the milk is not cold then I will not go to school and will not have dinner.
(a) If I have gone to school or I have not had dinner; then the milk is not cold.
(b) If I have gone to school and I have had dinner, then the milk is cold.
(c) If I have gone to school and I have not had dinner then the milk is cold.
(d) If I have gone to school or I have had dinner, then the milk is cold.

**Q.20** Unless you catch the criminals, the crimes will not stop.
(i) The criminals have been caught.
(ii) The crimes have stopped.
(iii) The criminals have not been caught.
(iv) The crimes have not stopped.
(a) iv-iii (b) iii-iv
(c) ii-iii (d) iv-i

## ANSWER KEYS

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **1.** (d) | **2.** (c) | **3.** (c) | **4.** (c) | **5.** (d) | **6.** (b) | **7.** (d) | **8.** (c) | **9.** (d) | **10.** (c) |
| **11.** (a) | **12.** (b) | **13.** (a) | **14.** (d) | **15.** (d) | **16.** (b) | **17.** (c) | **18.** (b) | **19.** (d) | **20.** (b) |

## HINTS AND SOLUTIONS

**1.** If I bought aeroplane, it must be the fastest & the costliest. If I did not buy the aeroplane it is either not the fastest or not the costliest or neither fastest nor the costliest (not necessarily neither fastest nor the costliest). Only option (d) show a feasible case of buying the aeroplane

**Hence, option (d) is the correct answer.**

**2.** If there is need I will definitely work hard. But, if I worked hard, it does not necessarily mean that there was need. Similarly, if I did not work hard there must not been need else I must have worked hard. So, option (c) show feasible case of not working hard as there is no need

**Hence, option (c) is the correct answer.**

**3.** If I wear a pad every time I bat, then it also shows that if I did not wear a pad, I did not bat. So, (ii) follows (iv) logically.

Please note that wearing a pad does not mean I batted. Logic is given other way round, that If I bat, then I wear a pad.

I may wear a pad, but do not bat.

**Hence, option (c) is the correct answer.**

**4.** If I get cold feet whenever I see a lion, then if I didn't get cold feet, I must not have seen a lion. So, (ii) follows (iv) logically

**Hence, option (c) is the correct answer.**

**5.** Whenever Devdas comes, Umrao Jaan sings. So, if Devdas has come, Umrao Jaan must be singing. So, (ii) follows (i) logically

**Hence, option (d) is the correct answer.**

**6.** If I can see a star only if I go to the planetarium, and then if I didn't go to the planetarium, I must not have seen a star. So, (ii) follows (iv) logically

**Hence, option (b) is the correct answer.**

**7.** If I can find Chinese toys only if I go to the fair, then if I didn't find the Chinese toys, I didn't go to the fair. So, (iv) follows (i) logically

**Hence, option (d) is the correct answer.**

**8.** If I will befriend Som only if he returns my book, then if he didn't return my book, I won't befriend him. So, (iii) follows (iv) logically

**Hence, option (c) is the correct answer.**

**9.** If you can see the Bengal tiger only in Bengal, then if you didn't go to Bengal you didn't see the Bengal tiger. So, (iv) follows (ii) logically

**Hence, option (d) is the correct answer.**

**10.** If you cannot clear the CAT unless you are hardworking, then if you are not hardworking you cannot clear the CAT. So, (iv) follows (iii) logically

**Hence, option (c) is the correct answer.**

**11.** If Amit Kumar is either an engineer or doctor, then if he is an engineer he cannot be a doctor. So, (ii) follows (i) logically

**Hence, option (a) is the correct answer.**

**12.** Either Raghav is sick or he is stoned. So, if he is not stoned he must be sick. So, (i) follows (iv) logically

**Hence, option (b) is the correct answer.**

**13.** When I see a RGV movie I had a bad dream. So, if I did not have a bad dream, I did not see a RGV movie. So, (ii) follows (iii) logically

**Hence, option (a) is the correct answer.**

**14.** Raju gets a mild flu whenever he eats an ice-cream. So, if he does not get a mild flu he has not eaten an ice-cream. So, (ii) follows (iii) logically

**Hence, option (d) is the correct answer.**

**15.** Either SRK is angry or he shows mock anger. So, if he does not show mock anger, he is angry. Also, if he is not angry he shows mock anger. So, (i) follows (iv) logically & (ii) follows (iii) logically

**Hence, option (d) is the correct answer.**

**16.** If whenever my mother scolds me, I either hide behind my father or complain to my grandma. Then, if I did not complain to my grandma & did not hide behind my father, my mother must not have scolded me

**Hence, option (b) is the correct answer.**

**17.** Either the paper is big or the pencil is small. So, if paper is not big, the pencil must be small. So, (iii) follows (ii) logically

**Hence, option (c) is the correct answer.**

**18.** Either the lion is not big or the fox is cruel. So, if lion is big, the fox is cruel. Therefore, (iii) follows (i) logically

**Hence, option (b) is the correct answer.**

**19.** If the milk is not cold then I will not go to the school & will not have dinner. Then, if I had gone to school or I had dinner, the milk is cold

**Hence, option (d) is the correct answer.**

**20.** Unless you catch the criminals, the crimes will not stop. So, if the criminals have not been caught, the crimes must not have stopped. Therefore, (iv) follows (iii) logically

**Hence, option (b) is the correct answer.**