

1. **What does Hofstadter claim is one of the most central notions running through GEB?**

The notion of a formal system.

2. **Who invented the sort of formal system that Hofstadter features in his book (the sort of system that the MIU-system exemplifies), and when did this invention take place?**

Emil Post invented the Post-Production-System which is featured predominantly in this book in the 1920s.

3. **In one four-word interrogative question, state the puzzle that is featured in this chapter.**

“Can you produce MU?”

4. **What is the given string in the MIU-system?**

The given string in the MIU-system is MI.

5. **What is the goal string in the MIU-system?**

The goal string in the MIU-system is MU.

6. **How many rules are in the MIU-system?**

There are four rules in the MIU-system.

7. **Carefully, precisely, write down the first rule of the MIU-system, and give two examples of its use, one directly from the chapter and one that does not appear explicitly in the chapter.**

“If you possess a string whose last letter is I, you can add on a U at the end.”

Example 1:

(1)MIIII

(2)MIIIIU from (1) by rule I

Example 2:

(1)I

(2)IU from (1) by rule I

8. **Carefully, precisely, write down the second rule of the MIU-system, and give two examples of its use, one directly from the chapter and one that does not appear explicitly in the chapter.**

“Suppose you have Mx. Then you may add Mxx to your collection.”

Example 1:

(1)MIU

(2)MIUIU from (1) by rule II

Example 2:

(1)MUU

(2)MUUUU from (1) by rule II

9. **Carefully, precisely, write down the third rule of the MIU-system, and give two examples of its use, one directly from the chapter and one that does not appear explicitly in the chapter.**

“If III occurs in one of the strings in your collection, you may make a new string with U in place of III.”

Example 1:

(1)UMIIIMU

(2)UMUMU from (1) by rule III

Example 2:

(1)III (2)U from (1) by rule III

10. **Carefully, precisely, write down the fourth rule of the MIU-system, and give two examples of its use, one directly from the chapter and one that does not appear explicitly in the chapter.**

“If UU occurs inside one of your strings, you may drop it.”

Example 1:

(1)UUU

(2)U from (1) by rule IV

Example 2:

(1)MUUU

(2)MU from (1) by rule IV

11. **What is the word used to describe strings that are producible by the rules of a formal system from strings that have already been produced?**

The word for such strings is “theorems.”

12. **What is the technical term for the string MI in the MIU-system?**

The term for this kind of starting string is “axiom”

13. **In a formal system, is it more appropriate to say that theorems are proven or that theorems are produced?**

It is more appropriate to say that theorems are produced in a system such as this.

14. **How does Hofstadter define the term *derivation*?**

“A derivation of a theorem is an explicit, line-by-line demonstration of how to produce that theorem according to the rules of the formal system.”

15. **Reproduce, line by line, character by character, (including “reasons” (rule citations)) Hofstadter’s derivation of the string MUIIU.**

(1) MI — Axiom

(2) MII — from (1) by rule II

(3) MIII — from (2) by rule II

(4) MIIIIU — from (3) by rule I

(5) MUIU — from (4) by rule III

(6) MUIUUIU — from (5) by rule II

(7) MUIIU — from (6) by rule IV

16. **Write down, line by line (including “reasons” (rule citations)) a derivation of the string MIIUIIU.**

(1) MI — Axiom

(2) MII — from (1) by rule II

(3) MIIU — from (2) by rule I

(4) MIIUIIU — from (3) by rule II

17. **On page 37, Hofstadter claims there is a fundamental difference between a machine and a human. What is the difference?**

“[I]t is *possible* for a machine to act unobservant; it is impossible for a human to act unobservant.”

18. **With respect to formal systems, what is the difference between working “inside the system” and working “outside the system?”**

Working within the system involves applications of the rules of the system, while working outside the system involves making observations about the system.

19. **Are there any theorems in the MIU-system that do not start with the letter M?**

No, none can be produced starting with only the axiomatic string “MI.”

20. **How is the previous question answered, by working within the system or by working outside the system?**

This can only be determined by working outside the system because an infinite number of unique strings can be produced by the system which prevents the creation of all strings.

21. **What does “M-mode” refer to? What does “I-mode” refer to?**

“M-mode” refers to mechanical mode. “I-mode” refers to intelligent mode.

22. **Do you think that humans can work in M-mode?**

Humans can absolutely work in mechanical mode, but they can not do it with the persistence and accuracy of machines.

23. **Do you think that machines can work in I-mode?**

Machines can work in intelligent mode, but it is rare and less significant than it could appear.

24. **Two of the rules of the MIU-system are lengthening rules. What does this mean? Two of the rules of the MIU-system are shortening rules.**

What does this mean?

The lengthening rules of the MIU-system are rules which produce a longer string than the one that they started with. The shortening rules are just the opposite.

They produce shorter strings than the ones they start with.

25. Define “decision procedure” with respect to a formal system.

“A test for theorem hood. . . which does always terminate in a finite amount of time.”