

SYNOPSIS

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Sentence

A combination of words that makes complete sense is called a sentence. The sense is not complete, unless **something is said about something else**. An English sentence is composed of subject and predicate.¹

Subject: The word or words denoting the person or thing about which something is said are called the subject of the sentence. For example, “A ship” is a subject in the following sentence.

A ship went out to sea.

Predicate: The word or words which say something about the person or thing denoted by the subject are called the predicate. For example, “went out to sea” is predicate in the following sentence.

A ship **went out to sea**.

Type of sentence

There are four different kinds of sentences: Statements, Desires, Questions, and Exclamations.

¹ Nesfield 2011 p 1-2

Statements are those sentences which simply **affirms** or **deny** something. Eg:

A man's success depends chiefly on himself. (Affirmative sentence)

He did not get much help from others. (Negative sentence)

Desires are those sentences which contain some command, request, entreaty, or wish. Eg:

Rely chiefly on your own effort. (**Command**)

Lend me a pen. (**Request**)

Save me. (**Entreaty**)

God save the Queen! (**Wish**)

Questions are those sentences which inquire about something. It may be objective (seeking reply in yes or no) or subjective (seeking an elaborate reply). Eg:

Have you finished your work? (**Objective question**)

Where are you going? (**Subjective question**)

Exclamations are those sentences which express sudden feeling, such as pleasure, anger or surprise, about something which has been said or done. Eg:

How wonderful! (**Pleasure**)

What a shame! (**Anger**)

What a piece of luck! (**Surprise**)

Proposition

A proposition is a **statement** which **asserts** something; and is a unit of reasoning. [*Copi 2012 p 1-2*]

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Here, statement is a kind of sentence; asserts implies either affirms or denies. For example,

All men are mortal.

A question asserts nothing ie it neither affirms nor denies a thing. Similarly, neither a desire nor an exclamation is a proposition.

**Structure of a proposition:** Proposition in its simplest form have three constituents viz. subject, predicate and copula. [CBSE Philosophy XI 2011 p 60]

**Subject** of a proposition is that about which something is said.

**Predicate** of a proposition states something about the subject.

**Copula:** Between the subject and the predicate occurs a verb generally in ‘to be’ form. The verb serves to connect the subject and the predicate and is called 'copula'. If there is no copula, there is no connecting link between the subject and the predicate, and consequently there is no proposition. For example, ‘are’ is the copula in the following sentence.

‘All men **are** mortal.’

**Affirmative and negative proposition:** A proposition may be affirmative or negative based on the assignment or denial of the predicate to the subject. A proposition is **affirmative** when predicate is assigned to subject. Eg:

‘Narendra Modi **is** the Prime Minister of India.’

A proposition is **negative** when predicate is denied to subject. Eg:

‘Mumbai **is not** the capital of India.’

**Conditional proposition:** A conditional proposition is that in which a predicate is assigned or denied to the subject on certain

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conditions. Conditional propositions are rather a compound proposition with conditional connectors. Eg:

**If** it does rains in time, **then** crops will be good. (A conditional sentence where the predicate is assigned conditionally)

Sita will not go **unless** she is invited. (A conditional sentence where the predicate is denied conditionally)

**Compound proposition:** Sometimes more than one proposition is asserted in combination in a single sentence such as “Mohan is a student and he is intelligent”. Here, one proposition is that “Mohan is a student” and another proposition is “Mohan is intelligent”. Such proposition is called compound proposition. So, a compound proposition has at least two simple propositions as components.

Compound proposition may be conjunctive, disjunctive, and alternative.

**Conjunctive:** When two simple propositions are joined by “and” it is called a conjunctive proposition. Eg:

Ram is a student **and** Mohan is a player.

**Disjunctive:** In disjunctive proposition two simple propositions are joined by “either, or” relation. Eg:

**Either** I will take ice cream **or** I will take chocolate.

**Alternative:** The alternative compound propositions are also joined by “either, or” relation. Eg:

Either I will drink tea or I will take coffee.

There is, however, **difference between disjunctive and alternative propositions** which can be deciphered through context only. A disjunctive proposition is 'inclusive' sense of 'either, or'. This sense of 'either, or' includes the possibility of

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‘**both**’ the options such as one may take both ice cream and chocolate at the same time. The 'exclusive' sense of 'either, or' suggests a meaning according to which it is simply '**not both**'. Alternative proposition is the exclusive sense of 'either, or'. The example cited above states that either a person will take tea or he will take coffee but not both at the same time. Alternative sense of 'either, or' thus excludes the possibility of both.

2.3 Categorical proposition

When the subject of a proposition indicates a class of objects, persons or events, the proposition is called as categorical (indicating category or class membership).² For example, ‘Some cats are black.’. Here, the term ‘some’ indicates that some members of a class 'cat' are 'black'. A categorical proposition is identified as well as classified by its quantity and quality.

Quantity of a categorical proposition refers to the number of members in the class represented by the **subject** of a proposition. It may refer to **all** the members of a class (universal) or to **some** of the members of a class (particular). For instance, in the proposition, "All men are mortal", the subject 'All men' denotes the entire class of 'man' and the quantity of the proposition is universal. In the proposition "No egg is red", again, the quantity is universal. Here the entire class of eggs is excluded from the entire class of red things. However, when the subject of a proposition indicates only part of a class, the quantity of the proposition is particular. For instance, in the proposition "Some cats are black", the quantity is particular and similarly, in the proposition, "Some roses are not red things", the quantity is particular. Thus, subject of a universal proposition indicates

² CBSE Philosophy XI 2011 p 64

unrestricted generalization, whereas subject of a particular proposition indicates only restricted generalization.

Quality of a categorical proposition indicates whether a proposition is **affirmative** or **negative**. This is done through **copula**. If a predicate is assigned to subject, then quality of the proposition is affirmative. For instance, in the proposition, "All roses *are* beautiful", the predicate 'beautiful' is assigned to the subject 'roses' through the copula 'are'. If a predicate is denied to subject, then quality of the proposition is negative. For instance, in the proposition "Some students *are not* voters" predicate being 'voter' is denied to the subject 'students' through the copula 'are not'. However, a negative term like 'immortal', 'unwise' etc. does not make a proposition negative. It is negative copula which makes a proposition negative. For example, "Some men are illiterate", is an affirmative proposition with a negative predicate whereas "Some men are not literate", is a negative proposition.

Types of categorical proposition

Quantity and quality of the categorical proposition together give four types of categorical proposition:

- (i) Universal affirmative (or A proposition),
- (ii) Universal negative (or E proposition),
- (iii) Particular affirmative (or I proposition), and
- (iv) Particular negative (or O proposition).

The letter A, E, I, and O is derived from Latin word *affirmo* (= I affirm) and *nego* (= I deny) such that 'A' and 'I' of *affirmo* for universal and particular affirmative respectively and 'E' and 'O' of *nego* for universal and particular negative respectively. [Copi 2014 p 174]

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**Universal affirmative:** In universal affirmative A proposition, quantity is universal and quality is affirmative. Logically it is represented as: All S is P. Eg:

All cats are mammals.

**Universal negative:** In universal negative or E proposition quantity is universal and quality is negative. Logically it is represented as: No S is P. Eg:

No child is a voter.

**Particular affirmative:** In particular affirmative or I proposition quantity is particular and quality is affirmative. Logically it is represented as: Some S is P. Eg:

Some students are voters.

**Particular negative:** In particular negative or O proposition quantity is particular while the quality is negative. Logically it is represented as: Some S is not P. Eg:

Some roses are not red.

In our day-to-day life, however, our arguments do not always contain propositions which are in clear and neat logical form. In sciences also universal or particular statements are not in the logical form. But for the logicians the validity of arguments needs the premises and the conclusion (which are also propositions) to be in the standard logical form. This aim, nevertheless, can be achieved by reducing the non-standard form sentences into logical form of A, E, I, O. In this process the meaning of the propositions should not be lost. In fact, the meaning of the proposition is the guide to tell us which type of proposition it is. For instance, "Every voter is citizen" means "All voters are citizens". Similarly, the sentence "Many students of

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this class are bright children" is "Some students of this class are bright children". "A few politicians are statesmen" is "Some politicians are statesmen".

## Terms

The word 'term' comes from the Latin word *terminus*, a limit or boundary. Terms limit the movement of the thought. Proposition is a unit of reasoning and terms are its constituents.<sup>3</sup>

A term may be defined as a word or group of words which is either a subject or a predicate of a proposition with a definite meaning of its own. If a word or a group of words is neither a subject nor a predicate of a proposition, then it is not a term. In the proposition, "All logicians are mathematicians", 'logicians' and 'mathematicians' are terms but 'all' and 'are' are not terms. For they can neither be subject nor predicate of the proposition. Thus, whereas all terms are words, all words are not terms. This is because all terms are classes for the traditional thinkers. In each categorical proposition (A, E, I, O) there are two terms, a subject and a predicate.

### Extension (denotation) and Intension (connotation) of term

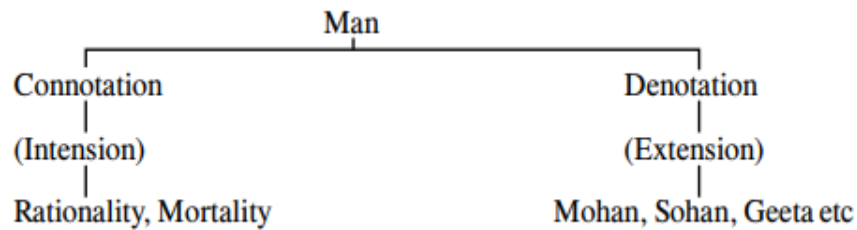
A term in a categorical proposition represents a class.<sup>4</sup> A class is a collection of all objects that have some specified characteristics in common. The meaning of a class or term can be known in two ways. Firstly, by knowing the members belonging to that particular class (denotation or extension of the term); and secondly, by knowing the essential qualities possessed by the members of that class (connotation or intension of the term). For example, in the class of 'man' we refer to all 'human beings' as

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<sup>3</sup> CBSE Philosophy XI 2011 p 68

<sup>4</sup> CBSE Philosophy XI 2011 p 69

members, and 'rationality' and 'mortality' as the essential attributes or qualities possessed by them.



The connotation of the term does not always refer to all attributes, essential or accidental. Connotation indicates only essential attributes of an object ie such attributes that are sufficient to distinguish that object from other objects. The bare minimum qualities without which the existence of a thing, person or an object is not possible. For example, the essential characteristics of term 'man' are only 'rationality' and 'mortality'. The accidental characteristics of 'man' are many like a man has two hands, two legs, two ears etc. There are men who do not have hand or leg. Man can exist without these accidental characteristics. But we will not call living being a man if he is immortal or if he is irrational. Rationality differentiates a man from 'animals', 'mortality' differentiates a 'man' from 'super human beings'.

Not all terms, however, have both denotation and connotation. Only the general terms (which are classes) have both connotation and denotation. The proper names like Ram, Sita, Mohan etc. do not have proper connotation. 'Ram' for example can refer to the student of standard X in the Y school or it can refer to a boy working in a factory or to a mythical character of Ramayana. Similarly, the imaginary objects do not have proper denotation. For example, a centaur (a creature from Greek mythology with the upper body of a human and the lower body and legs of a horse) has no reference, and thus has no denotation. At the same

time there are things which can be only known through denotation and not through connotation. For example, we can know the colours – red, yellow etc. only by looking at them. A blind man can never know the colours by stating or describing their characteristics. One learns meanings of terms quickly and correctly by looking at the objects and things, but from the view point of a logician connotation of a term is more basic and fundamental than denotation. There are classes which are empty like class of the 'square round objects'. Neither any example of this class is there nor can it be found. Yet the class is meaningful because of its connotation.

### **Increase or decrease of extension or intension**

When attributes are added to the intension of a term, we say that the intension increases.<sup>5</sup> Begin with a general term such as “person.” Add “living.” Add “over twenty years old.” Add “born in India.” With each such addition the intension increases; the intension of the term, “Living person over twenty years old born in India,” is far greater than that of “person.” So, these terms are given here in order of increasing intension. However, increasing their intension decreases their extension. The number of living persons is much lower than that of persons, and the number of living persons over twenty years old is lower still, and so on. Thus, the extension of a term (its membership) is determined by its intension; however, the reverse is not true ie the extension of a term does not determine its intension.

### **Argument**

With propositions as building blocks, an argument is constructed. In an argument one proposition is affirmed on the basis of some

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<sup>5</sup> Copi 2014 p 91-92

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other proposition positing an inference. And, for every possible inference there is a corresponding argument.⁶

Argument need not involve disagreement or controversy; it refers strictly to any group of propositions of which one (conclusion) is claimed to follow from the others (premises). Premises are regarded as providing support for the truth of the conclusion. Eg:

‘Every law is an evil, for every law is an infraction of liberty.’

Although this is only one short sentence, it is an argument because it contains two propositions, of which the first (every law is an evil) is the conclusion and the second (every law is an infraction of liberty) is the premise.

Deductive and inductive argument

Every argument makes the claim that its premises provide grounds for the truth of its conclusion; that claim is the mark of an argument. However, there are two very different ways in which a conclusion may be supported by its premises, and thus there are two great classes of arguments: the deductive and the inductive. [Copi 2012 p 24]

A deductive argument makes the claim that its conclusion is supported by its premises **conclusively** ie the conclusion is claimed to follow from its premises with absolute necessity, this necessity not being a matter of degree and not depending in any way on whatever else may be the case.

An inductive argument, in contrast, does not make such a claim ie the conclusion is claimed to follow from its premises only with **probability**, this probability being a matter of degree and dependent on what else may be the case.

⁶ Copi 2012 p 5

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Strength of the conclusion

Because an inductive argument can yield no more than some degree of probability for its conclusion, it is always possible that additional information will strengthen or weaken it. Newly discovered facts may cause us to change our estimate of the probabilities, and thus may lead us to judge the argument to be better (or worse) than we had previously thought. In the world of inductive argument - even when the conclusion is judged to be very highly probable - all the evidence is never in. New discoveries may eventually disconfirm what was earlier believed, and therefore we never assert that the conclusion of an inductive argument is absolutely certain. [Copi 2012 p 25]

Deductive arguments, on the other hand, cannot become better or worse. They either succeed or they do not succeed in exhibiting a compelling relation between premises and conclusion. If a deductive argument is valid (ie it succeeds in linking, with logical necessity, the conclusion to its premises), no additional premises can possibly add to the strength of that argument.

Reasoning

Knowledge is a set of propositions that guide human behaviour. This is substantiated by CBSE Philosophy XI 2011 p 54: ‘Human knowledge is mainly constitutive of propositions. Knowledge grows through reasoning.

Reasoning is *inferring conclusion from the premises*. In other words, reasoning is the process of deduction and induction. In deduction (formal reasoning) we infer a new proposition (conclusion) from a given set of existing propositions (premises). Whereas in induction (empirical reasoning) we infer the new proposition (conclusion) from observations ie we draw universal

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statements on the basis of particular facts. Inference is the cognitive process of establishing conclusion either from the proposition or from the observation. Inference is cognitive in the sense that it is psychological that goes in mind. It is a conscious intellectual activity such as thinking or remembering. Conclusion implies generalisation; culling out a general rule.

## Deduction

Deduction is a process in which one infers a conclusion from a given set of premises. In deduction we infer a conclusion from a given set of premises (propositions). The conclusion is either a particularisation or of equal generalization as that of premises; but in no case it goes beyond premises.<sup>7</sup> Eg:

All men are mortal.

Ram is a man.

Therefore, Ram is mortal.

**Immediate and mediate inference:** In formal reasoning or deduction an inference may either be drawn from one premise or more than one premise. If an inference is drawn from just one premise it is called **immediate inference** and where there is more than one premise, it is called **mediate inference**.<sup>8</sup>

**Square of opposition** and **eduction** are the two instances of immediate inference whereas **sylogism** is the instance of mediate inference where there are only two premises, and the conclusion follows from them jointly. Where inference is drawn from more than two premises then it is **non-syllogistic mediate inference**.

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<sup>7</sup> CBSE Philosophy XI 2011 p 10

<sup>8</sup> CBSE Philosophy XI 2011 p 80

## Induction

Induction is a process of inference in which we draw universal statements or scientific laws on the basis of particular facts. Experiences furnish us with particular facts and not with universal truths. For example, experiences inform us that some men whom we know are dead. But on the basis of these few instances, we draw a universal conclusion that all men are mortal. This is inductive procedure.<sup>9</sup> A concrete example of induction is:

Ram is mortal.

Shyam is mortal.

Gita is mortal.

...

Therefore, all men are mortal.

In induction the conclusion is more general than the premises because the number of instances observed is very small compared to the full number of which the statement is made. Induction relies on two fundamental principles, viz., the law of uniformity of Nature and the law of causation. These laws are called the formal grounds of induction.

**The law of uniformity of Nature:** The law of uniformity of Nature has been expressed in various forms such as, "Nature is uniform", "The future resembles the past", "Nature repeats itself". These various expressions mean that Nature behaves in the same way under the similar circumstances. If the same circumstances occur the same events will follow. In other words, if water quenched our thirst or fire burnt us in the past under

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<sup>9</sup> CBSE Philosophy XI 2011 p 2

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certain circumstances, water will quench our thirst and fire will burn us in future under similar circumstances. Thus, relatively speaking the law implies that there is no such thing as whim or caprice in Nature. At first sight Nature does not appear to be uniform. It is true that in Nature various kinds of phenomena occur but all these phenomena depend for their occurrences on certain conditions and if these conditions occur then the phenomena will occur. Consequently, corresponding to the various departments of Nature, there are laws. There is not one uniformity or law governing the whole universe but there are various uniformities or laws governing the various departments of Nature. And these are not distinct but are parts of one system. Hence, we speak of unity of Nature. The law of uniformity of Nature is a postulate or formal ground of induction. It forms the very basis of all inductive generalizations that from the particular facts we draw universal conclusion.¹⁰

The law of causation: The law of causation is second formal ground of inductive generalization. It states, "Every event has a cause" or as J.S. Mill puts it, "Every phenomenon which has a beginning must have a cause". It is the guiding principle of inductive generalizations. This law guarantees the formal truth of inductive generalization. According to some logician causation is a special kind of uniformity. According to certain other logician law of causation and law of uniformity of Nature are two distinct laws and they together constitute the formal grounds of induction.¹¹

Distinction between deduction and induction

¹⁰ CBSE Philosophy XI 2011 p 3

¹¹ CBSE Philosophy XI 2011 p 3

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In induction, as we have seen, we infer more comprehensive conclusion than the premises whereas in deduction we infer lesser or of equal strength of conclusion as of our premises. Like analysis and synthesis, deduction and induction mutually imply each other. Neither gives a complete account of knowledge of any object without the other. The work of the one is not over before the other begins. The process of acquiring knowledge involves both deduction and induction. Induction first completes the work of establishing the universal propositions or premises and deduction then explains the particulars in the light of that universal proposition. Not only do deduction and induction mutually involve one another they also proceed to the same ultimate principle. They differ in their starting point and not in their principle. In deduction we start with general principles and reach to its consequences, while in induction we start with the facts of observation and discover a general principle. In other words, the real process of inference in each case is the same, viz., an insight into the connection of facts according to some general principles. [CBSE Philosophy XI 2011 p 11]

### Analogy

Analogy is a weak form of Induction. Analogy is a kind of inference which proceeds from particular to particular. It is based on imperfect similarity and is only probable in character. The ground of inference in analogy is resemblance.<sup>12</sup>

Symbolically, analogy may be represented as –  
“A resembles B in certain properties, viz., x, y, z. B further possesses the property m. Therefore, A possesses the property m, even though no connection is known to exist between m and common properties x, y, z.”

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In law, analogy often bridges gaps where statutes are silent. For example, if tenancy law grants protection to ‘houses’ used as residences, and a tenant occupies a flat, the court may reason by analogy that a flat resembles a house in essential respects (being a dwelling, providing shelter, used for habitation). Therefore, the flat also falls under the protection.

### **Distinction between analogy and induction**

According to logicians, analogy possesses the main characteristic of induction, i.e., an inductive leap from the known to the unknown.<sup>13</sup>

However, analogy differs from induction in the following respects:

1. In analogy, we proceed from particular to particular, whereas induction establishes a general proposition.
2. Induction is based on the knowledge of a causal connection, while in analogy no such knowledge is involved.

### **Syllogism**

Syllogism is an application of deductive reasoning to infer conclusion based on two propositions (major and minor) that are asserted or assumed to be true.

Syllogism is as old as human thoughts. The very method of reasoning is based on syllogism. We can infer it in the conversation of Abraham and Moses with their God. Crediting its invention to Socrates / Aristotle is to belie the religious anthologies, may be to prove the secularism of the investigation.

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<sup>12</sup> CBSE Philosophy XI 2011 p 8

<sup>13</sup> CBSE Philosophy XI 2011 p 8

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It can, however, safely be said that the Socrates / Aristotle might have institutionalised the methodology as a subject of study. The human mind decides (reaches to a conclusion) anything in a syllogistic way. The general proposition stored in the mind acts as a touchstone whereupon a particular instance is tried and tested and the conclusion is drawn about the nature of that instance. A logician calls these three aspects of an argument as major premise, minor premise and conclusion. For example, in the argument – All men are mortal; Socrates is a man; therefore, Socrates is mortal. – the first proposition ‘All men are mortal’ is the major premise, the second proposition ‘Socrates is a man’ is an instance or minor premise, and the third proposition ‘therefore Socrates is mortal’ is the conclusion drawn from major and minor premises.

**Categorical syllogism:** A categorical syllogism is a syllogism which makes use of categorical propositions that is A, E, I and O.<sup>14</sup>

For example,

Premise 1: All monarchs are dictators.

Premise 2: Some monarchs are great scholars.

Conclusion: Therefore, some great scholars are dictators.

**Hypothetical syllogism:** Hypothetical syllogism is a syllogism having a conditional statement as one or both the premises.<sup>15</sup>

For example,

Premise 1: If surplus food grain is not distributed in time, it will be destroyed.

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<sup>14</sup> CBSE Philosophy XI 2011 p 86

<sup>15</sup> CBSE Philosophy XI 2011 p 87

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Premise 2: Surplus food grain is not distributed in time.

Conclusion: Therefore, food grain will be destroyed.

**Disjunctive syllogism:** Disjunctive Syllogism is a syllogism having a disjunctive statement as one of its premises.<sup>16</sup>

For example,

Premise 1: Either John is going to the party or Mary is going to the party.

Premise 2: John is not going to the party.

Conclusion: Therefore, Mary is going to the party.

### Structure of syllogism

Since each proposition consists of two terms (subject and predicate), the three propositions (two premises and one conclusion) of syllogism must consist of three terms with each term occurring twice.<sup>17</sup>

For example:

All self- confident persons are mentally strong.

No coward is mentally strong.

Therefore, no coward is self- confident person

The three categorical propositions in the above example contain exactly three terms that is ‘self-confident person’ ‘mentally strong’ and ‘coward’. To identify the terms by name we look at the conclusion. The predicate of the conclusion is called the **major term** (P). The subject of the conclusion is called the **minor term** (S). The term which occurs in both the premises but not in the conclusion is called the **middle term** (M). In the above

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<sup>16</sup> CBSE Philosophy XI 2011 p 87

<sup>17</sup> CBSE Philosophy XI 2011 p 88

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example, the term 'self-confident' person is the major term 'coward' is the minor term and 'mentally strong' is the middle term.

The premises of a syllogism also have names. Each premise is named after the term that appears in it. The premise that contains the major term is called the **major premise**. In the example 'self-confident person' is the major term, so the premise "All self-confident persons are mentally strong" is the major premise. The premise containing the minor term is called the **minor premise**. In the example, 'coward' is the minor term so "No coward is mentally strong" is the minor premise. It is the minor premise not because of its position but because it is the premise that contains the minor term.

A syllogism is said to be in **standard form** when its premises are arranged in a specified standard order. In a standard form of syllogism, the major premise is always stated first, the minor premise is second and the conclusion is last.

## Logic

Logic is the study of methods and principles used to distinguish between correct and incorrect reasoning.

When one reasons about any matter, he produces averments (premises) to support his statement (conclusion). However, not all reasons are good reasons. Therefore, one may always ask, when confronted with an argument: Does the conclusion reached follow from the premises assumed? To answer this question there are objective criteria which is studied in logic.

## Validity and truthfulness

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A logician is concerned with the **validity** of the argument and not with the **truthfulness** of propositions.

**Truth** is an *empirical* relation between the statement and what it asserts or denies about reality and may therefore vary with the additional information obtained through observation. The truth value of the conclusion always depends upon the truth value of the premises and if the truth value of the premises varies the truth value of the conclusion will also vary.<sup>18</sup>

**Validity** is a *logical* relation between premises and conclusion. A valid deductive argument indicates that the premises are supposed to provide absolute guarantee for the conclusion even though it may lack truth value.<sup>19</sup>

A logician who evaluates the argument is interested in the arguments as such i.e. he is not concerned about the truth or falsity of the conclusions drawn but will be concerned either about the form of an argument under consideration, to determine if that argument is of a kind that is likely to yield a warranted (correct) conclusion, or will be concerned about the quality of the argument, to determine whether it does in fact yield a warranted conclusion.

### Rules of validation

The connection between the truth and validity is by no means a simple one. There are some generic rules, however, through which this relationship can be best understood along with examples. It will also help us to ward off some likely misconceptions about these notions.

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<sup>18</sup> CBSE Philosophy XI 2011 p 55

<sup>19</sup> CBSE Philosophy XI 2011 p 55

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Rule 1 - True premises do not guarantee validity: The following example exemplifies this rule.

Cows are mammals.

Dogs are mammals.

Therefore, dogs are cows.

Rule 2 - A true conclusion does not guarantee validity: The following example exemplifies this rule.

Cars are mammals.

Tigers are mammals.

Therefore, tigers are cats.

Rule 3 - True premises and a true conclusion together do not guarantee validity: The following example exemplifies this rule.

Cars are mammals.

Tigers are mammals.

Therefore, tigers are cats.

Rule 4 - False premises do not guarantee invalidity: The following example exemplifies this rule.

Birds are mammals.

Cats are birds.

Therefore, cats are mammals.

Rule 5 - A false conclusion does not guarantee invalidity: The following example exemplifies this rule.

Cats are birds.

Dogs are cats.

Therefore, dogs are birds.

Rule 6 - False premises and a false conclusion together do not guarantee invalidity

Thus, while the truth of proposition and the validity of reasoning are distinct, the relationship between them is not entirely straight forward. When an argument has true premises and a false conclusion, it must be invalid. This is how we define invalidity. Although we can speak of valid and invalid arguments and argument-forms, it makes no sense to speak of valid or invalid statements. Nor does it make sense to call an argument as true or false. Validity and invalidity are properties of arguments; truth and falsity are properties of statements. Again, we should not be misled by true premises or true conclusion to suppose that that an argument is valid. Nor should we be misled by false premises or false conclusion to suppose that it is invalid. As a matter of fact, truth and validity are combined in the concept of soundness. An argument is sound if all its premises and conclusion are true, and its reasoning is valid; all others are unsound.

Logical form

A question arises as to how we can be sure that in valid argument there could be no possible way for premises to be true and conclusion to be false. How can we possibly prove such a thing? The answer to this question lies in the concept of form, pattern, or structure. To say that an argument could not possibly have true premises and a false conclusion is simply to say that it has a certain kind of form which does not admit of instances of such kind. It is the form of an argument, then, which determines its logical validity. Whether an argument is valid or invalid is determined entirely by its form. Let us examine the following example:

P1. All men are mortal.

P2. Socrates is man.

C: Therefore, Socrates is mortal.

What makes the above argument a valid argument has nothing to do with, Socrates, men or mortality. Rather each sentence in the argument exhibits a pattern, a logical form, which guarantees the truth of the conclusion given the truth of premises. More generally, the logical form of a sentence of natural language is what determines both its logical properties and its logical relations to other sentences. The logical form of a sentence of natural language is typically represented in a theory of logical form by well-formed formula in a logically pure language. In this language all meaningful symbols are expressions with fixed and distinct logical meaning. The arguments' validity is explained by the fact that premises formally entail (implies) the logical form of conclusion. Thus, the primary function of a theory of logical form is to explain a broad range of logical phenomena in terms of logical forms which it essentially assigns to sentences of natural language.

Logic and mathematics

Logic is one of the pillar stones on which mathematics rests, the other two being the set theory and the number theory. Mathematics deduces conclusions from self-evident truths or axioms and deduces further other conclusions from these. This brings order to the complicated abstractions of mathematics.

Quantifiable sciences like physics, chemistry and engineering use deductive methods to draw definite conclusions from their axioms. Qualitative sciences like biology, physiology, medicine and also the social sciences like economics, sociology and

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psychology use logic by observing particular facts, comparing and classifying them and then seek to explain them by general laws. They adopt the inductive methods and their conclusions are more or less probable. Thus, all the sciences apply logic to their methods of investigations.

The enormous success of computers in recent times owes a lot to logic. The growth and development of computers is largely due to logic. The complex electronic circuits are designed to work primarily on binary (two-valued) logic. The relationship between computer architecture and logic is best seen in a new branch of logic called **computational logic**. Further, a new three valued **fuzzy logic** has given a new direction to the present technology regarding controls. It is used for developing sophisticated control systems. Fuzzy logic addresses control applications perfectly as it resembles human decisions with an ability to generate precise solutions from certain or approximate information. For example, let's take a fuzzy washing machine. A load of cloths in it and we press start button; now the machine churns automatically choosing the best cycle for washing.

There are other kinds of logic which are very popular such as **modal logic** (relating to mode or form as opposed to substance) which is designed to express the logical structure of statements that contain modal terms like 'possible', 'necessary' and their variants. **Temporal logic** connected with the notions of time. **Deontic logic** (relating to duty and obligation as ethical concepts) is an attempt made to extend the arena of logic to certain kinds of reasoning in ethics. It deals with the ethical notions of permission, obligation and the like. Several deontic systems were developed but Nicholas Rescher's system is the most popular amongst all. **Epistemic logic** (relating to knowledge and its

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validation) is an attempt to extend resonating to discourses which are connected with the notions of 'knowledge' and 'belief'. These are all specialized branches analysing different types of discourses which are beyond the scope of this book. Today logic is sited at the intersection of philosophy, mathematics, linguistics and computer science as it deals with the structure of reasoning and the formal features of information. Regardless of advances in its allied areas, logic thrives. Its techniques are applied to many different domains of reasoning, and its connections with linguistics and computer science have strengthened the discipline and brought it new applications.