Chapter 3 of Logic Games

Relative Ordering

In This Chapter. . .

Getting Familiar

Do your best to complete the following game in **8:30 or less**. Use whatever approaches you see fit.

Exactly eight rock bands—M, N, O, P, R, S, T, and V—perform consecutively at a showcase on Friday night. No band performs more than once, and no two bands perform simultaneously. The following conditions apply:

T and P both perform at some time before O.
S performs at some time before R.
T performs at some time before N.
V performs at some time after S.
M performs at some time before V and at some time after O.

1. Which of the following could be the order of the performances from first to last?

   (A) P, T, O, M, R, S, V, N
   (B) T, N, M, P, S, O, V, R
   (C) P, T, N, O, M, V, S, R
   (D) T, P, N, O, S, M, V, R
   (E) T, N, O, S, P, R, M, V

2. Which of the following must be true?

   (A) At least four bands perform at some time after P.
   (B) At least four bands perform at some time after T.
   (C) At least two bands perform at some time after M.
   (D) At least two bands perform at some time before N.
   (E) At least two bands perform at some time before R.

3. If P performs fifth, then each of the following could be true EXCEPT:

   (A) R is the sixth band to perform.
   (B) N is the fourth band to perform.
   (C) S is the second band to perform.
   (D) T is the third band to perform.
   (E) R performs at some time before N but at some time after T.

4. If S performs at some time after N, and P performs at some time before T, which of the following could be true?

   (A) N performs earlier than P but later than O.
   (B) R performs earlier than M but later than N.
   (C) O performs earlier than N but later than S.
   (D) R performs later than S but earlier than T.
   (E) P performs earlier than O but later than R.

5. Each of the following could be true EXCEPT:

   (A) V performs earlier than N.
   (B) R performs earlier than T.
   (C) N performs earlier than P.
   (D) S performs later than O.
   (E) M performs earlier than P.

6. If T performs third and V performs sixth, then exactly how many different orders are there in which the bands can perform?

   (A) 1
   (B) 2
   (C) 3
   (D) 4
   (E) 5

7. There can be at most how many bands that perform after N but before S?

   (A) 1
   (B) 2
   (C) 3
   (D) 4
   (E) 5

Relative Ordering

About one in every eight games that appear on the LSAT is what we call a **Relative Ordering** game.

Hopefully, even if you found the Getting Familiar game to be a challenge, you didn't find it to be too unusual or unexpected. Hopefully, you saw it as related to the games we played in the previous chapter. Indeed, Relative Ordering games are a subset of Ordering games; however, because they are so common, and because they present a particular set of recognizable characteristics, it's useful for us to separate them out and discuss them specifically. Relative Ordering games are to general Ordering games as jeans are to pants—jeans are a type of pant, but so common that we also define them as a unique clothing category.

What Defines a Relative Ordering Game?

It's not the scenario given before the rules. To illustrate, let's take a look at the scenario for the Getting Familiar game you just played:

> *Exactly eight rock bands—M, N, O, P, R, S, T, and V—perform consecutively at a showcase on Friday night. No band performs more than once, and no two bands perform simultaneously. The following conditions apply:*

This introduction is not very different from the ones we saw for Basic Ordering games, and in fact, it could very well be the introduction to a Basic Ordering game.

What defines a Relative Ordering game are the rules themselves.

Let's take a look at the rules from the same game to illustrate:

> *T and P both perform **at some time before** O.*
> *S performs **at some time before** R.*
> *T performs **at some time before** N.*
> *V performs **at some time after** S.*
> *M performs **at some time before** V and **at some time after** O.*

Notice the similarity among all of the rules. They are all what we define as relative ordering rules—rules that inform us of a general ordering relationship between elements. None of these rules tell us exactly how many positions are between elements, and none of these rules tell us about specific assignments of elements to positions.

A Relative Ordering game is an ordering game for which all, or almost all, of the rules are about relative ordering. Relative Ordering games are one of the two types of games in which you'll always see all or almost all the rules conform to just one type. (The other type is Conditional Grouping, which we'll cover in a later chapter).

Picturing Relative Ordering Games and Notating Rules

When you first tried the Getting Familiar game, it's very possible that you drew a number line to get started. That's perfectly fine—there is no negative to drawing it, and it may serve as a useful reference later on.

However, notice that none of the rules are such that any elements can be placed on the number line. Other than some "not" inferences that you may or may not choose to notate, for this type of game, the number line is not particularly helpful in organizing the information given to us in the rules.

For Relative Ordering games, we recommend that you use another type of diagram that better represents the type of information these rules contain—we call this diagram the **Tree.**

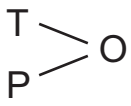
To create a Tree diagram, we don't need to start with a "base" of slots. Once you've recognized that a game is a Relative Ordering game, you can start creating your diagram with the first rule that you read.

Creating a Tree diagram is actually quite simple, and it plays off skills that you already worked on in the previous chapter. Let's use the Getting Familiar game to illustrate how to set up the Tree diagram, step by step.

Here are the scenario and rules again:

> *Exactly eight rock bands—M, N, O, P, R, S, T, and V—perform consecutively at a showcase on Friday night. No band performs more than once, and no two bands perform simultaneously. The following conditions apply:*
>
> *T and P both perform at some time before O.*
> *S performs at some time before R.*
> *T performs at some time before N.*
> *V performs at some time after S.*
> *M performs at some time before V and at some time after O.*

Step 1: Start with the first rule, and draw lines between any two letters for which the relative position is known.



This form of notation should be familiar to you from the previous chapter. The line in between elements will always mean the same thing in our diagrams—we know of a relative relationship between elements, but not a specific one. Note that since we don't know, at least from this rule, the relationship between T and P, we don't connect these elements to one another.

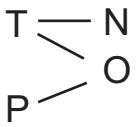
Also notice that though we chose to draw T above P, we could just have well drawn it below P. When we construct a Tree diagram, the vertical organization of elements is irrelevant—all we care about is the horizontal relationship between elements. This notation allows us to see that both T and P are before O, but also that we do not know, specifically, the relationship between T and P.

Step 2: Move on to the next rule that can be connected to any part of the existing diagram.

You want to develop a habit, from early on and for any game, of handling the rules in an order that is most convenient for you.

For Relative Ordering games, that means looking out for rules that share a common element. In this case, once we've diagrammed the first rule, we want to skip the second rule, because it shares no elements in common with the first.

The third rule has a T, which also appeared in our first rule. So we want to add that third rule, like this:



Let's pause for a minute and think about what we know at this point, having brought these two rules together.

We know that T is before N, and that T is before O, but what about the relationship between N and O? Note that the way we drew in the second rule was somewhat arbitrary. We could have placed N a bit to the left of O, or a bit to the right, and either would have been fine. We don't know about the relationship between N and O. We know both come after T, but that's it.

What about the relationship between N and P? We never knew the relationship between T and P to begin with, so we certainly don't know the relationship between N and P.

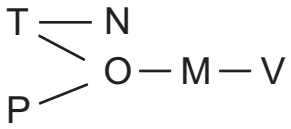
Let's keep going.

Step 3: Repeat until all rules have been used.

It's a good idea to keep track of the rules we've already notated, and one way we can do so is to put check marks next to these rules. It might look something like this:

✓*T and P both perform at some time before O.*
S performs at some time before R.
✓*T performs at some time before N.*
V performs at some time after S.
M performs at some time before V and at some time after O.

We want to look for the next rule that shares a common element with what we've got in our diagram so far, and in this case it is the fifth one, which tells us that we can place an M after the O we already have, and a V after our M, like so:



If you were confused by that last rule, consider that it contains two pieces of information about M: M comes before V, and M comes after O. Once you've understood those pieces separately, it's easy to join them together.

Now let's pause again for a moment and think a bit about what we know of the relationship between P and V. It appears that P must be before V, but do we know that for certain?

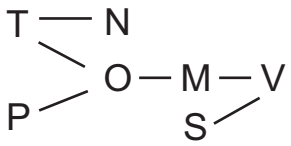
Yes, we do, because we have a link of inferences that we can follow: P is before O, which we know is before M, which we know is before V. Therefore, P must be before V.

What about the relationship between N and V? N is positioned to the left of V, but do we know that N comes before V?

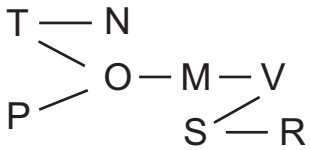
No, we don't. All we know about N, actually, is that it is after T. So it could be right after T, and well before V, or it could be well after T, and even after V.

Why can we infer something about the relationship between P and V, but not about N and V? At this point, it may be that you get why this is so, but perhaps not in a clear, definable way. Knowing when a relationship can be inferred is an important concept to understand, and one we'll revisit in just a bit. For now, let us plant this seed in your mind: we can "stretch" or "shrink" the T–N connection so that N appears to come before or after V. But no matter how you shrink or stretch the P–O–M–V connections, P will always be before V. Hmmm.

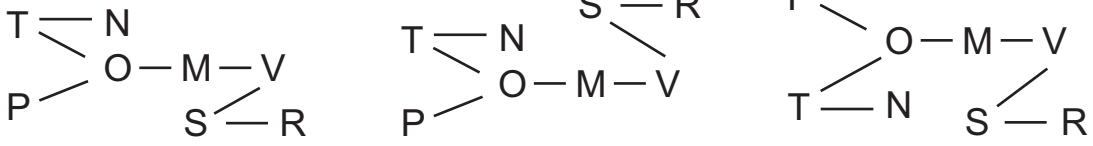
For now, let's get back to creating our diagram. We can move on to the fourth rule, which involves S, and add that rule to what we already have:



Finally, we have a place to attach the second rule. We can finish up our diagram like so:



Note that our final diagram could have ended up looking quite different, while giving us exactly the same information. Remember that vertical orientation, as well as the length of the lines used to connect elements, is not relevant to the inferences that this diagram is meant to yield. All we care about are the horizontal (left to right, or right to left) relationships between elements. Note that these three somewhat different looking diagrams all give us exactly the same horizontal relationships:



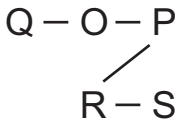
The Tree diagram consolidates the information from all the rules and gives us a clear picture of the relationship between the elements. The Tree does not give us the order of elements, nor is it meant to; we do not have enough information to make such a determination. The Tree does give us every single inference regarding relative relationships, and as you'll see shortly, these inferences are the key to success on Relative Ordering games. We will unlock the full power of the Tree momentarily when we discuss how to draw inferences from the diagram in order to answer questions. First, let's get more comfortable with the setup process by drilling the mechanics.

DRILL IT: Relative Ordering Setups

Each problem will contain one or more rules. Your task is to construct a Tree diagram for each one. Be sure to check your diagram against the solution on the next page AFTER EACH AND EVERY PROBLEM. Make sure you understand each exercise before moving on to the next one.

Example:

S departs at some point after R.
O departs at some time before P but at some point after Q.
P departs at some point after R.



1. X plays earlier than W but later than T.
   Y plays later than Z.
   Z plays earlier than X.

2. Both M and H are written later than N.
   O is written at some time before H but after J.
   J is written earlier than K.
   K is written earlier than N.

3. Both T and V call at some time before M.
   N calls at some time after R.
   O calls at some time before N but after M.
   P calls at some time before M.
   T calls at some time before S.

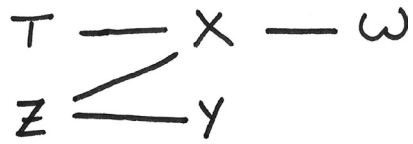
4. M arrives at some time after O.
   L arrives earlier than N
   J arrives at some time after L but before P.
   S arrives at some time after J.
   N arrives later than O.

5. Both S and Y finish at some time before R.
   T finishes at some time after X.
   S finishes at some time after W but before V.
   X finishes earlier than Z.

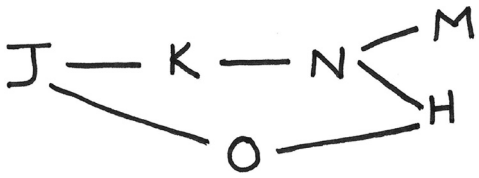
6. K is produced at some time after N but before O.
   Both L and J are produced at some time before N.
   M is produced at some time after P.
   R is produced at some time before O.
   J is produced at some time before M.

SOLUTIONS: Relative Ordering Setups

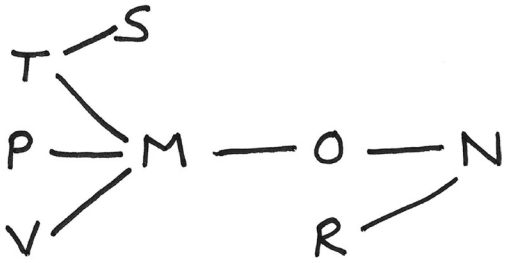
1. X plays earlier than W but later than T.
   Y plays later than Z.
   Z plays earlier than X.



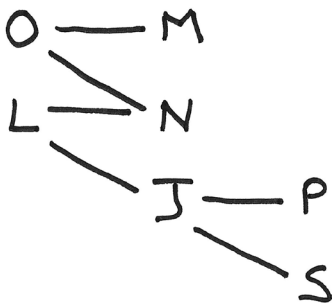
2. Both M and H are written later than N.
   O is written at some time before H but after J.
   J is written earlier than K.
   K is written earlier than N.



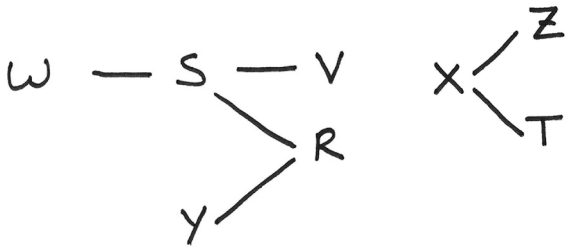
3. Both T and V call at some time before M.
   N calls at some time after R.
   O calls at some time before N but after M.
   P calls at some time before M.
   T calls at some time before S.



4. M arrives at some time after O.
   L arrives earlier than N
   J arrives at some time after L but before P.
   S arrives at some time after J.
   N arrives later than O.

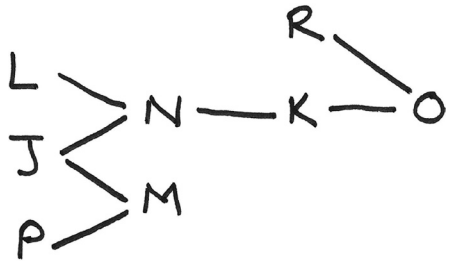


5. Both S and Y finish at some time before R.
   T finishes at some time after X.
   S finishes at some time after W but before V.
   X finishes earlier than Z.



(Yes, you might end up with two Trees! Don't try to force them together …)

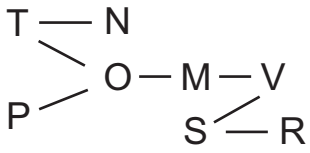
6. K is produced at some time after N but before O.
   Both L and J are produced at some time before N.
   M is produced at some time after P.
   R is produced at some time before O.
   J is produced at some time before M.



Using the Tree to Make Inferences

Now you know how to draw these fancy Trees, but how can you use them to answer the questions? Let's figure out how to use this powerful diagramming system.

If you have properly set up your Tree diagram, you have essentially uncovered **all** of the key relative ordering inferences required to answer the questions. Your ability to utilize these inferences, however, depends on your ability to correctly read the Tree. There are just two important rules that you must keep in mind. We'll discuss these rules one at a time using our completed Tree diagram from our rock band example:



Rule #1: The relative position between two elements, or letters, *can* be determined if we can trace a continuous path between these two elements without changing the horizontal direction of our path.

It should make sense why this is so. If T is before O, and O is before M, and M is before V, we can say for certain that T must be before V. As long as we are linking our understanding in "one direction," we can make such valid inferences.

Example: P to V

Starting at P, we can follow a solid line to the right towards O, continue to the right towards M, and again trace to the right to arrive at V. Note that we have traced a *continuous* path from P to V, and we did not have to change horizontal directions to do so. We moved to the right the entire time. Thus, the position of P relative to V is known. Even though the rules never referenced a direct relationship between the two, we can infer that P sits somewhere before V (with at least O and M between them).

Example: M to T

From M, we can follow a solid line to the left towards O, then continue on a solid line to the left arriving at T. Thus, we can conclude that T sits somewhere before M.

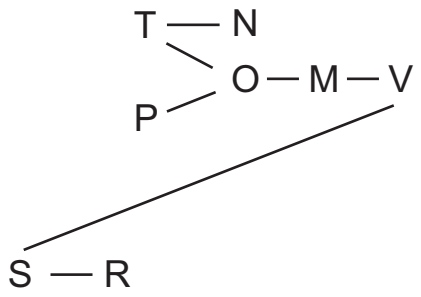
Rule #2: The relative position between two elements *cannot* be determined if the path between them includes one or more changes in horizontal direction. In other words, if there's a zigzag connection between two elements, we don't know which one comes before the other.

Example: N to O

From N, we can follow a solid line to the left towards T, but then we must change horizontal directions, moving back to the right to arrive at O. Thus, the position of N relative to O *cannot* be determined. N could come somewhere before O, but it could also come somewhere after O.

Example: P to R

This is a tough one. It *looks* like P comes before R, but the relationship between them is actually unknown. Remember, the Tree is a map of relative position, NOT a physical picture of order. From P, we can follow continuous, solid lines to the right towards V, but then we must change horizontal directions back to the left towards S, and then change again to move right towards R. Thus, the position of P relative to R *cannot* be determined. P could come somewhere before R, but it could also come somewhere after R. This is tough for some folks at first since R is so far to the right of S in the diagram. But remember that since the connections between elements simply show that one precedes the other, we can make our lines as short or as long as we like. All you would need to do is stretch the S–V connection and your diagram could look like this (and still be correct):

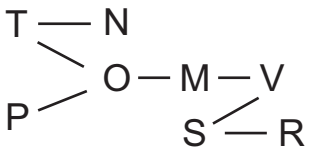


That's it! The Tree diagram presents a simple-to-understand visual representation of all that we know about the relative relationships between elements, and as long as you understand how to utilize the above two rules, the Tree can be a powerful tool for helping you get through a Relative Ordering game quickly and effectively.

Here are some additional tips for utilizing the Tree effectively:

1. Be mindful of "strays." We define a "stray" as an element that has a known relationship with just one other element.

If we take a look at our sample diagram:



The two "strays" for this game are N and R. We know that N comes after T, but we know nothing else about N. We know R comes after S, but we know nothing else about R.

Before you read on, identify all the various positions in the number line, one through seven, that N can occupy, and all the positions that R can occupy.

N can occupy any position from two to seven, as can R. Because these elements have a lot of flexibility in terms of where they can be placed, they can often be the key "wrinkle" in a particular problem. Furthermore, because of the way we tend to represent these strays, it can be easy to forget them or misunderstand them. For our image above, for example, it can be very easy to forget that N could be the last element.

2. Become practiced at placing elements into positions during questions. Note that in setting up our diagram, we focused on the relationships between elements, rather than on where those elements can and cannot go. With most Relative Ordering games, we don't recommend spending time making additional inferences onto a number line diagram during your setup. However, when we get to the point of answering questions, we'll often need to transfer what we know about relative relationships to a set of concrete positions.

Let's think for a moment about the diagram we have set up. What positions in the order could M occupy? Think about it on your own before reading on.

Here's what we know about M: there are three elements—T, O, and P—that all MUST go before M, and there is one element—V—that MUST go after M. Therefore, M can't go in one of the first three positions, and M can't go in the last position. M could go in positions 4, 5, 6, or 7.

Let's think about the diagram from another perspective. Which elements could go first? Again, think about it on your own before reading on.

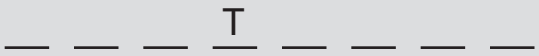
To answer this, it's helpful to know what prevents an element from going first. An element can't go first if there are other elements that have to go before (or to the left) of it. If we look at our diagram, there are three elements that have no other elements to the left of them—that is, no elements that must go before them. These three elements—T, P, and S—could all go first.

3. Know when to draw a new Tree. For conditional questions that provide an *assignment* (e.g., R is third), drawing out a number line makes a lot of sense. But for those times when we're provided with a new *relationship*—F comes before Q—drawing a new tree for that question generally is more appropriate.

Just like with conditional questions that tell us an assignment, with these relationship conditionals you might find that you can do the inference work in your head. Great. As you start your prep, default to writing out your work, and later, as you develop a strong grasp on your approach and an understanding of what your brain can actually handle under pressure, you can start to pull away from the paper for easier questions.

Using the Cloud to Represent Limited Uncertainty

Now, let's imagine that in a different question, we were told that T occupies the fourth position. We would start thinking about the situation by drawing a number line beside the question, and placing T fourth, like so:

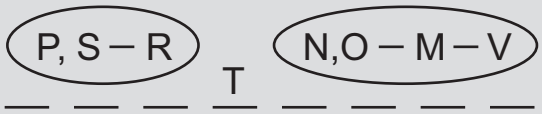


What do we know about T? We know that N, O, M, and V must all come after T. If T is fourth, there are four spaces after it—5, 6, 7, and 8—in which to place these four elements. However, we can't be sure exactly which position each element goes in. We do know something that severely limits our options—O must be before M which must be before V—but we don't want to waste time thinking about and representing every possibility for every position. Instead, we can do something like this:

The cloud tells us generally where elements go, while also noting that there are still various options. It makes it easy to see that we have four elements to occupy four spots, and because the cloud preserves the known relationships between the elements, it's easy to do more specific deductive work about the specific positions elements can go in if the answer choices require that from us.

Note that we do not know anything about T's relationship with P, S, or R, and one way we know that we don't know anything is that we can't connect T to any of these elements without "crisscrossing" our horizontal direction. But since N, O, M, and V are taking up all the slots after T, we can infer that the rest of the elements fall before T.

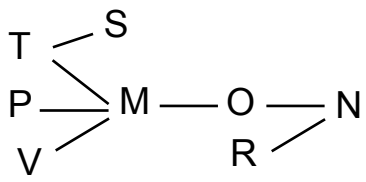
We can finish off our diagram by placing the remaining three elements in a cloud in front of the T:



DRILL IT: Tree Inferences

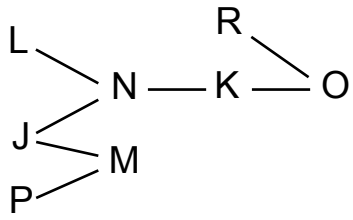
Each exercise will contain a completed Tree diagram. Your task is to answer the associated questions based on your understanding of the diagram. Be sure to check your answers against the solutions AFTER EACH SET OF QUESTIONS. Make sure you understand before moving on to the next exercise.

Exercise #1:



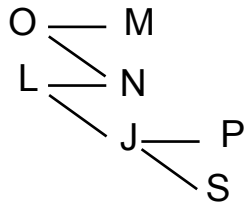
1. Does V come somewhere before O? Yes, no, or maybe?
2. Does T come somewhere before R? Yes, no, or maybe?
3. How many letters must come after P?
4. Of the eight letters, which ones could occupy the eighth position?
5. Of the eight letters, which ones could occupy the first position?
6. What is the earliest position that O could occupy?

Exercise #2:



1. Does M come somewhere before R? Yes, no, or maybe?
2. Does K come somewhere before J? Yes, no, or maybe?
3. How many letters must come before O?
4. Of the eight letters, which ones could occupy the eighth position?
5. Of the eight letters, which ones could occupy the first position?
6. If N occupies the third position, what is the earliest position that M could occupy?

Exercise #3:



1. Of the seven letters, which ones could occupy the first position?

2. Of the seven letters, which ones could occupy the last position?

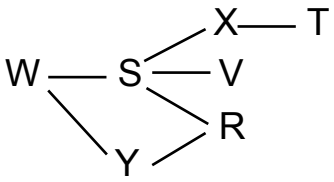
3. How many letters must come before J?

4. How many letters must come after L?

5. What is the latest position that O could occupy?

6. If J occupies the third position, list all of the possible positions that N could occupy.

Exercise #4:



1. What is the earliest position that R could occupy?

2. What is the earliest position that T could occupy?

3. If V occupies the third position, what is the earliest position that R could occupy?

4. What is the latest position that S could occupy?

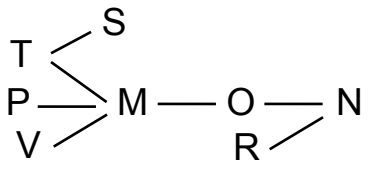
5. If Y occupies the second position and V occupies the fourth position, how many different possibilities are there for the ordering of the seven letters? Write them out.

6. If T occupies the fourth position, which letters could occupy the seventh position?

For more practice, log in to your Student Center!

SOLUTIONS: Tree Inferences

Exercise #1:



1. Does V come somewhere before O? Yes, no, or maybe? **YES**

We can trace a solid line from V to M to O without changing horizontal directions.

2. Does T come somewhere before R? Yes, no, or maybe? **MAYBE**

From T, we can trace a solid line all the way to N without changing directions, but then we must move back to the left in order to arrive at R. Thus, we *cannot* determine the position of T relative to R. T could come before R or after R.

3. How many letters must come after P? **THREE**

Moving to the right, we can trace a continuous connection between P and M, P and O, and P and N. Thus, M, N, and O must all come after P. Remember, R is a stray! It could potentially come before P.

4. Of the eight letters, which ones could occupy the eighth position? **N, S**

Remember that S is a stray! The only thing we know about S is that it must come after T. Other than that, S is free to occupy any position, including the eighth position.

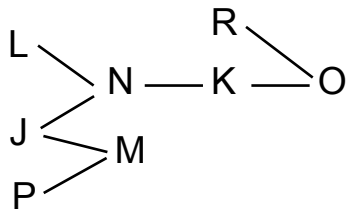
5. Of the eight letters, which ones could occupy the first position? **T, P, V, R**

Remember that R is a stray! The only thing we know about R is that it must precede N. Other than that, R is free to occupy any position, including the first position.

6. What is the earliest position that O could occupy? **5TH**

Notice that T, P, V, and M must all come before O. If these four letters must precede O, then the fifth position is the earliest position that O could occupy.

Exercise #2:



1. Does M come somewhere before R? Yes, no, or maybe? **MAYBE**

Tracing the path from M to R involves changing directions twice. Thus, the position of M relative to R *cannot* be determined. M could come before or after R.

2. Does K come somewhere before J? Yes, no, or maybe? **NO**

From J, we can trace a continuous path to the right to arrive at K. Thus, K comes *after* J, not before.

3. How many letters must come before O? **FIVE**

R, K, N, L, and J can all be traced back to O on a continuous, one-directional path.

4. Of the eight letters, which ones could occupy the eighth position? **O, M**

In this case, M functions somewhat like a stray. We know that M must be preceded by both J and P. Other than that, however, M is free to occupy any position, including the last position.

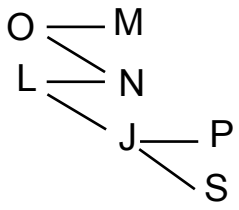
5. Of the eight letters, which ones could occupy the first position? **L, J, P, R**

Don't forget about the stray R! We know that R must come before O. Other than that, however, R is free to occupy any position, including the first.

6. If N occupies the third position, what is the earliest position that M could occupy? **5TH**

If N occupies the third position, L and J must occupy the first and second positions (not necessarily in that order). We know that P must come before M. With the first three positions filled, the earliest that P could come is fourth. Thus, the fifth position is the earliest position that M could occupy.

Exercise #3:



1. Of the seven letters, which ones could occupy the first position? **O, L**

Every other letter has at least one letter that must precede it.

2. Of the seven letters, which ones could occupy the last position? **P, S, M, N**

Watch out for the stray M! Also note that N functions somewhat like a stray in this case. We know that O and L must precede N. Other than that, however, N is free to occupy any position, including the last.

3. How many letters must come before J? **ONE**

L must come before J, and P and S must come after J. J's relationship with O, N, and M is uncertain because we cannot trace a one-directional line between J and O, J and N, or J and M.

4. How many letters must come after L? **FOUR**

N, J, P, and S must all come after L. L's relationship with O and M is uncertain because we cannot trace a one-directional line between L and O or L and M.

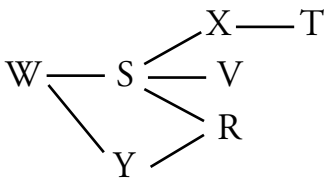
5. What is the latest possible position that O could occupy? **5TH**

All we know about O is that both M and N must come after it. Thus, O cannot occupy the sixth or seventh positions, but it could occupy the fifth position.

6. If J occupies the third position, list all of the possible positions that N could occupy. **4TH, 5TH 6TH, 7TH**

If J occupies the third position, L and O must occupy the first and second positions (not necessarily in that order). This leaves the fourth, fifth, sixth, and seventh positions for M, N, P, and S. Since there is no one-directional connection between any of these four letters, their relative positioning is uncertain. Thus, N could occupy any one of the last four positions.

Exercise #4:



1. What is the earliest position that R could occupy? **4TH**

S, Y, and W must all come before R.

2. What is the earliest position that T could occupy? **4TH**

X, S, and W must all come before T.

3. If V occupies the third position, what is the earliest position that R could occupy? **5TH**

If V occupies the third position, W and S must occupy the first and second positions, respectively. Y must come before R. With the first three positions filled, the fourth position is the earliest that Y could occupy. R could occupy the fifth position immediately after Y.

4. What is the latest possible position that S could occupy? **3RD**

X, T, V, and R must all come after S. Thus, the latest position that S could occupy is the third.

5. If Y occupies the second position and V occupies the fourth position, how many different possibilities are there for the ordering of the seven letters? Write them out.

W Y S V R X T
W Y S V X R T
W Y S V X T R

If Y occupies the second position and V occupies the fourth position, W must occupy the first position and S must occupy the third position.

6. If T occupies the fourth position, which letters could occupy the seventh position? **V, R**

If T occupies the fourth position, W, S, and X must occupy the first, second and third positions, respectively. This leaves V, R, and Y for the last three positions. Y must come before R, so Y can't occupy the last position.

For more practice, log in to your Student Center!

Try It Again

Now that you've learned how to draw inferences from the Tree diagram, it's time to put your skills to good use. Let's revisit the rock band game introduced at the start of the chapter. Try developing your Tree from scratch, and then use it to tackle the questions. Again, limit yourself to **8 minutes and 30 seconds.** We'll work through the solutions together on the pages to come.

Exactly eight rock bands—M, N, O, P, R, S, T, and V—perform consecutively at a showcase on Friday night. No band performs more than once, and no two bands perform simultaneously. The following conditions apply:

T and P both perform at some time before O.
S performs at some time before R.
T performs at some time before N.
V performs at some time after S.
M performs at some time before V and at some time after O.

1. Which of the following could be the order of the performances from first to last?

   (A) P, T, O, M, R, S, V, N
   (B) T, N, M, P, S, O, V, R
   (C) P, T, N, O, M, V, S, R
   (D) T, P, N, O, S, M, V, R
   (E) T, N, O, S, P, R, M, V

2. Which of the following must be true?

   (A) At least four bands perform at some time after P.
   (B) At least four bands perform at some time after T.
   (C) At least two bands perform at some time after M.
   (D) At least two bands perform at some time before N.
   (E) At least two bands perform at some time before R.

3. If P performs fifth, then each of the following could be true EXCEPT:

   (A) R is the sixth band to perform.
   (B) N is the fourth band to perform.
   (C) S is the second band to perform.
   (D) T is the third band to perform.
   (E) R performs at some time before N but at some time after T.

4. If S performs at some time after N, and P performs at some time before T, which of the following could be true?

   (A) N performs earlier than P but later than O.
   (B) R performs earlier than M but later than N.
   (C) O performs earlier than N but later than S.
   (D) R performs later than S but earlier than T.
   (E) P performs earlier than O but later than R.

5. Each of the following could be true EXCEPT:

   (A) V performs earlier than N.
   (B) R performs earlier than T.
   (C) N performs earlier than P.
   (D) S performs later than O.
   (E) M performs earlier than P.

6. If T performs third and V performs sixth, then exactly how many different orders are there in which the bands can perform?

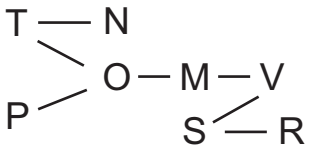
   (A) 1
   (B) 2
   (C) 3
   (D) 4
   (E) 5

7. There can be at most how many bands that perform after N but before S?

   (A) 1
   (B) 2
   (C) 3
   (D) 4
   (E) 5

How Did You Do?

Since we discussed the setup of this game earlier, we're going to just transfer our diagram, and focus on the questions themselves. Please refer back a few pages if you need help with any part of the setup.



The Big Pause

In Relative Ordering games, the Tree diagram serves as a thorough representation of all the inferences, so there's no need for any deep consideration of the game or prioritization of the rules. However, it's definitely worth checking that you've notated each rule correctly. At some point you'll see how time-consuming it is when you jump into the questions with a diagram based on "F is after G" when the rule actually says "F is before G"!

Attack the Questions

1. Which of the following could be the order of the performances from first to last?

   (A) P, T, O, M, R, S, V, N
   (B) T, N, M, P, S, O, V, R
   (C) P, T, N, O, M, V, S, R
   (D) T, P, N, O, S, M, V, R
   (E) T, N, O, S, P, R, M, V

(D) is correct.

This is an Orientation question, and we can use the rules to eliminate answers:

The first rule allows us to eliminate (E).
The second rule allows us to eliminate (A).
The fourth rule allows us to eliminate (C).
The fifth rule allows us to eliminate (B).

Alternately, if you are comfortable with your Tree diagram, you can use an approach that we call the "String Technique." Here's how it works:

Looking at our Tree, we see a P–O–M–V string. These four letters must come in that order (not necessarily consecutively, but certainly in that order). So let's start by eliminating any answer choices that do NOT contain the P–O–M–V string. (B) has M–P–O–V. Eliminate it. (E) has O–P–M–V. Eliminate

it. Now let's take another string: S–V. Let's eliminate any choice that does NOT contain the S–V string. Eliminate (C). Lastly, we'll evaluate the S–R string. Eliminate (A). We're left with (D).

Note that the String Technique is just a different way of using rules to eliminate wrong answers.

2. Which of the following must be true?

   (A) At least four bands perform at some time after P.
   (B) At least four bands perform at some time after T.
   (C) At least two bands perform at some time after M.
   (D) At least two bands perform at some time before N.
   (E) At least two bands perform at some time before R.

(B) is correct.

N, O, M, and V must all perform after T.

Remember that a big key to questions such as this one is to not spend too much time on incorrect answers. If you are asked to identify an answer that must be true, or must be false, you want to focus on just finding the right answer, rather than on eliminating incorrect answers.

3. If P performs fifth, then each of the following could be true EXCEPT:

   (A) R is the sixth band to perform.
   (B) N is the fourth band to perform.
   (C) S is the second band to perform.
   (D) T is the third band to perform.
   (E) R performs at some time before N but at some time after T.

(A) is correct.

If P performs fifth, we know O, M, and V must follow it (in that order), and so O must be sixth, M seventh, and V eighth. That leaves T, N, S, and R for the first four slots. We can represent the information we know as follows:

We are looking for an answer that MUST BE FALSE. (A) must be false.

4. If S performs at some time after N, and P performs at some time before T, which of the following could be true?

   (A) N performs earlier than P but later than O.
   (B) R performs earlier than M but later than N.
   (C) O performs earlier than N but later than S.
   (D) R performs later than S but earlier than T.
   (E) P performs earlier than O but later than R.

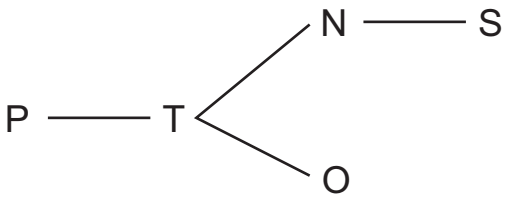
(B) is correct.

Here's our second conditional question. Unlike the previous one, this question provides a *relationship* instead of a *position*. Therefore, instead of drawing a number line to make inferences, we'll want to draw a new tree.

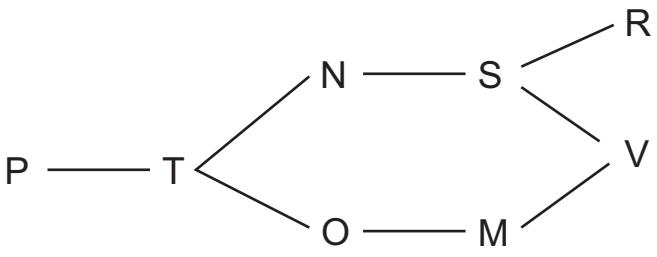
We can start by simply notating the two relationships, roughly placing them in a position that might work in terms of where all the elements will eventually be placed:

Now we want to build the rest of the diagram around these relationships. No need to be fancy; simply take a rule and add it in. See if you can finish that off before reading on.

You could start by adding in that T must come before N, and then add that O must follow T:



The final diagram for this question should look something like this:



It may seem odd to build a new diagram for a question, but it shouldn't take long, and it will set us up nicely to move through the answer choices quickly.

We want something that could be true, so the four wrong answers must all be false.

(A) is clearly wrong—N can't perform earlier than P.

(B) is correct. R and M are connected by a zig zag, so R could definitely come before M, and R must come after N.

You wouldn't keep moving through the choices, but go ahead now and confirm for yourself why (C) through (E) must be false.

5. Each of the following could be true EXCEPT:

   (A) V performs earlier than N.
   (B) R performs earlier than T.
   (C) N performs earlier than P.
   (D) S performs later than O.
   (E) M performs earlier than P.

(E) is correct.

This is another question that requires us to identify one answer that MUST BE FALSE. M cannot perform before P, because we know P performs before O, and O performs before M.

The other four answers represent relations about which we are not certain. For practice, you may want to think about how connecting each of the elements in the respective answer choices—V and N for (A), R and T for (B), etc.,—requires you to "crisscross" your horizontal path. Remember that a zigzag is the physical sign that allows us to see that we do **not** know the relationship between two particular elements.

6. If T performs third and V performs sixth, then exactly how many different orders are there in which the bands can perform?

   (A) 1
   (B) 2
   (C) 3
   (D) 4
   (E) 5

(D) is correct.

We will discuss this type of question in fuller detail shortly.

7. There can be at most how many bands that perform after N but before S?

   (A) 1
   (B) 2
   (C) 3
   (D) 4
   (E) 5

(C) is correct.

We will discuss this type of question in fuller detail shortly as well!

Review Questions

Now that you've had a chance to take another look at the game, and to read how another person might approach solving the questions, how do you feel?

Here are some of the review questions we discussed in the previous chapter. Let's apply them to this game, and use them to think about other Relative Ordering games.

1. Could I picture the game easily? Did I understand the general situation?

Do you understand what characteristics make this a Relative Ordering game? Will you able to recognize Relative Ordering games when you see them on the exam?

2. Did I understand the rules correctly? Did I notate them in a way that allowed me to think about them easily?

Were you able to correctly put together your Tree, or did you make an error somewhere? Do you feel confident that you can construct similar diagrams without error, or do you feel you need practice to get more comfortable?

3. Did I make the key inferences at the right times? Did I understand which rules to prioritize?

For Relative Ordering games, the Tree diagram gives us every up-front inference we need going into the questions. It will show us every "link" between relative relationships, and it will make it easy to see which positions elements can and cannot go into (and we need not and should not notate all of these possibilities up front). The Big Pause is simply a diagram check. The questions themselves will require us to make additional inferences, often by applying what we know to specific positions on a number line. Make sure you have a good understanding of how to think about inferences for Relative Ordering games.

4. Did I attack each question wisely?

In reading the solutions for this game, hopefully you were able to notice similarities and differences between your own thought process and the one we've outlined. If any questions took you more time than they should have, think carefully about the "unnecessary" steps you may have taken, or the moment at which your thought process may have gotten stuck. Perhaps just as importantly, think carefully about the questions that you answered very quickly and effectively. Walk through your thought process, and consider what the keys that led to such success were.

Spotlight on Question Types: Options Questions

In the previous chapter, we discussed the two most common types of questions, Orientation questions and Standard questions. On a typical exam, all but 2 to 4 of the questions that you will see in the games section will fit into one of those two categories (with Standard questions being, by far, the most significant category). In this chapter and the next, we will discuss the two "families" of minor question types—we'll discuss "Options" questions in this chapter, and "Rules" questions in the next.

Options questions require you to use what you know about a game to consider various possibilities for how to arrange the elements. Options questions come in five main types:

1. **Possible arrangements of all elements**
2. **Maximum or minimum**
3. **Possible elements for a particular position**
4. **Possible positions for a particular element**
5. **What would determine the complete assignment of elements to positions?**

The first two question types on the list are typically a bit more challenging, so we will focus our discussion on those two, but we'll also give suggestions for the remaining types of Options questions.

1. Possible Arrangement of All Elements

We had an example of this type of question in our Getting Familiar game:

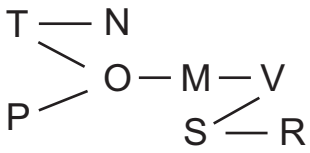
> *If T performs third and V performs sixth, then exactly how many different orders are there in which the bands can perform?*

Almost all such questions that ask us to calculate total possibilities are conditional in nature; that is, they give us new information that will help us to further limit options before we have to count them. It makes sense why this is so; without new rules, there would generally be so many possibilities that it would be unreasonable to expect us to count them all in the course of a minute or so.

Therefore, you can expect conditions for these questions, and you should expect to be able to whittle down the uncertainty to just a few unset positions and a few unassigned elements.

Let's return to the question mentioned above to discuss these concepts further:

6. If T performs third and V performs sixth, then exactly how many different orders are there in which the bands can perform?



(A) 1
(B) 2
(C) 3
(D) 4
(E) 5

We want to start by placing T third and V sixth. Initially, it might appear that those are the only assignments we know for certain, but it would be a mistake, at this point, to move into thinking about the number of possibilities for each remaining position. With six positions open, the math is simply too much. We *know* we can uncover other assignments that are certain.

And if we think about it, there is more to uncover. Since there are two positions between third and sixth, and two elements—O and M—that must go between T and V, in that particular order, O must go in the fourth position and M must go in the fifth position.

That leaves P, S, N, and R for the remaining open positions—1, 2, 7, and 8.

We know we're going to get further limitations—if we just have four elements for four positions, with no other restrictions, that would yield 24 possible orders (we won't list them here), which is too many for the test writers to realistically expect us to calculate in the limited time frame (and is also not an answer choice).

We can figure out that P must go in one of the first two positions, and N in one of the final two positions. Since S must perform before R, that means S must also go in one of the first two positions, and R in one of the final two positions. As we mentioned in the solution before, we end up with the following understanding:

There are certain mathematical formulas that we can use to think about our possibilities. However, in general, we don't recommend that you use such formulas. Games often present unique limitations on where elements can go, and it's very easy to misrepresent these limitations when applying formulas under pressure. The situations presented are always simple enough that it makes more sense to manually count out the possibilities.

One tip we have is to focus on the positions that are uncertain. Once we've filled 3–6, we don't have to think about them anymore, and, mentally at least, the issue looks something like this:

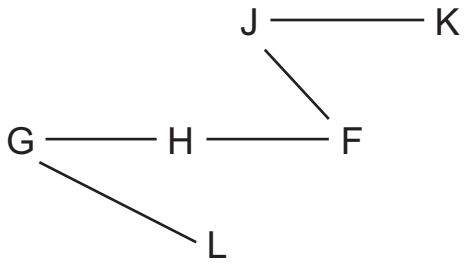
Now it's a bit easier, perhaps, to walk through all possible permutations:

P, S	N, R
P, S	R, N
S, P	N, R
S, P	R, N

DRILL IT: Possible Arrangements

Here is a mini-drill to practice Possible Arrangement questions. Use the provided diagrams to solve each question.

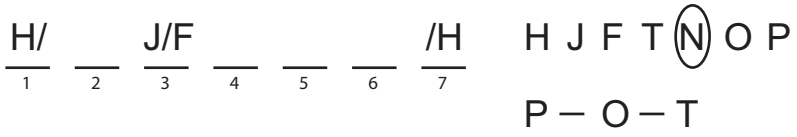
1.



If H is third and L is fifth, how many possible sequences of letters are there?

(A) 2
(B) 3
(C) 4
(D) 5
(E) 6

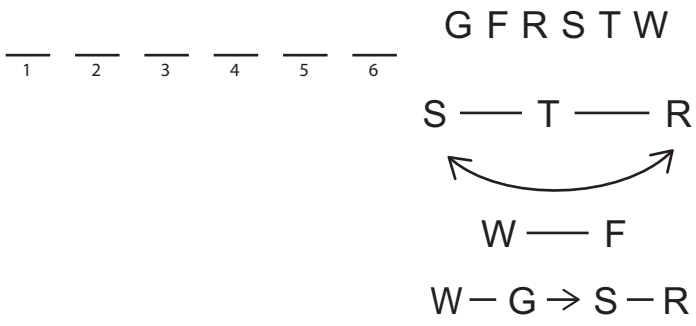
2.



If N comes immediately before H, how many orderings of letters are possible?

(A) 5
(B) 6
(C) 7
(D) 8
(E) 9

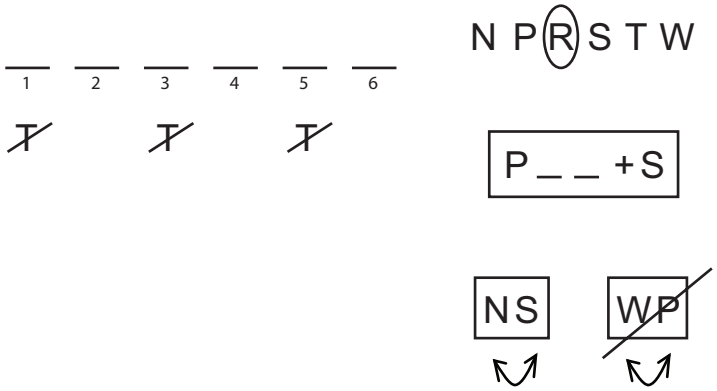
3.



If T is third and F is fourth, how many different arrangements are possible?

(A) 1
(B) 2
(C) 3
(D) 4
(E) 5

4.



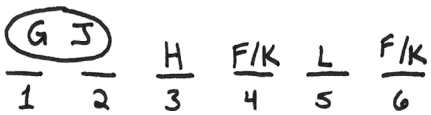
If R comes fourth, how many different assignments are possible?

(A) 2
(B) 3
(C) 4
(D) 5
(E) 6

For more practice, log in to your Student Center!

SOLUTIONS: Possible Arrangements

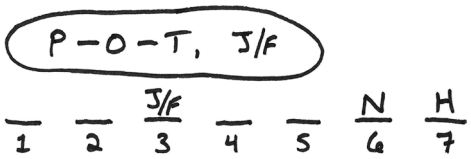
1. **(C) is correct.** H must come after G and before F. So we know G is in either 1 or 2, and F is in either 4 or 6. J must come before F and K, so we know J is in either 1 or 2, and K is in either 4 or 6:



Thus, four scenarios are possible:

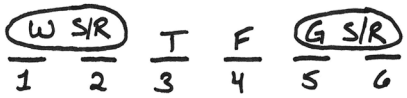
G J H F L K
G J H K L F
J G H F L K
J G H K L F

2. **(D) is correct.** N must be in 6 to come immediately before H. We still have to determine the positions for P, O, T, and J/F:

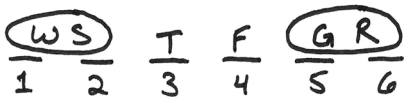


Assuming that J goes third, there would be four places F could go: 1, 2, 4, or 5. Since it also could be F going third instead of J (and J going in 1, 2, 4, or 5), that gives us a total of eight arrangements.

3. **(D) is correct.** We have to place W in either slot 1 or 2. Because of the S, T, R rule, we'll have to place either R or S before T as well. That leaves the other (R or S) to slot 5 or 6, along with G. We have this so far:



However, we've ignored the W – G → S – R rule! Since W will definitely come before G in this case, S must come before R. Thus, we actually have this situation:



And from here it's easy to see that there are four possible arrangements:

W S T F G R
W S T F R G
S W T F G R
S W T F R G

4. **(B) is correct.** Since R is in 4, T can only be in 2 or 6. However, T in 6 would leave only slots 1–3 for the NS chunk, and since P must come at least three spaces before S, that will not work. Thus, T must go in 2. There's now only one place to put the NS chunk—slots 5 and 6. If S is in 6, P can go in either 1 or 3, with W in the other. That's two arrangements so far. If S is in 5, P cannot go in 3, so P must go in 1, and W in 3. Thus, there are three possible arrangements:

W T P R N S
P T W R N S
P T W R S N

If T were in 6, the NS chunk would have to go in one of the first three spaces. However, that would not leave enough room to place P. Thus, T cannot go in 6.

For more practice, log in to your Student Center!

The Possible Arrangement Flip Side

Like many questions on the LSAT, possible arrangement questions have a "flip-side" equivalent. While this *doppelgänger* is far less common, it is still worth discussing.

Here is the question we were looking at:

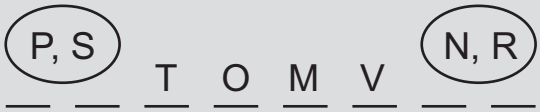
> *If T performs third and V performs sixth, then exactly how many different orders are there in which the bands can perform?*

Imagine if the same question were written in the following manner:

> *If T performs third and V performs sixth, then for exactly how many of the bands is their position in the order known?*

Note that both of these questions require the same type of work from us— we must take the given information and make inferences from it. The difference in the questions is that the answer choices are meant to test different aspects of our thought process.

For either type of question, the work we do gives us the following information:



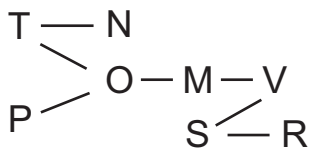
If we get the question in the first form, we find our answer in the positions still left uncertain. If we get the second, less common form of the question, we look at the positions that are now certain (the correct answer would be four—T, O, M, and V).

2. Max/Min

Another common form of the Options question involves consideration of minimums and maximums. These minimums and maximums can be about a few different types of issues. We can be asked about the maximum number of positions between two elements in an ordering question, or, in some other game that doesn't have anything to do with ordering, we can be asked the about the maximum number of elements in a particular group.

The final question from the previous game was an example of a Max/Min question. Let's break it down and evaluate it further:

7. There can be at most how many bands that perform after N but before S?



(A) 1
(B) 2
(C) 3
(D) 4
(E) 5

When confronted with a Max/Min question during an ordering game, we want to think about three possible issues:

1. What is the *earliest* that (in this case) N can perform?
2. What is the *latest* that (in this case) S can perform?
3. How many bands *must* (in this case) perform *between* the two?

Go ahead and think about these issues one at a time before reading on.

1. The earliest N can perform is second, because it must perform after T.
2. The latest S can perform is sixth, because it must perform before R and V.
3. Since there is zigzag between N and S, there are no requirements for how many bands must perform between them.

Therefore, there can be at most three (in positions 3, 4, 5) elements after N and before S.

3. Possible Elements for a Particular Position

Example: Which of the following is a complete list of bands, any one of which could perform third?

This is a more limited type of Options question—one that requires you to consider the options for just one particular space.

When you're asked this question about a particular space, take a second or two to consider what other elements *can't* go in the space. Armed with what you've figured out, you typically can eliminate several answer choices.

Now you want to test the remaining elements strategically, and the elements that are most attractive to test are the ones that differentiate the answers.

For example, let's imagine we have been given the question below, along with five answers. Let's also imagine that our well-honed powers of deduction have allowed us to eliminate two of the answer choices:

Which of the following is a complete list of bands, any one of which could perform third?

(A) M, N, O
~~(B) M, N, O, P, Q~~
(C) M, N, P
~~(D) M, N, Q~~
(E) M, N, O, P

If we are uncertain about which of the remaining answers is correct, it would make sense to try out O and P in the third slot, since the differences between the remaining answers involve O and P. As a counterpoint, trying out M or N in the third position would do us no good.

4. Possible Positions for a Particular Element

Example: Which of the following is a complete list of positions, any one of which can be occupied by O?

For most games, we probably won't already have thought out where O *can* go, but rather, we'll have considered where it *cannot* go. So, we'll start by thinking about where O can't go, and eliminate wrong answers. This will typically allow us to eliminate several answers.

When we're down to a few answer choices, we'll want to try out positions, and like on the previous type of question, we want to be strategic about the positions we try out—look for those that differentiate the answer choices from one another.

Note that this is the flip side of the question "O can go in each of the following positions EXCEPT:."

5. What would determine the complete assignment of elements to positions?

Example: Which of the following, if true, would determine the complete order of performances?

These questions, while not terribly difficult, are often time-consuming. Get ready to spend a bit of extra time if you run into this type of question.

Why is this question time-consuming? By its nature, this is a question that requires us to consider the answer choices. This is not a question where we can easily find an answer, or even eliminate wrong answers, based on our initial understanding of the game or the question stem.

We'll look at one of these questions in just a bit, but in general the most important thing to keep in mind is that four answers will *not* lead to a complete assignment of elements to positions. That is, four answers will eventually result in uncertainty about where elements can go. Uncertainty can lead to doubt and panic in the typical test-taker. A key to your success is that you understand the uncertainty for what it is and manage it.

For these types of questions, do not waste time on wrong choices. If you can't make complete inferences from an answer, the answer is probably wrong and you should move on. Try to find the one right answer that is "sticky"—that has multiple ramifications for the other elements—and that leads you on a chain of inferences. Even if you are a little uncertain of your path, if you find an answer that allows you to make three or four deductions, most likely that is going to be the right answer. Each of the wrong choices might lead to a deduction or two about where other elements will go, but those trails will quickly peter out.

A more high-level addition to your approach to this question type is to take a moment to consider the issues at play before you dive into the answer choices. Your understanding of the game's mechanics—an understanding you gained through the Big Pause and through your work on earlier questions—can help you speed up your work on this question type. For example, if you know that the answer must deal with the choice between F and G for the first position, as well as the ambiguous ordering of H, I, and J, keep that in the back of your mind as you evaluate answer choices. If an answer clearly leaves the relevant issues unresolved, then move on to the next one.

Practice Game 1: PT38, S2, G1

Note that on the next page we've added seven bonus questions for this game scenario. These are questions you can use to practice the minor question type processes we've just discussed. Note that these additional questions are NOT official LSAT problems, so don't go yelling at the nice folks over there if the questions are particularly hard.

P

Give yourself 8 minutes for the original game and questions (though if you feel very comfortable with Relative Ordering games, try to push the pace and go even faster!), and add 7 additional minutes for the seven bonus questions.

[For copyright reasons, this question set and all associated explanations have been removed from this downloadable sample document]