

Arguments and Logic

Logic

Logic is a system of consistent reasoning that allows us to arrive at conclusions using available data and critically check the validity of these conclusions. It can help us with significant choices (e.g. decision making) and can help us analyze data and integrate the relevant parts to decide a future course of action.

In general, we can respect the directness of a path even when we don't accept the points at which it begins and ends. Thus, it is possible to distinguish correct reasoning from incorrect reasoning independently of our agreement on substantive matters. Logic is the discipline that studies this distinction by determining the conditions under which the truth of certain beliefs leads to the truth of some other belief.

Although logic is undoubtedly a powerful tool for critical thinking, it is but a means to help us arrive at a conclusion and is of little help to examine the validity of the premises which have been used. Logic can therefore give us a consistent and reliable method of inferentially arriving at a conclusion but cannot guarantee the validity of the statements used in constructing an argument.

Arguments

The chief concern of logic is how the truth of some propositions is connected with the truth of another. Thus, in Critical Reasoning we will usually consider a group of related propositions. An argument is a set of two or more propositions related to each other in such a way that all but one of them (the premises) provide support for the remaining one (the conclusion). The transition or movement from premises to conclusion, the logical connection between them, is the *line of reasoning* upon which the argument relies.

What distinguishes an argument from a mere collection of propositions is the conclusion that can be drawn from the statements in the argument.

Thus, for example, "I had a haircut today. My computer has crashed yet again. I need new shoes." is just a collection of unrelated

propositions; the truth or falsity of each has no bearing on that of the others.

But "Abhay is a doctor. So Abhay went to medical school, since all doctors have gone to medical school." is an argument; the truth of its conclusion, "Abhay went to medical school," is inferentially derived from its premises, "Abhay is a doctor." and "All doctors have gone to medical school."

One and the same proposition can (and often does) appear as the conclusion of one line of reasoning but also as one of the premises of another.

In GMAT® critical reasoning, it's your ability to analyze a given thought stimulus that's being evaluated, not your opinions on social, political, geographical, scientific religious or any other issues. You have to therefore unconditionally accept the premises* that the Thought Stimulus (TS) contains without debating over the veracity of the statements given. For example you might get a TS that looks like this:

*All actors are emotional people
All emotional people are psychopaths
Therefore all actors are psychopaths*

Even if this is factually incorrect, it would be a logically sound argument (assuming that the premises are true)

-Logic can give us a consistent and reliable method of inferentially arriving at a conclusion but cannot guarantee the validity of the statements used in constructing an argument

- A proposition or a premise is a statement from which another is inferred or follows as a conclusion

-An argument is a group of related propositions which serve to support a proposition called a conclusion

Terms used in logic

Premises

A premise is a statement or proposition from which another is inferred or follows as a conclusion. It is also termed as an assertion or a proposition.

A premise generally forms the basis for a **conclusion** (a judgment or decision reached on the basis of the premise/s)

If the premises are valid and sufficient, then the conclusion must be true. Conversely if the conclusion is invalid, then the premises must be invalid or insufficient or both. **

** Note that if the premise/s is/are invalid, the conclusion is not necessarily invalid.

Assumptions

These are premises that are accepted as true or as certain to happen, without proof.

Assumptions are unstated premises and can make or break the conclusion of the thought stimulus (TS) e.g.

Chinmay is a student of IIT Powai (Premise)
Therefore Chinmay is intelligent (Conclusion)

In the above example, the fact that Chinmay is a student of IIT Powai cannot be challenged because it is an observation which also happens to be a fact. Nonetheless, the conclusion can be shown to be possibly invalid.

The fallacy in the given TS is not immediately apparent. Anyone who has heard of the IITs will agree that IITians are generally intelligent. The conclusion however rests on the assumption that **all** IITians are generally intelligent. To weaken this kind of TS we need to find one IITian who is not intelligent. After modifying the above thought stimulus to include the assumption, we get

Chinmay is a student of IIT Powai (Premise)
All IIT Powai students are
intelligent (Assumption)
Therefore Chinmay is intelligent (Conclusion)

We see that if the assumption is true, then the conclusion has to be true whereas if the assumption is invalid then the conclusion has to be invalid.

Inferences

These are unstated partial conclusions that can be drawn from the given premises.

Understanding the difference between conclusions and inferences

An inference can serve as a link in the line of reasoning but is not the same as a conclusion. A conclusion invariably addresses the central idea of a TS whereas an inference serves only to support the conclusion e.g.

Students who get at least seven hours of sleep at night tend to be more alert the next day than those who don't get seven hours of sleep.
The ability to get a good score in any competitive exam depends on one's level of alertness.

What can one *infer* from these premises?

If you are a student ***you are likely to be more alert*** the next morning if you get seven hours of sleep

What can one *conclude* from these premises?
Students wishing to do well in competitive exams should try and get at least seven hours of sleep on the day before the exam.

Consider another example:

Since all events have causes and all beginnings involve events we can conclude that because the universe has a beginning, it has a cause.

The line of reasoning is as follows:

Every event has a cause (premise)
The universe has a beginning (premise)
All beginnings involve an event (premise)
This implies that the beginning of the universe involved an event (inference)
Therefore the universe has a cause (conclusion)

Understanding the difference between assumptions and inferences

Although both assumptions and inferences are links in the line or the chain of reasoning the difference between the two is that assumptions are premises that the author of the TS takes for granted whereas the inferences are the premises that the reader can logically deduce from the given premises.

Strategies in Critical Reasoning

Read the thought stimulus carefully with a focus on structural clues (words which indicate either continuity or contrast as well as help us in getting the central idea of the TS) and, also, in addition, Moreover, Hence, Therefore, Thus, but, yet, still, however, nonetheless, in spite of etc. These clues are vital for spotting the structure of the TS and getting the central idea.

1. Identify the conclusion

The conclusion of the argument is the starting point of your analysis. This is because the conclusion invariably contains the central idea behind the topic.

2. Separate the evidence from the conclusion.

Differentiating clearly between the evidence and the conclusion is crucial for understanding the line of reasoning. Separating the two will help you to unscramble the argument and eliminate any statements which serve to distract.

3. Rearrange the premises and the conclusion to get a clear line of reasoning

This is done by identifying and arranging the given premises in a sequential order so that one can immediately spot whether they clearly support/give rise to the intended conclusion.

Diagramming and Paraphrasing the TS:

The technique of diagramming is an extraordinarily powerful tool for getting the line of reasoning in the TS. Diagramming involves rearranging the TS such that we get an argument which follows a syllogistic pattern and gives us a clear line of reasoning. Paraphrasing (restating) the TS in simpler words is crucial since it helps us to get rid of the unnecessarily wordy parts which serve only to distract us from the central idea. e.g.

Ex. 1 *An international conference on the development of the world's undersea resources has proposed that all future use of these resources through undersea mining, harvesting of food in international waters, or other forms of development be subject to an international tax, to be set at a fixed percentage of the profits. The revenues from this tax would be used to support industrial development in the poorest nations of the world. This scheme, if adopted, will probably halt all future development of undersea resources. By removing the profit incentive, the*

proposed tax will discourage industrial nations from making the investments needed to exploit these valuable but remote undersea resources.

Which of the following questions would be most relevant in evaluating the validity of the conclusion reached above?

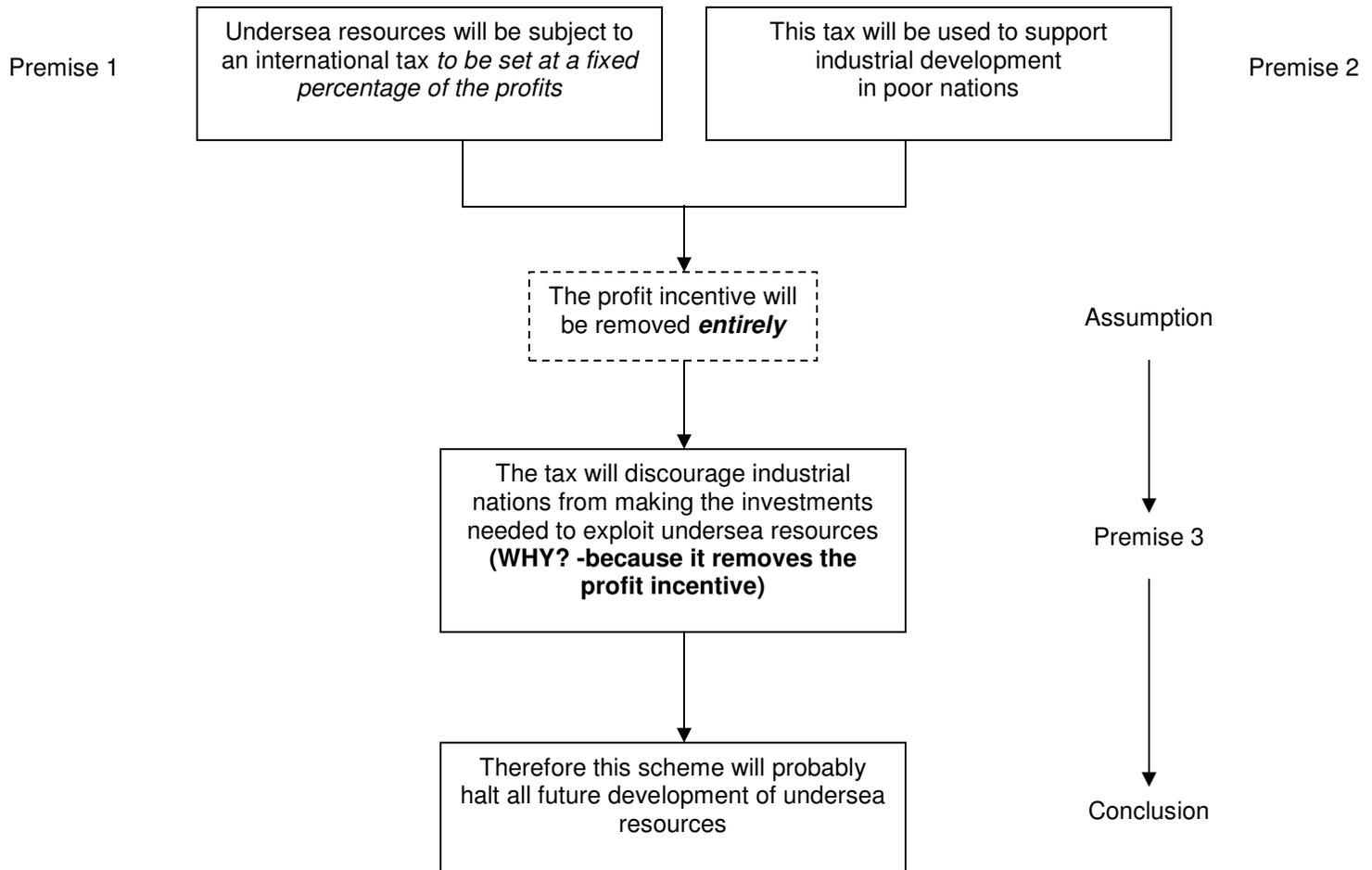
- (A) *What kinds of development projects would be supported by the proposed tax?*
- (B) *What percentage of the profits derived from exploitation of undersea resources would be taken by the proposed tax?*
- (C) *What position has been taken on the issue of the tax by the representatives of the nations that would benefit from the tax?*
- (D) *What definition of international waters will be used for purposes of levying the proposed tax?*
- (E) *What international agency would have the responsibility for assessing the tax and redistributing the revenues?*

In order to decide which of these is most relevant in addressing the validity of the conclusion, we need to spot the conclusion first. Note that the conclusion is not necessarily the last sentence of the TS. It could be the first one or even one that is somewhere in the middle of the TS. In this question, for example, the conclusion is given by the sentence 'This scheme, if adopted, will probably halt all future development of undersea resources'

The diagrammatic representation of the TS is given on the next page.

We see that to examine the validity of the conclusion, we need to answer the question, "Will the profit incentive necessarily be removed?". If a significant percentage of the profits is lost in taxes then the profit incentive might be lost. However if a small percent of the profit is lost in taxes then the profit incentive is not necessarily removed and therefore the scheme may not halt all future development of undersea resources. The only answer choice that addresses this question is (B) which is therefore the right answer.

Diagrammatic representation of Ex. 1



Ex. 2

The pre-eminence of television in modern political campaigns has produced several deleterious effects on our democratic system. Because the attention span of television-trained audiences has been artificially shortened, candidates are forced to encapsulate their programs and ideas in 30- or 60-second summaries - mere slogans embellished with emotionally evocative imagery. And because television commercials are so costly, candidates must spend much of their campaign time raising money rather than delving deeply into the issues confronting our nation and its leaders

The conclusion of this TS is given by the first sentence. There are two reasons which are given as evidence to substantiate the conclusion.

A simplified and rearranged version of the TS is:

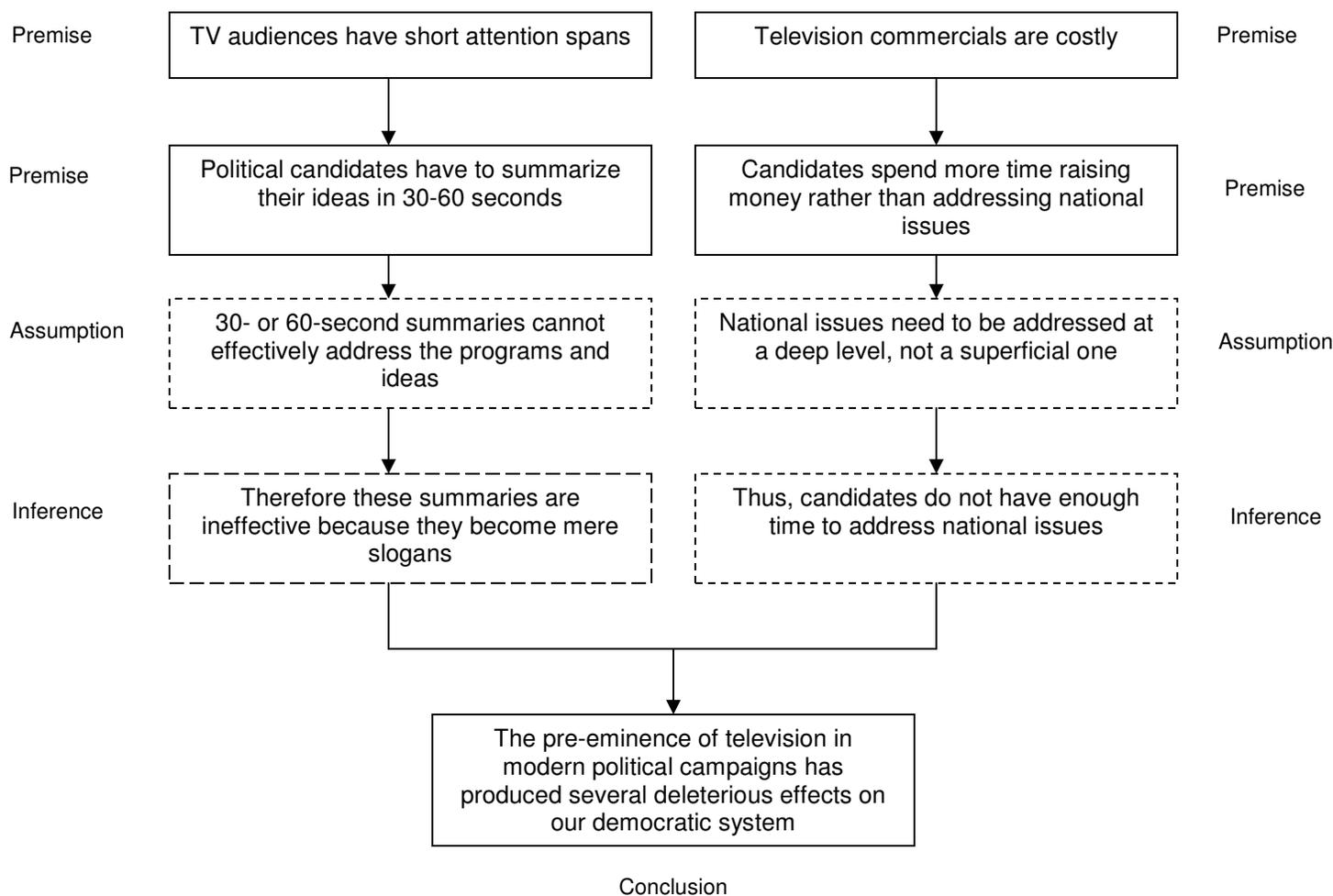
Due to TV audiences' short attention spans candidates have to condense their ideas in 30-60 second summaries

Since TV commercials are so costly, candidates spend their time raising money instead of tackling national issues.

Thus the pre-eminence of TV has produced harmful effects on our democratic system.

Note that both these statements actually involve separate lines of reasoning which converge at the conclusion.

Diagrammatic representation of Ex. 2



-Diagramming and paraphrasing are powerful tools for getting the line of reasoning and getting a better understanding of the TS.

-Diagramming involves rearranging the TS such that we get an argument which follows a syllogistic pattern and gives us a clear line of reasoning

-Paraphrasing (restating) the TS in simpler words helps us to get rid of the unnecessary parts which serve only to distract us from the central idea

-In the actual test, you may or may not get enough time for diagramming. Use this technique judiciously

4. Identify the question type.

The strategies mentioned above are generally 'universal' and will prove useful when attempting any question but there are some questions which require customized strategies.

Thus the strategy you employ will depend on the type of question you are about to attempt. To decide which strategy works for which question we need to have an understanding of the common question types.

Question Types in the GMAT

There are 6 basic question types which are tested in the GMAT

- **Identify the assumption, Strengthen/ Weaken the conclusion**
- **Identify the conclusion**
- **Deduce the conclusion**
- **Get the inference**
- **Mimic the reasoning**
- **Resolve the paradox**

Identify the assumption, Strengthen/ Weaken the conclusion

These are questions that are essentially interlinked. By definition the assumption can validate or strengthen the argument if true or can invalidate/weaken the argument if false. Therefore such questions essentially involve spotting the assumption and checking it to see if it validates/invalidates the argument.

These questions can take various forms such as:

What is the assumption being made in the argument?

Which of the following is most helpful in discussing the validity of the argument?

Which of the following is necessary to strengthen/weaken the argument?

Which of the following most directly influences the conclusion of the argument?

Spotting assumptions

Get all the assumptions that have been made before reaching the conclusion. If you're not sure that you have the right assumption, use this quick strategy: an assumption is something that

if invalid renders the conclusion and hence the entire argument useless.

While identifying the assumptions it is important to separate the powerful ones from the weak ones. **In other words you need to separate what is relevant from what is crucial to the discussion** e.g.

Ex. 3 *The KB Pulsar can accelerate from 0-60 kmph in 4.5 seconds and is one of the fastest bikes in the market.*

Clearly it is the bike that you should buy.

*Which of the following, if true, would **most directly** strengthen/weaken the argument?*

- (A) *The KB is cheaper than other bikes*
- (B) *No other bike has an acceleration rate that is comparable to the KB*
- (C) *You are looking for a bike with a high rate of acceleration*
- (D) *Acceleration is the most important factor to be considered while buying a bike*
- (E) *You want to buy the KB.*

Applying the strategies that we have formulated, we can see that the second sentence of the TS is clearly a conclusion whereas the first one is evidence which is trying to support the conclusion. The italicized part (*most directly*) should be noted since it makes the question very specific.

We are looking for something that would strengthen the argument if true and weaken the argument if false. The task, therefore, is to identify the assumption.

At first glance all the answers might seem tempting since they seem to support the conclusion. At this point however, you should remember that in the GMAT it is your ability to focus purely on what is given, not your background knowledge that is tested.

(E) can be eliminated immediately since it introduces redundancy – if you wanted to buy the KB then further argument would be unnecessary.

(A) gives us a good reason for buying **a** bike but is completely outside the scope of the TS. At no point does the TS talk about the cost of a bike. (A) would support a conclusion that said that the KB is a good bike because it is not only powerful but also cheap. It doesn't support the conclusion

‘You should buy it’. The price of the bike may not be an important factor for you.

(B) is simply an approximate but not accurate restatement of the second premise. The only reason given to support the conclusion is that ‘it is one of the fastest bikes....’. (B) would support a conclusion that said ‘You should buy one of the fastest bikes’.

(C) and (D) remain. A careful look at (D) tells us that it is too specific to be a possible answer in this case. (D) says that acceleration is the *most important factor...* which makes it too specific. The TS assumes that acceleration is *a* factor when selecting a bike but doesn’t necessarily assume that it’s the most important one. Moreover (D) does not support the conclusion directly. For example if one of your friends suggests, “This shirt is blue; you should therefore buy it”, does it mean that he believes that blue is the best color for a shirt?

Now, an assumption is something that can establish the conclusion if valid and demolish it if it is invalid. (D) does strengthen the conclusion if valid but doesn’t necessarily invalidate the conclusion if it is invalid. If (C) is true, it supports the conclusion powerfully and if it’s not true i.e. You are not looking for a bike with a high rate of acceleration, then the conclusion is completely invalid.

Thus (C) is the *best* answer.

Identify the conclusion

The conclusion of the TS is the part that gives the central idea behind the question. The other parts directly or indirectly add up to it. Conclusions are generally indicated by key words like *therefore, hence, thus, in sum, consequently* etc e.g.

Ex. 4 *When young students first look at modernist abstract painting, their eyes are assailed by a seemingly meaningless mass of squiggles. It is only after a study of the history of art and the forces, which led up to abstraction that it is possible to appreciate the intellectual sophistication of modern art. Thus, a high-school study of modern art should always begin with a study of the history of art.*

Which of the following is the main point of the passage above?

- (A) *To understand the history of art, it is necessary to study modern art.*
- (B) *Young students are unable to appreciate fully the complexities of modern art.*
- (C) *An understanding of the history of art is essential to an understanding of modern art.*
- (D) *To understand abstract art, students must first study the history of art.*
- (E) *A high-school study of modern art will have little relevance to students who lack a historical perspective.*

The main point of the argument is given by the conclusion. So this is actually an ‘Identify the Conclusion’ type question. Now, let us have a look at the options.

- (A) reverses the second *premise*, so it definitely isn’t the conclusion. Eliminate.
- (B) states the first *premise*. Eliminate.
- (C) is again a correct statement of the second *premise*. Eliminate.
- (D) looks really good, since it is the restatement of the last sentence of the passage. So here is the answer.
- (E) looks rather tempting, but be careful. It passes comment on something that is not stated in the argument – students (in general) who lack a historical perspective. So it goes beyond the scope of the argument.

The diagrammatic representation of the argument is given on the next page.

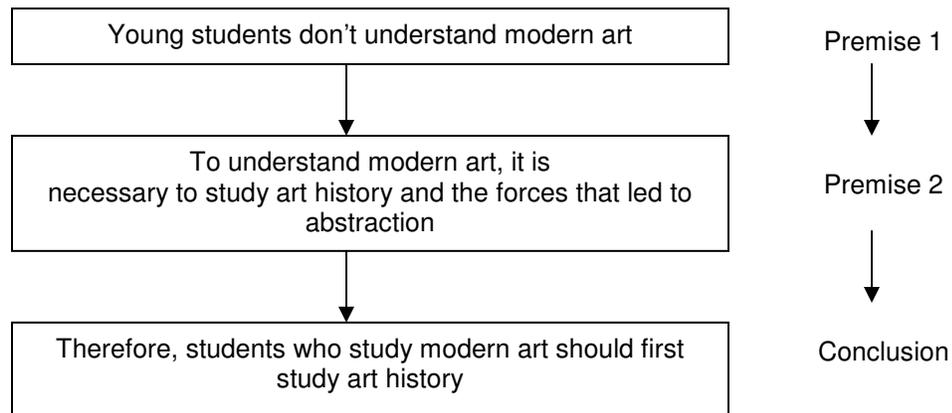
SPOTTING CONCLUSIONS

-The conclusion is supported by all the evidence in the passage and not just part of it

-For ‘identify the conclusion’ questions, remember that since the conclusion is not in the passage, the answer can’t be a restatement of the information given in the passage

-The conclusion is the one that contains the central idea of the TS

Diagrammatic representation of Ex. 4



**Deduce the conclusion/
Get the inference**

In both these questions, the conclusion/inference will not be provided in the passage. So, you see the general trend in which the premises are driving you, and find an option that is well supported by the information provided. Any option that brings in extra information is out, because the place for extra information is in the passage, not outside it. Additionally, when the question says, "if the information provided in the passage is true", any option that expresses doubt about the information provided is also out e.g.

Ex. 5 *In reaction against the heavy, ornate designs favored by the neoclassical architects of the Victorian era, architectural critics and historians in the first half of this century went to the opposite extreme, declaring that only what was stripped-down, light, and free of decoration could be beautiful. Today, an overdue re-evaluation of this aesthetic in under way, as exemplified by the current exhibition of designs from the Beaux Arts school of the nineteenth century.*

It can be inferred from the passage above that the present movement among architectural critics is toward

- (A) *a renewed appreciation of the use of decorative motifs in building designs*
- (B) *a rejection of neoclassical standards of beauty in architectural design*
- (C) *a greater admiration of the light, simple designs characteristic of the early twentieth century*

- (D) *the adaptation of Victorian styles in the work of today's younger architects*
- (E) *a deeper understanding of the aesthetic values of underlying post-neoclassical theory*

The line of reasoning is as follows:

Neoclassical architects preferred heavily decorated designs.

Architectural critics and historians in the first half of this century preferred light designs (the opposite of what neoclassical architects preferred)

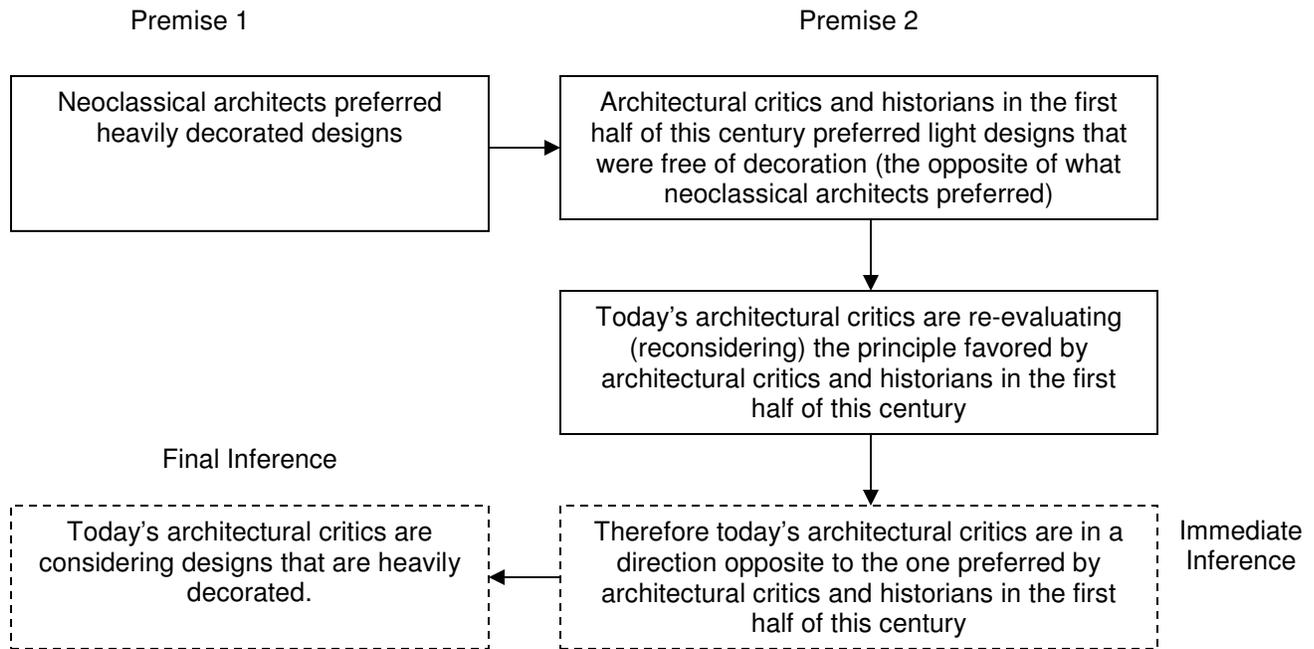
Today's students are reconsidering the principle favored by architectural critics and historians in the first half of this century

Therefore today's students prefer the opposite of what architectural critics and historians in the first half of this century preferred

Therefore today's architectural critics are considering designs that are heavily decorated.

The diagrammatic representation of the argument is given on the next page.

Diagrammatic representation of Ex. 5



Mimic the reasoning

Such questions generally involve the principles of basic logic like negation and Venn diagrams (see supplement 4). Once the structure of the TS is spotted getting the right answer is fairly easy

A very common form of argument that GMAT examiners frequently use is the Aristotelian syllogistic.

This is a type of argument in which the conclusion or the inference is based on two premises e.g.

*All men are mortal
Socrates is a man
Therefore, Socrates is mortal*

This can be reduced to

*All As are Bs
C is A
Therefore C is B*

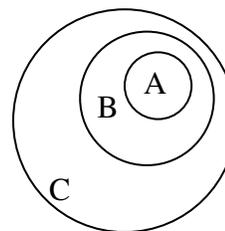
This argument and its variants figure prominently in mimic the reasoning questions.

VENN Diagrams

A Venn diagram is a graphical representation (of an argument). It helps one understand the intersection and union of sets. Venn diagrams are quick and reliable tools of problem solving in the GMAT e.g.

All four stroke vehicles need intensive maintenance after a year
This bike is a four stroke bike
Therefore this bike will need intensive maintenance after a year

This can be represented graphically as follows



- C : Vehicles needing intensive maintenance after a year
- B: All four-stroke bikes
- A: This bike

The GMAT usually tests this syllogism as well as fallacious variants of the syllogism. Yet again we notice that in the GMAT the premises don't have to be *factually correct* for the conclusion to be *logically valid* e.g.

All As are Bs

C is B

Therefore C is A – Not necessary (Possibly Invalid conclusion)

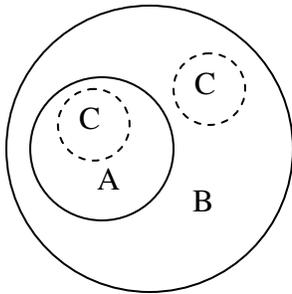
Consider the following argument:

All men are idiots

Anil is an idiot

Therefore Anil is a man

The graphical representation of this syllogism is:



B: Set of all idiots

A: Set of all men (contained within B)

C: Anil (can fall outside A)

Since C doesn't have to necessarily be a member of A, we can reasonably conclude that Anil *might* be a man, but not *necessarily* so. Anil could be a woman or something else.

Another interesting variant of the syllogistic is as follows

Only As are Bs

C is B

Therefore C is A – valid conclusion

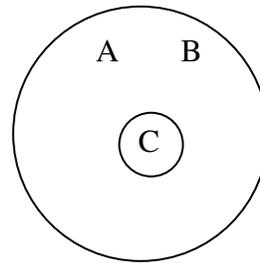
Since the word *All* in the first premise has been replaced by the word *only*, this argument is valid.

Only those who study for the GMAT have excellent analytical skills

Sunaina has excellent analytical skills

Therefore, Sunaina is studying for the GMAT

The graphical representation of this argument is:



B: Set of people with excellent analytical skills

A: Set of people studying for the GMAT

C: Sunaina

We can see from the diagram that B and A are one and the same set. Therefore we can reasonably conclude that Sunaina is studying for the GMAT

The basic structure is essentially the same i.e.

All As are Bs

All Bs are Cs

Therefore A is C is a valid conclusion

Note that the TS can be logically valid without being factually correct i.e.

e.g.

P1 All actors are emotional - *disputable*

P2 All emotional people are psychotic – *not necessarily factually incorrect*

C Therefore all actors are psychotic – *logically valid*

Logical operators

These are generally needed in questions which involve straightforward negation or conditional analyses.

The NOT operator (denoted by !)

If A

! A

Conditional logical negation works on the principle

If A then B

If ! B then ! A

e.g.

If it rains, I'll take the car

Negation: If I haven't taken the car, it hasn't rained

MIMIC THE REASONING QUESTIONS

-Simplify such questions and get the conditions in terms of X, Y and Z etc.

-Use Venn diagrams to clearly identify the structure of such questions

AND (denoted by &)

The AND operator works in the sense

If $A \& B = C$,
 $\neg A \Rightarrow \neg C$
 $\neg B \Rightarrow \neg C$
 $\neg(A \& B) \Rightarrow \neg C$

This means that if either A or B is not satisfied then C won't take place because it depends on both A & B e.g.

If I am intelligent AND I study hard, then I'll get good grades.

If I'm not intelligent, I won't get good grades
 If I don't study hard, I won't get good grades
 If I'm neither intelligent nor studious, I won't get good grades

OR (denoted by ||)

The and operator works in the sense

If $A || B = C$,
 $\neg A \& \neg B$ implies $\neg C$

This means that for C to be invalid **both** A and B must be invalid e.g.

If she is beautiful OR rich, then I shall propose

If she is beautiful but not rich, I shall propose
 If she is rich but not beautiful, I shall propose
 If she is neither beautiful nor rich, I shall not propose

Resolve the paradox question

In this type of question, you will be given a paradox. A paradox is a seemingly absurd or self-contradictory statement, even if actually it is well founded. For example, if the prices of the cinema hall tickets do not go down and if the number of viewers goes up, then the total revenue from the sale of cinema tickets should go up. If an argument says that the revenue actually went down, then that will become a paradoxical situation. To explain it, you will have to find some new information – for example, if the number of people buying cheaper tickets has gone up and the number of people buying costlier tickets has gone sufficiently down, then the situation doesn't remain a paradox.

An example of this type of question is given below.

In 1996, the Tip Top Airline reported an increase in the total number of passengers it carried from the year before, but a decrease in total revenues - even though prices for its tickets on all routes remained unchanged during the two-year period.

Which of the following, if true, best reconciles the apparent paradox described above?

- (A) *Tip Top Airlines was a victim of a mild recession in 1996.*
- (B) *Total passenger miles were up in 1996.*
- (C) *Fuel costs remained constant during the two-year period.*
- (D) *Passengers traveled shorter (and thus less expensive) distances in 1996.*
- (E) *Tip Top did not buy any new airplanes or equipment in 1996.*

Simply put, Tip Top's revenues went down though the number of passengers went up. So, the increase in passengers must have happened in such a way that they didn't contribute *as much* towards the revenues as was expected. This is explained in (D), and that is the answer.

(A) talks about a mild recession. The price of tickets being the same and the number of passengers increasing aren't exactly the signs of a recession.

(B) says that the total passenger miles went up. But that is no reason for the revenues to go *down*. Actually they should have gone up.

(C) says fuel costs remained constant. This again is no reason for a drop in the revenues.

(E) says Tip Top didn't buy any new airplanes or equipment which is bad for the airplane and equipment industry, no doubt. But then if Tip Top *didn't* spend money in some category, it doesn't explain the loss in revenues.

Strategies for Critical Reasoning (Summarized)

Identify the assumption

- Avoid answers that restate the premises
- Substitute the answer choice in the line of reasoning and check its impact on the conclusion
- If you shortlist more than one answer the right answer will be the one that has a greater impact on the conclusion

Strengthen/ Weaken the conclusion

- Avoid answers that do the opposite of what is asked
- Keep an eye out for the 'EXCEPT' questions. In such questions the right answer is the one that least significantly affects the conclusion

Identify the conclusion

- For identify the conclusion questions, remember that since the conclusion is not in the passage, the answer can't be something that is a restatement of the information given in the passage
- The conclusion is the one that contains the central idea of the TS

Get the inference, Deduce the conclusion

- Inferences serve only to support the conclusion and do not contain the central idea
- Any answer choices that involve too many unwarranted assumptions on our part cannot be right answers
- The conclusion is supported by *all* the evidence in the passage and not just part of it

Mimic the reasoning

- Simplify such questions and get the conditions in terms of X, Y and Z etc.
- Use Venn diagrams to clearly identify the structure of such questions

Resolve the paradox

- Avoid answers that strengthen either of the self-contradictory ideas in the TS
- The right answer contains information not given in the TS

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