CHAPTER – 9

LOGICAL DEDUCTIONS

In many competitive exams, questions based on deriving conclusions from a given set of statements (set of two or more than two statements) are asked. These kinds of questions are referred to as “Deductions”. Different methods are used to answer these questions. The two most popular methods are by application of certain rules (called rules of Syllogism) and by using Venn Diagrams to visualize all possible scenarios for the given set of statements.
One pattern of the question is - two statements are given, and the examinees are asked to find the conclusion that can be derived from both the given statements but not from any one of them. Here the examinees need to find a conclusion(s) that is/are true in all possible scenarios for the given pair of statements. The method advised for solving this pattern of questions is by application of syllogism rules. Exercise (a) of this chapter contains questions where conclusions are to be derived from two statements and exercise (b) contains questions where Venn Diagram method is used to find conclusions. We shall discuss the syllogism rules method first.

Let us look at some basic terms used in the rules and understand what they mean.

The two statements given in the question are called 'premises' and the answer, the conclusion.

e.g. All dogs are cats - (i)
All cats are pigs - (ii)

These two statements are called 'premises.'
Conclusion : All dogs are pigs.

The premises normally start with the words All, No, Some and Some - Not.
The word “All” has its synonyms as – Every, Any, Each, whereas the word “Some” can also be replaced by Many, Few, A little, Most of, Much of, More, etc.
These words are referred to as qualifiers (also termed as quantifiers).

A premise consists of a subject and a predicate wherein the first term [e.g. "dogs" in statement (i)] is the subject and the second term [e.g. "cats" in statement (i)] the predicate. Similarly, in statement (ii), "cats" is called the subject and "pigs" is the predicate.

The word that occurs in both the premises is known as the 'middle term' ("cat" in the example, given above). The answer or "conclusion" should consist of the other two words (“dogs” and “pigs” in the above example) and the middle term should not appear in the answer.
The premises can be divided into
(a) Universal statements and
(b) Particular statements

This classification of the premises into the above categories is dependent on the qualifier used in the premise. For example, the statements where "All" is used are called Universal statements and the statements where "Some" is used are called Particular statements.
Premises can also be divided into
(i) Positive (affirmative) statements and
(ii) Negative statements.

If there is a negative term like "not" or "no" in the statement, it is called a negative premise. Otherwise it is called a positive premise or an affirmative statement.

The combination of the two different categories of classifications leads to four different premises as given in Table I below.

TABLE I

	Affirmative	Negative
Universal	All A	No E
Particular	some; many I	some not; many not O

The subject or the predicate can be either distributed or not distributed in the given premise.

The subject and the predicate are either distributed (✓) or not distributed (×) depending on what kind of a statement it is (particular affirmative etc.). Table II shows the distribution pattern of the subject and the predicate.

TABLE II

	Subject	Predicate
Universal affirmative	✔	×
Universal negative	✔	✔
Particular affirmative	×	×
Particular negative	×	✔

Note: ✔ indicates distributed.
x indicates not distributed.

RULES FOR DEDUCTIONS

[1] Every deduction should contain three and only three distinct terms.
[2] The middle term must be distributed at least once in the premises.
[3] If one premise is negative, then the conclusion must be negative.
[4] If one premise is particular, then the conclusion must be particular.
[5] If both the premises are negative, no conclusion can be drawn.
[6] If both the premises are particular, no conclusion can be drawn.
[7] No term can be distributed in the conclusion, if it is not distributed in the premises.

We take examples of each type and look at them in detail.

Example - I

All dogs are cats. -- (i)
All cats are pigs. -- (ii)

As the first statement is a Universal affirmative statement, the subject (dogs) has to be distributed (✔) and the predicate (cats) is not distributed (×). As the second statement is also Universal affirmative, the subject cat is distributed (✔) and the predicate pigs is not distributed (×). The above answer/logic is arrived at on the basis of Table II.
The middle term ("cats" is the middle term as it occurs in both the premises) is distributed once in the premises. Hence it satisfies Rule [2]. As "dogs" is distributed in the

premise and "pigs" is undistributed in the deduction also, they should appear accordingly. The type of statement that satisfies both of them is Universal affirmative statement, i.e. a statement with "All". Hence the answer will be

All dogs are pigs.

The answer cannot be 'All pigs are dogs', because Rule [7] states that no term can be distributed in the conclusion if it is not distributed in the premises. As "pigs" is not distributed in the premise, it cannot be distributed in the conclusion (because if we take "All pigs are dogs", then the subject "pigs" will be distributed). Hence, the conclusion "All pigs are dogs." is wrong.

Example - II

All cats are dogs. -- (i)
All cats are pigs. -- (ii)

Statement (i) is Universal affirmative and hence the subject "cats" is distributed and the predicate "dogs" is not distributed as per Table II.

Statement (ii) is also Universal affirmative and hence the subject "cats" is distributed and the predicate "pigs" is not distributed as per Table II.

Here, the middle term "cats" ("cats" is the middle term as it is occurring in both the premises) is distributed; hence we can draw a conclusion.

The answer should contain the terms "dogs" and "pigs" and both the terms are not distributed. Referring to Table II, we find that this is possible only in Particular affirmative [the conclusion cannot start with the qualifier 'All' as the subject in "All" should be distributed]. According to Rule 7, a term cannot be distributed in the conclusion if it is not distributed in the premises. So the answer will be

Some dogs are pigs.
or
Some pigs are dogs.

Example - III

All dogs are cats. -- (i)
All pigs are cats. -- (ii)

Statement (i) is a Universal affirmative and hence the subject "dogs" is distributed and the predicate "cats" is not distributed. In statement (ii), which is also a Universal affirmative, the subject "pigs" is distributed and the predicate "cats" is not distributed. This is arrived at on the basis of Table II.

The middle term "cats" ["cats" is the middle term as it occurs in both the statements] is not distributed in either of the two statements. From Rule [2], which states that the middle term should be distributed at least once in the premises for drawing a conclusion, we cannot draw any conclusion in this case.

Example - IV

All cats are dogs. -- (i)
Some cats are pigs. -- (ii)

The first statement is a Universal affirmative premise and hence the subject "cats" is distributed and the predicate "dogs" is not distributed (×). The second statement is Particular affirmative and hence both the subject "cats" and the predicate "pigs" are not distributed (×) as per Table II. As we have a particular premise, the conclusion should also be a particular one as per Rule [4]. The middle term is distributed, hence we can draw a conclusion. So the answer will be

Some dogs are pigs.
or
Some pigs are dogs.

Example - V

All dogs are cats. -- (i)
No cats are pigs. -- (ii)

As the first premise is a Universal affirmative, the subject (dogs) is distributed and the predicate (cats) is not distributed. In the second premise, which is a Universal negative, the first term (cats) and the second term (pigs) are both distributed (as per Table II). As the middle term is distributed at least once in the premises, Rule [2] is satisfied and hence we can draw a conclusion.

From Rule [3], which states that if one of the premises is negative the conclusion should be negative, the conclusion should be negative and as both the terms “dogs” and “pigs” are distributed, the conclusion should be a Universal negative statement. Hence the answer will be
No dogs are pigs.
or
No pigs are dogs.

Example - VI

All dogs are cats. -- (i)
Some cats are pigs. -- (ii)

Since the first statement is a Universal affirmative, "dogs" is distributed and "cats" is not distributed. Since the second statement is a Particular affirmative, "cats" is not distributed and "pigs" is also not distributed (as per Table II).

In the above given example, no conclusion can be drawn, as Rule [2] states that the middle term ("cats" in the above example as it occurs in both the premises) should be distributed at least once in the premises, which is not satisfied.

Example - VII

All dogs are cats. -- (i)
Some cats are not pigs. -- (ii)
The first statement is a Universal affirmative and hence the subject (dogs) is distributed and the predicate (cats) is not distributed.
The second statement is a Particular negative and hence the subject (cats) is not distributed and the predicate (pigs) is distributed (Table II).

But as the middle term (cats) is not distributed at least once in the premises, Rule [2] is not satisfied and hence we cannot draw any conclusion.

Example - VIII

All cats are dogs. -- (i)
Some cats are not pigs. -- (ii)

The first statement is a Universal affirmative and hence "cats" is distributed and "dogs" is not distributed. The second statement is a Particular negative and hence "cats" is not distributed and "pigs" is distributed (as per Table II).

Here, the middle term (cats) is distributed and hence we can draw a conclusion.

The conclusion should be Particular negative as Rule [3] states that if a premise is negative, the conclusion should also be negative. Also Rule [4] states that if a premise is Particular, the conclusion should also be Particular. Hence, the conclusion should be a Particular negative.
In Particular negative, we know that the subject is not distributed and the predicate is distributed.

The terms "dogs" and "pigs" should come in the conclusion. Also, since "dogs" is not distributed in the premise, it cannot be distributed in the conclusion, as per Rule [7].
As per the above reasoning, only "pigs" can be the predicate in the conclusion and hence "dogs" will be the subject.
Thus the answer will be - Some dogs are not pigs.

Example - IX

No dogs are cats. -- (i)
No cats are pigs. -- (ii)
We cannot draw any conclusion, as Rule [5] states that if both the premises are negative, we cannot draw any conclusion.

Example - X

No dogs are cats.
Some cats are not pigs.

As both the premises are negative, hence, as per Rule [5], we cannot draw any conclusion.
(Please note that the first premise is a Universal negative and hence the subject (dogs) is distributed and the predicate (cats) is also distributed as per Table II.
The second statement is a Particular negative and hence the subject (cats) is not distributed and the predicate (pigs) is distributed as per Table II).

Example - XI

Some cats are not pigs. -- (i)
Some cats are dogs. -- (ii)
As the first premise is a Particular negative, the subject (cats) is not distributed and the predicate (pigs) is distributed. In the second premise, both the subject and the predicate (cats and dogs respectively) are not distributed, since the premise is a Particular affirmative (as per Table II).

No conclusion can be drawn, as both the premises are particular as per Rule [6].

Example - XII

Some cats are not dogs. -- (i)
Some cats are not pigs. -- (ii)

We cannot get an answer from the two premises, as Rule [5] states that from two negative premises, no conclusion can be drawn. Also, Rule [6] states that from two particular premises, no conclusion can be drawn.

Exercise – 9(a)

Directions for questions 1 to 7: Select the alternative that logically follows from the two given statements, but not from one statement alone.

1. All cooks are drivers.
All drivers are dancers.

(A) All dancers are drivers.
(B) All cooks are dancers.
(C) No cook is dancer.
(D) Both (A) and (B)

2. All sane are men.
Some sane are insane.

(A) Some men are insane.
(B) No men are insane.
(C) All men are insane.
(D) None of the above

3. No plane is ship.
No ship is bus.

(A) No bus is plane.
(B) No plane is bus.
(C) Both (A) and (B)
(D) None follows

4. All cats are dogs.
No dogs are rats.

(A) All cats are rats.
(B) Some cats are rats.
(C) No cat is rat.
(D) None of the above

5. Some books are brooks.
Some brooks are not cooks.

(A) Some books are cooks.
(B) Some books are not cooks.
(C) Both (A) and (B)
(D) None follows

6. Some shirts are pants.
All pants are shorts.

(A) No shirt is shorts.
(B) Some shirts are shorts.
(C) All shirts are shorts.
(D) None of the above

7. Some gauges are cages.
Some cages are not catches.

(A) Some guages are not catches.
(B) No guage is a catch.
(C) Some guages are catches.
(D) None of the above

Directions for questions 8 to 12: Each of these questions consist of two statements followed by two conclusions marked I and II. Consider the statements to be true, even though they seem to be at variance with the commonly known facts and find out which of the given conclusion(s) logically follow(s) the two given statements (but not from any one of them), disregarding the commonly known facts. Mark your answer as,

(A) if only I follows.
(B) if only II follows.

(C) if neither I nor II follows
(D) if both I and II follow

8. Statements: All seas are bees.
Some teas are bees.

Conclusions: I. All teas are seas.
II. Some seas are teas.

9. Statements: All grapes are apples.
All apples are mangoes.

Conclusions: I. All grapes are mangoes.
II. All mangoes are grapes.

10. Statements: Some doctors are lawyers.
Some lawyers are architects.

Conclusions: I. Some doctors are architects.
II. All architects are doctors.

11. Statements: All weddings are writings.
All weddings are wirings.

Conclusions: I. Some writings are wirings.
II. All writings are wirings.

12. Statements: Some queues are rows.
No row is a circular.

Conclusions: I. All circular are queues.
II. Some circulars are queues.

Directions for questions 13 to 17: The questions given below have four groups of three statements each. Read the statements in each group carefully and identify the group/groups where the third statement logically follows the first two statements together in the group.

13. (a) All books are copies. All copies are papers. All books are papers.
(b) All cubes are squares. All cubes are triangles. All triangles are squares.
(c) All singers are dancers. All dancers are musicians. All musicians are singers.
(d) No cock is hen. All hens are chickens. No hen is chicken.

(A) Only d (B) Only a
(C) Only b and c (D) Only a and d

14. (a) Some journals are magazines. Some magazines are periodic. Some journals are periodic.
(b) Some horror is ghost. All ghosts are faints. Some horror are faints.
(c) All scientists are researchers. All researchers are professors. Some professors are scientists.
(d) Many baggages are luggages. All luggages are packages. Some packages are not baggages.

(A) Only b, c and d (B) Only b and c
(C) Only a and d (D) Only b

15. (a) Many fountains are cascades. No waterfall is fountain. Some cascades are not waterfalls.
(b) No bag is pack. No pack is jack. No jack is bag.
(c) No good is bad. All bad is not good. Some good is not good.
(d) Scale is ruler. No ruler is pointer. No pointer is scale.

(A) Only a (B) Only d
(C) Only b and c (D) Only a and d

16. (a) No esthetic is an atheist. Some esthetics are monotheists. Some monotheists are not polytheists.
(b) All sentences are words. No word does not have meaning. Some which do not have meanings are not sentences.
(c) No river is sea. Some seas are oceans. Some oceans are not rivers.
(d) No MMTS is MRTS. All public transports are MRTS. No public transport is MMTS.

(A) Only b, c and d (B) Only c and d
(C) Only a and b (D) Only b and c

17. (a) No sitar is a guitar. No guitar is violin. No violin is a sitar.
(b) Ragas are songs. Some pops are not songs. Some pops are not ragas.
(c) Some costume designers are not hair designers. All designers are not hair designers. Some designers are not costume designers.
(d) AC's are not DCs. Some DCs are not BC's. Some AC's are not BC's.

(A) Only b and d (B) Only a and d
(C) Only b (D) Only a and b

Directions for questions 18 to 22: Each of these questions consists of six statements followed by sets of three statements each. Find the set in which the third statement can be logically concluded from the first two statements together.

18. (a) No wolf is a tiger.
(b) No deer is tiger.
(c) Some bears are not tigers.
(d) Many deers are not bears.
(e) Some bears are wolves.
(f) No deer is wolf.

(A) aec (B) bfd (C) efd (D) fbd

19. (a) Anything which is kind is gentle.
(b) Everything which is gentle is not hard.
(c) Nothing which is firm is gentle.
(d) Something which is firm is hard.
(e) Many things which are hard are not kind.
(f) Nothing which is kind is firm.

(A) acf
(B) dfe
(C) abe
(D) More than one of the above

20. (a) Screening is sedimentation.
(b) Sedimentation is purification.
(c) Purification is filtration.
(d) Filtration is screening.
(e) Screening is purification.
(f) Sedimentation is filtration.

(A) cde (B) bfc (C) bcf (D) aeb

21. (a) No fish is bird.
(b) Flyers are gliders.
(c) No flyer is fish.
(d) Some gliders are birds.
(e) No flyer is bird.
(f) Some flyers are birds.

(A) dbf (B) ace
(C) efd (D) None of these

22. (a) Junk food contains more fat.
(b) Fast food is not healthy.
(c) Fast food does not contain more fat.
(d) Junk foods are fast foods.
(e) Some fast food are junk foods.
(f) Junk food is not healthy.

(A) ace (B) ade (C) bfe (D) bdf

Directions for questions 23 to 27: Each of these questions consists of six statements followed by sets of three statements each. Find the set in which the statements are logically related.

23. (a) Shed is not shelter.
(b) Roof is protection.
(c) Roof is shed.
(d) Roof is shelter.
(e) Some shelter is not protection.
(f) Shed is protection.

(A) cda
(B) aef
(C) bcf
(D) More than one of the above

24. (a) Engineers are not doctors.
(b) Some doctors are psychologists.
(c) Some doctors are not professors.
(d) Some engineers are professors.
(e) No professor is a psychologist.
(f) Some psychologists are not engineers.

(A) acd (B) def
(C) bfa (D) All the above

25. (a) All cricketers are footballers.
(b) All footballers are magicians.
(c) All magicians are cricketers.
(d) Some cricketers are footballers.
(e) Some footballers are magicians.
(f) Some magicians are cricketers.

(A) abc (B) efb (C) bcd (D) def

26. (a) Some RCs are not DCs.
(b) All PCs are ACs.
(c) Some ACs are not RCs.
(d) Some ACs are not DCs.
(e) Many RCs are PCs.
(f) Some PCs are not DCs.

(A) ceb (B) fdb (C) afe (D) dbe

27. (a) Truss is not roof.
(b) Truss is not timber.
(c) Post is roof.
(d) Timber is roof.
(e) Post is not truss.
(f) Timber is post.
(A) bfe
(B) cae
(C) cdf
(D) More than one of the above

Directions for questions 28 to 30: Each question consists of a set of numbered statements. Assume that each one of these statements is individually true. Each of the five choices consists of a subset of these statements. Choose the subset as your answer where the statements therein are logically consistent among themselves.

28. (a) Those who think more can create new things.
(b) Those who do not have brain are dull.
(c) Those who has brain are intelligent people.
(d) Those who has brain are artists.
(e) Some intelligent people are not artists.
(f) Intelligent people think more.
(g) Dull people cannot think more.
(h) Those who can create new things are artists.

(A) a, d, c, h and f (B) h, e, f, a and c
(C) b, g, f, e and d (D) b, c, d, f and a

29. (a) Mangoes are not oranges.
(b) Grapes are apple.
(c) Apples are mangoes.
(d) Mangoes are bananas.
(e) Bananas are oranges.
(f) Oranges are grapes.
(g) Bananas are not apples.
(h) No mango is an orange.

(A) b, c, d e and f (B) a, d, b, f and g
(C) c, d, e, f and g (D) h, d, f, b and c

30. (a) Some violates are not blue.
(b) All oranges are red.
(c) No orange is red.
(d) Some oranges are violates.
(e) Some blues are greens.
(f) Every red is green.
(g) No green is blue.
(h) All violates are red.

(A) a, b, f, e and d (B) a, c, d, f and g
(C) a, b, g, f and d (D) b, h, f, e and g

VENN DIAGRAMS METHOD:

The questions where more than two statements are given, and a conclusion derived from a single statement is also accepted as a conclusion can be solved using Venn Diagram method. Moreover, we come across answer choices like "Either I or II follows" in these questions which are not found in the questions where conclusion is to be drawn using both the statements.

The statements given in the questions and the conclusions that are derived may not confine to generally accepted facts. None of the three statements below is a fact, but they still may be a part of a question.

Eg: 1. All cats are dogs.
2. Some birds are elephants.
3. Some flowers are not mountains.

To understand and analyze these statements and to draw conclusions, we can use symbolic logic for clear expression of our thoughts. The examinee has to understand the logical implications of the given statements and verify the logical correctness of each of the given conclusions, strictly within the preview of the given statements. Each of the given statements has to be taken as true, though they deviate from generally accepted facts, and check whether the given conclusions logically follow the statements.

To achieve the above task, the given statements have to be represented in a combined format. Representation through Venn diagrams is an effective way to combine and to draw conclusions based on these hypothetical statements.

Venn Diagrams: These are diagrammatic/pictorial representation of sets by using geometrical figures. The Venn diagram drawn to represent all the given statements should be a combined diagram. A set of given statements

can be represented in several ways using Venn diagrams. We can conclude that a conclusion definitely follows the given statements only if that conclusion is true for all possible diagrammatic representations.

Quantifiers: A quantifier describes the extent (quantity) to which one kind (or term) is similar (or dissimilar) to another kind (or term). The main quantifiers are "All", "No", "Some" and "Some-not". Following are few examples of statements/ conclusions consisting of each of the above four quantifiers.

All:
All A's are B's, All animals are living things, All shoes are socks, etc.

No:
No A is B, No boy is girl, No bat is rat, No weak is coward, etc.

Some:
Some A's are B's, Some doctors are men, Most girls are brave, etc.

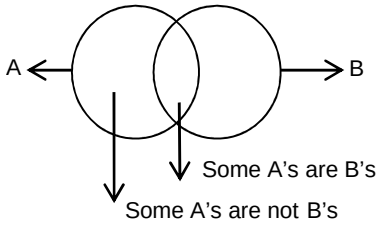
Some – not:
Some A's are not B's, Some Cricketers are not Indians, etc.

Words like "a few, most, many, more", etc are treated as synonyms to "Some", "Not all" is equivalent to "Some-not".

The statements, which contain the qualifiers 'All' and 'Some', are called affirmative statements and those containing the qualifiers 'No' and 'Some-not' are called negative statements.

COMPLEMENTARY PAIR:
Certain combinations of conclusions, consisting of one negative and the other affirmative, negate each other. For example,

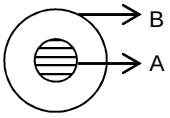
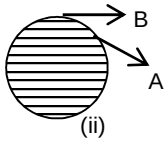
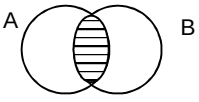
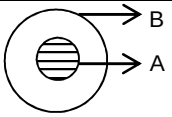
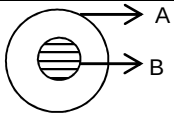
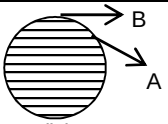
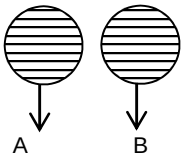
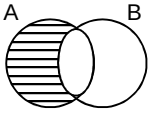
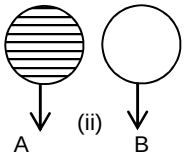
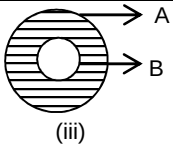
'**SOME** A's are B's' negates '**NO** A is B'.
'**ALL** A's are B's' negates **SOME** A's are **NOT** B's i.e., when 'Some A's are B's' is true, 'No A is B' cannot be true, and vice versa.
Similarly, when 'All A's are B's' is true, then 'Some A's are not B's' cannot be true, and vice versa.
In each of the above pairs, only one statement can be true or false at a time but both cannot be true or false at the same time.
Thus, 'Some A's are B's' and 'Some A's are not B's' does not form a complementary pair, as both can be true at the same time, as in the following figure.



Similarly, 'All A's are B's' and 'No A is B' does not form a complementary pair, because they both are false at the same time as for the above diagrams.
Thus, the pairs of qualifiers ('Some' and 'No') and ('Some not' and 'All'), for the same terms, form complementary pairs. The existence of conclusions can be observed while reading the question itself

The following table shows different ways of representing a statement consisting of a qualifier, by using Venn Diagrams.

TABLE - I

Qualifier	**Representations using Venn Diagram**			
1) ALL: Eg.: All A's are B's		 (i)		 (ii)
2) SOME: Eg.: Some A's are B's	 (i)	 (ii)	 (iii)	 (iv)
3) NO: Eg.: No A is B				
4) SOME, NOT: Eg.: Some A's are not B's	 (i)		 (iii)	

From the above table, it is clear that a statement can be represented diagrammatically in several ways.

Similarly, a diagram may represent more then one statement.

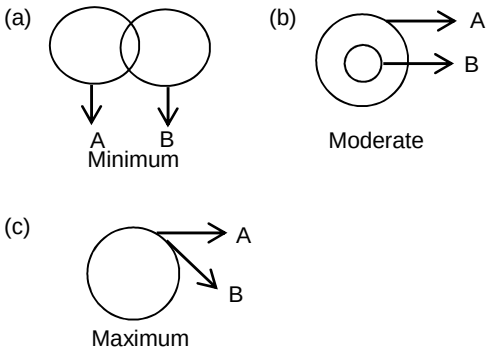
From the above table, we can draw the following possible conclusions.

Statement	*Definitely True*	*Definitely false*	*May or may not be true*
(1) All A's are B's	Some A's are B's Some B's are A's	No A is B No B is A	All B's are A's Some B's are not A's
(2) Some A's are B's	Some B's are A's	No A is B No B is A	All A's are B's All B's are A's Some A's are not B's Some B's are not A's
(3) No A is B	No B is A Some A's are not B's Some B's are not A's	Some A's are B's Some B's are A's All A's are B's All B's are A's	_____
(4) Some A's are not B's	_____	All A's are B's Some A's are B's Some B's are A's	Some B's are not A's No A is B No B is A All B's are A's

The diagrams are also classified as "Basic Diagrams" (BD) and "Alternate Diagrams" (AD), basing on intersections and extent of overlap.

Basic Diagram (BD):

This is a diagram which represents the least possible situation for a given statement is referred to as basic diagram. To get least possible representation, the diagram should contain minimum overlapping. The extent of overlap is of three kinds, as shown.



In figure (a), circles (A) and (B) are overlapping with each other only to some extent, i.e. minimum for both.
In figure (b), one circle i.e., B, is completely overlapped by A, but circle A is overlapped by B only to some extent. Here, the extent of coverage of one circle is full and the other is partial i.e., overlap is moderate on the whole.
In figure (c), each of the circles is overlapped to maximum extent by the other i.e., overlapping is the maximum.

In table-I, for statement (1), figure (i) has lesser overlapping than figure (ii). Hence, figure (i) forms the BD for statement (1). Similarly, figure (i) for statement (2) has least overlapping among all possible diagrams for that statement. Hence, figure (i) forms BD for statement (2). Similarly, figure (ii) for statement (4) is the BD for it. For statement (3) only one diagram is possible.

Alternate Diagram (AD):
Any diagram, other than BD for the given statements, is an alternate diagram. For each set of statements several alternate diagrams are possible.

Method to draw Venn Diagrams for the given statements:

Each question contains two or more statements. The Venn diagrams, that we draw to represent these statements, should be a combined diagram i.e., the diagram should link all the given statements. The following examples show how a combined diagram is drawn.

Example 1:
Statements: All A's are B's.
Some B's are C's.

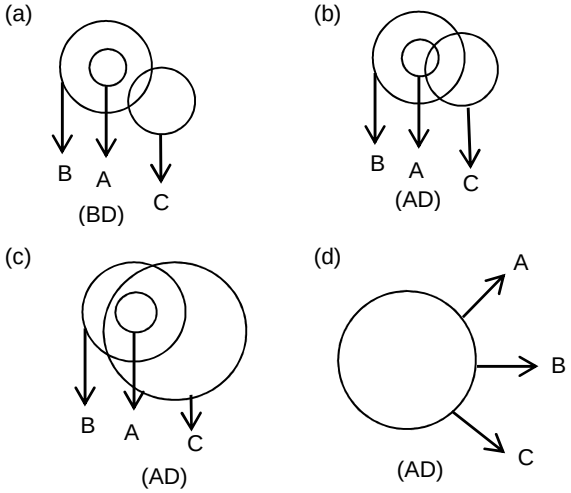
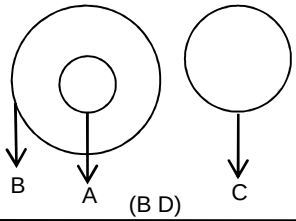


Figure (a) is the BD, as the overlapping for each of A, B and C is least, in view of the given statements.
Figures (b) and (c) are the ADs because the overlap is moderate. Several other ADs are possible for the given statements. Figure (d) is the AD with the maximum overlap.

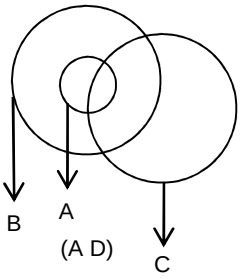
Example 2:

Statements: All A's are B's.
Some A's are not C's.

(a)



(b)



(c)

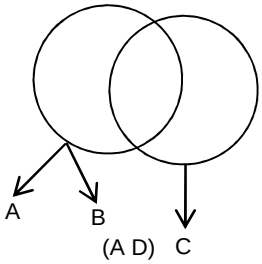


Figure (a) is the BD, as it has minimum overlapping. Figure (b) is the AD with moderate overlapping and figure (c) is the AD with maximum overlapping.
While drawing these diagrams it has to be ensured that no diagram contradicts the given statements.

Answering the questions:
In each question, the statements are followed by three or more conclusions. The student has to verify whether the given conclusions follow the statements or not. Conclusion is said to follow the given statement, if it is true for all possible Venn diagrams for a given set of statements. We can see that in examples (1) and (2), several diagrams are possible. Instead of drawing all possible diagrams and verifying truthfulness of each conclusion in each of these diagrams, it would be convenient if we can verify the truthfulness of these conclusions by using minimum number of diagrams. A student has to think logically in order to minimize the number of diagrams required to verify the truthfulness of a conclusion.

Guidelines to minimise the number of diagrams:

(i) We know that BD represents the least possible situation for the given set of statements. If an affirmative conclusion is true for BD, then it will be true for all ADs.
(ii) If an affirmative conclusion or a negative conclusion is false for BD, then it can be said that the conclusion does not follow the given statements.
(iii) If a negative conclusion is true for BD, it may or may not be true for ADs.

Let us understand the above with the help of the following example.

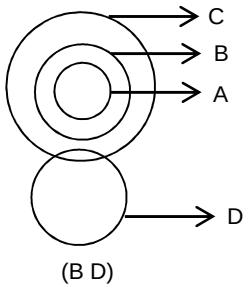
Example 3:

Statements: All A's are B's.
All B's are C's.
Some C's are D's.

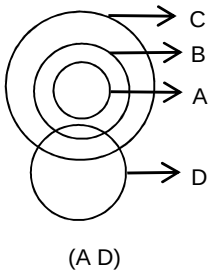
Conclusions: I. All A's are C's.
II. Some B's are D's.
III. No A is D.
IV. No C is A.

The following are some of the possible diagrams for the given set of statements.

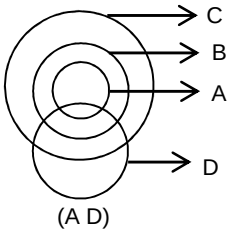
(a)



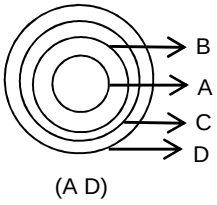
(b)



(c)



(d)



Conclusion (I), "All A's are C's", is affirmative and is true for the basic diagram (a). This means that it will be true for all the ADs. Hence, conclusion (I) follows the given statements. Conclusion (II), "Some B's are D's", is affirmative and is false for the BD. Therefore, it does not follow the given statements. Conclusion (III), "No A is D", is negative and is true for BD. This means that we will have to draw some ADs to verify its truthfulness. It observed that the statement is true for the AD (b), but false for the ADs (c) and (d). Hence, it can be concluded that conclusion (III) does not follow the given statements. Conclusion (IV), "No C is A", is negative and is false in the BD. Hence, it does not follow the given statements.

Analysis:
Since, BD represents the least possible situation, for the given statements, an affirmative conclusion, which is true for the least possible situation, will always be true. On the other hand, a negative conclusion, though true for the possible situation, may or may not be true for the other situations.

From the above example, it is clear that we need to draw AD only when a negative conclusion becomes true for BD. As per above, the truthfulness of such negative conclusion be checked by drawing all possible ADs. But instead of checking in so many ADs, we need to draw only one AD, in which the statement, which is complementary to this particular conclusion, is true. Hence, if the "complementary conclusion" turns out to be true, then the conclusion under consideration is false. While trying to draw such AD, it has to be ensured that no given statement is negated in the AD. If such AD can be drawn, then the negative conclusion does not follow the given statements; otherwise such a conclusion is always true.

If a complementary pair exists in the given conclusions, then either negative conclusion of that pair is true and the affirmative conclusion is false for the BD, or the negative conclusion becomes false for the BD and the affirmative conclusion becomes true. In such circumstances, we choose the answer choice in terms of "either-or". There may

be occasions where the negative conclusions always remain true for all ADs and the affirmative statements are always false. In such a case, the "either-or" situation does not arise.

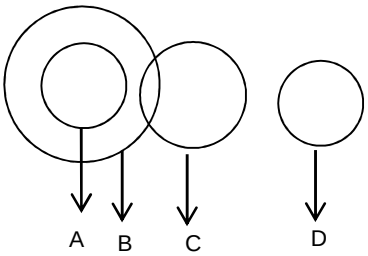
The following example will be helpful in understanding the above concept.

Example 4:

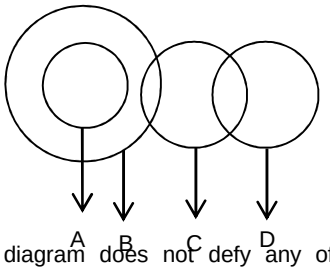
Statements: All A's are B's.
Some B's are C's.
No B is D.

Conclusion: I. No C is D.
II. No A is D.
III. Some C's are not D's.

Solution:



Above diagram is the BD for the given statements.
Conclusion I is negative and is true.
Conclusion II is negative and is true.
Conclusion III is negative and is true.
To prove conclusion I, "No C is D", to be false, we have to prove that its complementary conclusion, "Some C's are D's", is true. Hence, the AD for this will be as shown below:



The above diagram does not defy any of the given statements. Conclusion I, "No C is D", is false for this diagram, hence is not valid.
To negate conclusion II, "No A is D", and III, "Some C's are not D's", we have to prove that their respective complementary conclusions "Some A's are D's and "All C's are D's", are true. This is possible, only if D encroaches into B. But this will violate statement (3). Hence, no diagram can be drawn to negate these two conclusions.
Hence, only conclusion II and III follow.

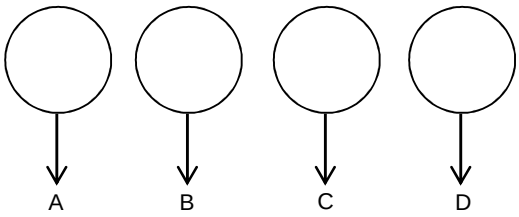
Thus, we are able to answer the question with only two diagrams. From the BD, we can verify the truthfulness of each statement and accordingly decide whether a conclusion follows the given statements or not. In case of a negative conclusion becoming true, we go for AD to prove the negative conclusion false. If such AD is possible, the negative statement does not follow, otherwise it follows the given statements. In certain rare cases we may have to go for a second AD, as shown in the following example.

Example 5:

Statements: Some A's are not B's.
Some B's are not C's.
Some C's are not D's.

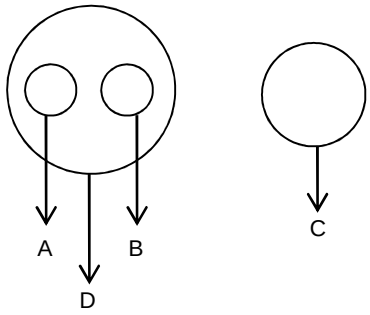
Conclusions : I. Some A's are not D's.
II. Some B's are not D's.
III. Some A's are not C's.
IV. Some C's are not A's.

Basic diagram:



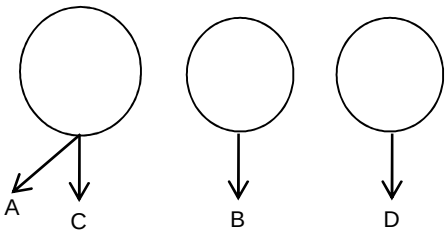
Conclusion I is negative and is true.
Conclusion II is negative and is true.
Conclusion III is negative and is true.
Conclusion IV is negative and is true.
We observe that:
'All A's are D's' is complementary to conclusion I.
'All B's are D's' is complementary to conclusion II.
'All A's are C's' is complementary to conclusion III.
'All C's are A's' is complementary to conclusion IV.

Alternate diagram 1:



Conclusion I is false.
Conclusion II is false.
To negate conclusions III and IV, we have to draw another alternate diagram.

Alternate diagram 2:



Conclusion III is false.
Conclusion IV is false.
Hence, none of the conclusions follows.

From the above example, it is also clear that no conclusion can be drawn when all the statements are negative.
Let us take some more examples.

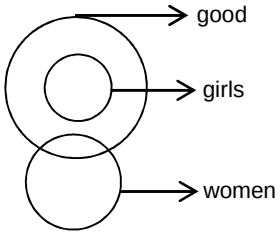
Example 6:

Statements: All girls are good.
Some good are women.

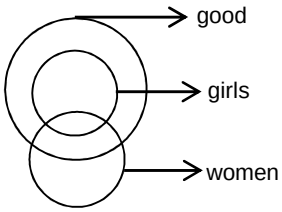
Conclusions: I. Some women are girls.
II. No woman is a girl.

Clearly, the above two conclusions form a complementary pair.

Basic Diagram:



Conclusion I is affirmative and is false.
Conclusion II is negative and is true.
Now, we should draw an AD, which would make conclusion II false i.e., which proves "Some women are girls".
Alternate Diagram:



From the above diagram, conclusion II is false, but conclusion I is true at the same time. But they both cannot be true or false at the same time. Hence, either I or II follows.

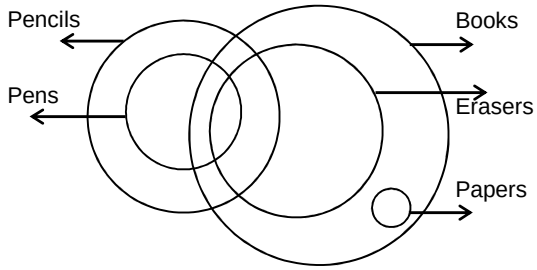
Example 7:

Statements: All pens are pencils.
Some pens are erasers.
All papers are books.
All erasers are books.

Conclusions: I. Some pencils are books.
II. Some books are pens.
III. No paper is pen.
IV. Some erasers are papers

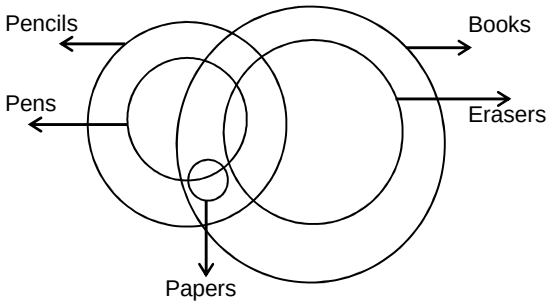
(A) Only I, II and IV (B) Only I and II
(C) Either I or II (D) Only III and IV

Solution:
The given statements can be represented in the following basic diagram.



From the above diagram,
Conclusion I, affirmative, follows.
Conclusion II, affirmative, follows.
Conclusion III, negative follows.
Conclusion IV, affirmative, does not follow.

As the affirmative conclusions (I and II) are true in the basic diagram, they will always be true. The affirmative conclusion IV is false in the basic diagram. Even if it is true in other diagrams, it cannot said to be true as there is a situation, where it is false.
The negative conclusion III, which is true in the basic diagram, has to be checked whether it can be false in any alternate diagram. The following is such diagram.



There is a situation, where conclusion III is false. Hence, only I and II are true, Choice (B)

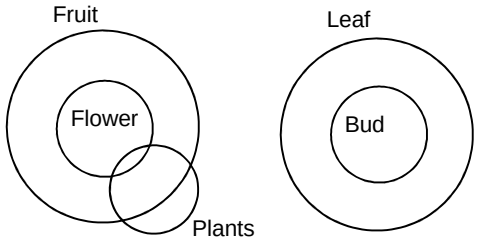
Example 8:

Statements: No leaves are fruits.
Flower is fruit.
Every bud is leaf.
Some plants are flowers.

Conclusions: I. No flower is bud.
II. Some plants are not fruits.
III. Some plants are not leaves.
IV. Some leaves are not buds.

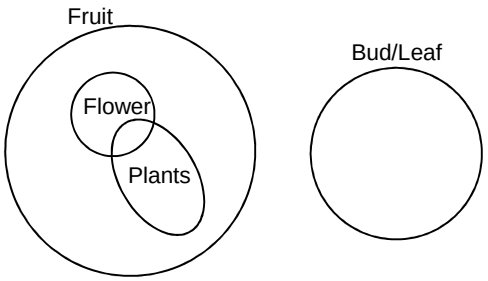
(A) Only I (B) Only II
(C) Both I and III (D) Both II and III

Solution:
The given statements can be represented in the following basic diagram.



From the above diagram,
Conclusion I, negative, follows.
Conclusion II, negative, does not follow.
Conclusion III, negative, follows.
Conclusion IV, negative, follows.
As the negative conclusions are true for the basic diagram, let us try to negate them. As no leaf is fruit (given statement), no flower which is inside the circle fruit can ever be a bud which is inside the circle leaf. Hence, conclusion I cannot be negated. Similarly, the some plants which are inside the circle flowers, can never be leaves. Hence, conclusion III cannot be negated.
Conclusion IV can be negated in the following alternate diagram.

The alternate diagram is



Hence, only I and III follow. Choice (C)

Summary:

(1) The words 'Some', 'Some-not', 'All' and 'No' are called qualifiers.
(2) Words like 'Many', 'More', 'a Few', 'Most', etc, are treated as synonyms to 'Some'. Words like 'Not-all' is treated equivalent to 'Some-not'.
(3) Statements/conclusions with qualifiers 'Some' and 'All' are classified as affirmative statements/conclusions, and those with qualifiers 'Some-not' and 'No' are classified as negative statements/conclusions.
(4) ("Some", "No"), and ("Some-not", "All") form complementary pairs.
(5) Diagram with the least encroachment is called Basic Diagram (BD) and all other diagrams are called Alternate Diagrams (AD).
(6) Truthfulness of conclusions are first tested for BD. Only when a negative conclusion is true for BD, AD is required to be drawn in such a way that this negative conclusion which was true for BD, becomes false in the AD. If such AD is not possible, then the conclusion is always true.
(7) Whenever there is a complementary pair of conclusions, check for 'either – or' as answer.
(8) When all the statements are negative, no conclusion can be drawn. In such a case, the answer is always 'None of these'.
(9) As a corollary, when all the conclusions are affirmative, BD alone is sufficient to answer the question

Exercise – 9(b)

Directions for questions 1 to 5: In each of the following questions, three statements followed by three conclusions marked I, II and III are given. Consider the statements to be true, even though they seem to be at variance with the commonly known facts and find out which of the given conclusion(s) logically follow(s) the statements, disregarding the commonly known facts.

1. Statements: All digits are symbols.
All symbols are letters.
Some letters are elements.

Conclusions: I. All digits are letters.
II. Some symbols are elements.
III. All letters are digits.

(A) Only I and II follow
(B) Only II and III follow
(C) Only I and III follow
(D) Only I follows

2. Statements: All fats are mats.
Some mats are rats.
All rats are cats.

Conclusions: I. Some fats are cats.
II. Some mats are cats.
III. Some rats are fats.

(A) Only I follows
(B) Only II follows
(C) Only III follows
(D) Both I and II follow

3. Statements: All inputs are outputs.
Some outputs are results.
No result is good.

Conclusions: I. Some inputs are results.
II. Some goods are not outputs.
III. Some inputs are good.

(A) Only I follows
(B) Only II follows
(C) Both II and III follow
(D) None follows

4. Statements: No pen is pencil.
No pencil is paper.
No paper is board.

Conclusions: I. No pen is paper.
II. Some pencils are not boards.
III. No board is pen.

(A) Only I follows (B) Only II follows
(C) Only III follows (D) None follows

5. Statements: No one is two.
Some two are threes.
All four are two.

Conclusions: I. Some four are threes.
II. No one is a four.
III. Some four are not one.

(A) Only I and II follow (B) Only I and III follow
(C) Only II and III follow (D) Only I follows

Directions for questions 6 to 10: In each of the following questions, three statements followed by four conclusions marked I, II, III and IV are given. Consider the statements to be true, even though they seem to be at variance with the commonly known facts and find out which of the given conclusion(s) logically follow(s) the statements, disregarding the commonly known facts.

6. Statements:
Some arguments are arrangements.
All arrangements are agreements.
Some agreements are achievements.

Conclusions:
I. All arguments are agreements.
II. Some agreements are arguments.
III. Some arguments are achievements.
IV. Some arrangements are achievements.

(A) Only I and III follow.
(B) Only I, II and III follow.
(C) Only II and IV follow.
(D) Only II follows.

7. Statements:
All even are odd.
Some even are prime.
All prime are digits.

Conclusions:
I. Some odd are prime.
II. All odd are prime.
III. All odd are even.
IV. Some digits are even.
(A) Only I and II follow
(B) Only II and III follow
(C) Only I and IV follow
(D) Only I and III follow

8. Statements:
Some shirts are trousers.
Some trousers are not shorts.
All shorts are costly.

Conclusions:
I. Some shirts are shorts.
II. No shirt is costly.
III. Some trousers are shorts.
IV. Some costly are trousers.
(A) Only I follows (B) Only II follows
(C) Only I and II follow (D) None follows

9. Statements:
Some north are east.
No east is west.
All west are south.

Conclusions:
I. No north is west.
II. Some east are west.
III. Some south are not east.
IV. All south are east.
(A) Only I follows (B) Only II follows
(C) Only III follows (D) Either III or IV follows

10. Statements:
No cause is effect.
All weak are effect.
Some effect are strong.

Conclusions:
I. Some strong are cause.
II. No cause is a weak.
III. Some strong are not cause.
IV. Some weak are strong.
(A) Only I follows
(B) Only II and III follow
(C) Only III follows
(D) Only II, III and IV follow

Directions for questions 11 to 15: In each of the following questions, four statements followed by four conclusions are given. Consider the statements to be true even though they appear to be at variance with the commonly known facts. Find which of the conclusion(s) logically follow(s) the given statements, disregarding commonly known facts and choose appropriate answer choice.

11. Statements:
All pedals are frames.
All frames are roses.
All hubs are roses.
All keys are hubs.

Conclusions:
I. All roses are pedals.
II. All keys are roses.
III. Some hubs are frames.
IV. Some frames are keys.
(A) Only II follows
(B) Only II and III follow
(C) Only III and IV follow
(D) Only I, II and III follow

12. Statements:
Some baskets are caskets.
Some caskets are trunks.
All trunks are fans.
All sweets are fans.

Conclusions:
I. Atleast some baskets are trunks is a possibility.
II. Atleast some fans are caskets is a possibility.
III. All fans are baskets is a possibility.
IV. Atleast some sweets are not caskets is a possibility.

(A) Only I and III follow
(B) Only II and IV follow
(C) Only I, II and III follow
(D) All follow

13. Statements:
Some forks are spades.
Some spades are not shovels.
All chisels are shovels.
No potato is a chisel.

Conclusions:
I. Some shovels are not a potatoes is a possibility.
II. Atleast one chisel is a spade is a possibility.
III. All potatoes are shovels is a possibility.
IV. Some forks are chisels is a possibility.
(A) Only III and IV follows.
(B) Only II and IV follow.
(C) Only I, II and IV follow.
(D) All follow

14. Statements:
All bolts are nuts.
All chips are washers.
Some screws are nuts.
All nuts are washers.

Conclusions:
I. All bolts are washers.
II. Some washers are screws.
III. Some washers are bolts.
IV. All chips are screws.
(A) Only I follows
(B) Only I and II follow
(C) Only I, II and III follow
(D) All follow

15. Statements:
Some doctors are actors.
Some actors are teachers.
All dancers are teachers.
All doctors are engineers.

Conclusions:
I. Some actors are engineers.
II. Some teachers are engineers.

III. No engineer is a teacher.
IV. All teachers are doctors.

(A) Either II or III follows
(B) Only I follows
(C) Only I and III follow
(D) Only I and exactly one of II or III follows

Directions for questions 16 to 20: Each of the following questions consists of four statements followed by four conclusions. Consider the statements to be true even if they vary from the normally known facts and find out which of the conclusion(s) logically follow(s) the given statements and choose the proper alternative from the given choices.

16. Statement:
Some watches are clocks.
Some clocks are times.
Some times are fast.
Life is fast.

Conclusions:
I. Some watches are life.
II. Some lifes are time.
III. Some clocks are fast is a possibility.
IV. Some watches are fast is not a possibility.

(A) Only I and II
(B) Only III follows.
(C) Only II, III and IV
(D) All follow

17. Statements:
Earth is tree.
All trees are branches.
All branches are leaves.
All branches are flowers.
Conclusions:
I. Earth is a flower.
II. All flowers are leaves is a possibility.
III. Some trees are flowers.
IV. No flower is leaf is not a possibility.

(A) Only II and IV
(B) Only I, II and III
(C) Only I and III
(D) All follow.

18. Statements:
Some boys are engineers.
All engineers are graduates.
All graduates are literate.
Some girls are literate.

Conclusions:
I. No boy is a girl.
II. Some boys are literates.
III. Some girls are engineers.
IV. All engineers are literate.

(A) Only II and IV
(B) Only I, II and IV
(C) Only II, IV and I or III
(D) Only III and II

19. Statements:
No rice is curd.
All rice is grain.
Oats are grains.
No flour is grain.

Conclusions:
I. No curd is grain.
II. No rice is oat.
III. No flour is oat.
IV. Some oats are curds.
(A) Only I, II and III
(B) Only III
(C) Only II and III
(D) Only III and II or IV

20. Statements:
Flowers are beautiful.
No beautiful is ugly.
Coal is ugly.
Beautiful is attractive.

Conclusions:
I. Flowers are attractive.
II. No flower is coal.
III. Some flowers are not ugly.
IV. Some attractive are not coal.
(A) Only I
(B) Only I, II and III
(C) Only II, III and IV
(D) All follow

Directions for questions 21 to 25: Each of these questions consists of three/four statements and five choices. Consider the statements to be true, even though they seem to be at variance with the commonly known facts and find out which choice logically does not follow the statements, disregarding the commonly known facts:

21. Statements: Some bazaar are beach.
No beach is a beauty.
All beauty are bean.
(A) Some beaches being beans is not a possibility.
(B) Some beauty are bean.
(C) Some bazaar being bean is a possibility.
(D) All bean being beauty is a possibility.

22. Statements: All chat are compete.
Some chat are cherry.
All clean are compete.
(A) Some compete are cherry.
(B) Some clean are compete.
(C) Some clean are chat.
(D) All cherry being compete is a possibility.

23. Statements: All giant are glow.
Some glow are not locks.
Some locks are music.
(A) Some giant are glow.
(B) Some music being glow is a possibility.
(C) Some locks are giant.
(D) All glows being giant is a possibility.

24. Statements: Some mute are sound.
Some sound are pink.
Some sweet are sound.
(A) Some pink being mute is a possibility.
(B) All mute being sound is not a possibility.
(C) Some pink are sound.
(D) Some mute being pink is a possibility.

25. Statements: No battle is paper.
Some paper are word.
All battle are amount.

(A) All paper being word is a possibility.
(B) Some amount are battle.
(C) Some word being amount is a possibility.
(D) Some battles are papers.

Directions for questions 26 to 30: In each of the following questions, two conclusions are given followed by some statements. Consider each statement to be true even if they vary with the commonly known facts and find out from which of the statements both the conclusions follow.

26. Conclusions:
I. Some reptiles are not insects.
II. All birds being mammals is a possibility.

(A) Some reptiles are mammals. All mammals are insects. No mammal is a bird.
(B) Some mammals are not reptiles. All reptiles are birds. Some birds are insects.
(C) All birds are insects. Some birds are reptiles. No reptile is a mammal.
(D) Some birds are reptiles. No bird is an insect. All insects are mammals.

27. Conclusions:
I. Some codes are not letters.
II. Some marks are posts.

(A) Some codes are marks. Some marks are posts. No post is a letter. Some letters are banks.
(B) Some codes are marks. All marks are posts. Some posts are banks. No bank is a letter.
(C) All codes are marks. Some codes are posts. No post is a letter. Some letters are banks.
(D) Some codes are marks. Some marks are not posts. All letters are posts. Some letters are books.

28. Conclusions:
I. Some scrubs are liners.
II. All polishes can be liners.

(A) All polishes are nails. No polish is a glow. All glows are liners. Some glows are scrubs.
(B) Some nails are polishes. Some polishes are liners. No liner is glow. Some a glows are scrubs.
(C) Some polishes are glows. All glows are scrubs. Some scrubs are not nails. Some nails are liners.
(D) More than one of the above

29. Conclusions:
I. All times being watches is a possibility.
II. All tracks can be covers.

(A) Some times are titans. All titans are covers. No titan is track. Some tracks are watches.
(B) Some times are tracks. No track is cover. Some covers are titans. All titans are watches.
(C) All titans are watches. All watches are tracks. No titan is cover. Some covers are times.
(D) All tracks are watches. No track is cover. Some covers are titans. All titans are times.

30. Conclusions:
I. Some leaves are not looks.
II. Some lives are leaves.

(A) Some leaves are lives. All lives are lifts. Some lifts are looks. No live is lime.
(B) Some leaves are lifts. All lifts are lives. No live is a look. Some looks are limes.
(C) All lifts are leaves. No lift is look. All looks are lives. Some lives are limes.
(D) All looks are leaves. Some looks are lives. Some lives are not lifts. Some lifts are limes.

Key

Exercise – 9(a)

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

Exercise – 9(b)

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