

Maths
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Logic and Reasoning
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CHAPTER I

DEFINITION, SCOPE AND USE OF LOGIC

The Subject-matter of Logic.—There are many sciences, such as Botany, Zoology, Astronomy, and each science has some subject-matter; each science studies something. Botany studies plants, Zoology studies animals, Astronomy studies heavenly bodies, and similarly other sciences study other things. What does Logic study? In order to answer this question, let us see the meaning of the word "logic." The word "logic" comes from the Greek word "logos" which has two meanings: (1) *thought* and (2) *word*. So Logic studies thought; and because thought is always expressed in words, Logic is also concerned with word as the expression of thought.

Definition of Logic.—The definition of a Subject can best be given at the end of that subject, and not at the beginning. When we have finished our study of a subject, we can look back and see the whole field that we have covered, and are then in a position to frame a complete and satisfactory definition of that subject. We may, however, give a provisional definition even at the beginning, so that we may have some idea of what we are going to study.

Logic may provisionally be defined as *the Science of the laws of valid thought*. Let us explain

the meanings of the words 'science,' 'laws,' 'valid' and 'thought' which we have used in our definition.

(1) **Science.**—Science means knowledge; but let it be clearly understood that, while all science is knowledge, all knowledge is not science. A man may know the names of the various parts of the human body, and yet his knowledge may not be scientific. You know something about plants and heavenly bodies, but your knowledge may not be scientific. Science is not mere knowledge; it is **systematic**, accurate and complete knowledge of some **subject-matter**. A physiologist has a scientific knowledge of the human body; a botanist, of plants, and an astronomer, of heavenly bodies. Unsystematic knowledge cannot be called science just as **unnarrayed bricks** (that is, bricks lying in a heap without any order) cannot be called a building.

So a science is a methodical, exact and exhaustive knowledge of some subject-matter; and because Logic gives us a methodical, exact and exhaustive account of the laws of thought, it is a science.

Sciences are of two kinds: *Natural* (or *positive*) and *Normative* or (*regulative*). Natural sciences deal with things as they are, but normative sciences deal with things as they should be. Botany is a natural science; it studies plants as they actually are. Similarly, Astronomy is a natural science; it studies heavenly bodies as they actually are. Logic, on the other hand, is a normative science because it studies thought, not as it actually is, but as it should be. There are two other normative sciences like Logic, namely, Aesthetics and Ethics. Aesthetics

tics studies beauty as it should be, and Ethics studies character as it should be.

Logic, then, is a normative science. It studies thought as it should be ; it sets up a norm or standard according to which our thought should be ; it does not tell us how we actually think but how we should think.

(ii) Laws.—Every science deals with its own facts. But it must be remembered that a science does not deal with its facts for the sake of the facts themselves but for the sake of the *laws* which govern those facts. In other words, a science is interested in *general laws* which it deduces from its facts. The science of Physics, for example, is not so much concerned with this or that instance of heat and light as with the general laws of heat and light. Similarly, the science of Astronomy is not so much interested in the movements of this or that star as in the general laws which govern the movements of all heavenly bodies. In the same manner, the science of Logic is not so much concerned with this or that piece of valid thought as with the general laws of valid thought.

What is meant by laws ? The answer is that laws are general or universal truths. There are three kinds of laws, namely, *Political Laws*, *Natural Laws* and *Normative Laws*. Political laws are commands issued by some superior authority. They state what must be. They can be changed as well as violated. Natural laws state what is. They can neither be changed nor violated. The law of gravitation which says that all material bodies fall

to the ground is a natural law. Normative laws state what *ought* to be. We have read that there are three normative sciences, namely, Logic, Aesthetics and Ethics. The laws of Logic, then, are normative or regulative laws. They do not tell us how we *must* think, or how we *actually* think, but how we *ought* to think. Hence they differ both from political and natural laws. They cannot be changed but can be violated. Nobody compels us to think validly, nor are we punished if we think invalidly. We can violate the laws of valid thinking but cannot change them.

The laws of Logic resemble the laws of Ethics (moral laws) and the laws of Aesthetics in being normative.

Valid.—Valid means true. Now it is quite clear that any thought which is self-contradictory cannot be true. If, for example, we think of a square circle, or a four-sided triangle, or a circular rectangle, our thought will be self-contradictory and hence invalid. Similarly, if we argue as follows:—

Men are mortal

Students are men

Therefore, students are not mortal

our argument will not be valid, because it is self-contradictory. So *validity or truth means freedom from self-contradiction*. Consider now the following argument :—

Men are tables

Books are men

Therefore, books are tables.

In this argument, there is no self-contradiction ; the conclusion necessarily follows from the two statements, and yet this argument is invalid. Why? Because what is said in this argument is not according to actual reality. The statements that we have made do not agree with actual facts. So *validity also means agreement with actual facts.*

Thus, there are two meanings of the word 'valid' : (1) Valid means that which is self-consistent or free from self-contradiction ; and (2) valid means that which agrees with actual reality. Validity in the first sense is called formal, and in the second sense, material. In formal validity, we only see whether our thought agrees *with itself* or not ; that is, whether there is self-consistency in our thought or not. In material validity, we see whether our thought agrees *with actual reality* or not ; that is, whether our thought is consistent with actual facts or not.

This distinction of validity has divided Logic into two parts, namely, Deductive Logic and Inductive Logic. Deductive Logic only sees the formal validity of thought, and is therefore called Formal Logic. Inductive Logic, on the other hand, sees the material validity of thought, and is therefore called Material Logic. Deductive Logic raises the question : Is this thought consistent with itself? Inductive Logic raises the question : Is this thought consistent with actual reality? One sees the form of thought, and the other sees the matter of thought.

It is quite easy to understand that both form and matter must be valid. What do you see in a coin? Both its form and matter. Similarly,

Thought.—We have read that Logic is concerned with thought. But we must remember that Logic is not concerned with how we actually think; that is, it is not concerned with the *processes* of thought, but with the *results* or *products* of thought. The products of thought are *concepts*, *judgments* and *reasonings*. These are the three forms in which thought expresses itself.

(i) A concept means a general idea. When, for example, we say 'man is mortal,' we do not refer to any particular man, but to man in general. Such a general idea of man is called the concept 'man.' Similarly, the concept 'triangle' refers to triangles in general, that is, to all triangles, and not to any one triangle. Thus, man, triangle, horse, book, etc., are concepts in so far as they refer to each and every object denoted by them in general and yet to no one of them in particular. A concept, when expressed in language, is called a *term*.

(ii) A judgment is a combination of two concepts. When we compare two concepts, so as to see whether they agree or disagree, we have a judgment. Man is mortal, triangles are three-sided, wolves are fierce, circles are not squares, doctors are not lawyers, tables are not chairs, etc., are judgments. Thus, a judgment consists of two

concepts. In the judgment 'man is mortal,' there are two concepts 'man' and 'mortal', and there is a relation of agreement between them. Similarly, in the judgment 'circles are not squares' there are two concepts, 'circles' and 'squares', and there is a relation of disagreement between them.

When expressed in language, a judgment is called a *proposition*.

draw conclusion from premises

(iii) A reasoning means an inference which is drawn from one judgment or more than one judgment. If, for example, we say that all Punjabis are Pakistanis, therefore no Punjabi is a non-Pakistani, we have a reasoning. Such a reasoning, in which we pass directly or immediately from one proposition to another, is called an *immediate inference*. But when in our reasoning we get an inference by putting together two propositions, we have a *mediate inference* or *syllogism*. The following is an example of a mediate inference :—

Men are mortal

Students are men

Therefore, students are mortal.

Thus, in reasoning, we pass from one or more propositions which are given, to another proposition. The proposition or propositions which are given and from which we argue are called the *premise* or *premises*, and the proposition which is drawn from them is called the *conclusion*.

→ A reasoning, when expressed in language, is called an argument.

To sum up : thought means concepts, judgments and reasonings, which are called terms, propositions and arguments respectively.