2. Probabilities of sequences.

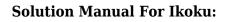
Assume that the four bases A, C, T, and G occur with equal likelihood in a DNA sequence of nine monomers.

- (a) What is the probability of finding the sequence AAATCGAGT through random chance?
- (b) What is the probability of finding the sequence AAAAAAAA through random chance?
- (c) What is the probability of finding any sequence that has four A's, two T's, two G's, and one C, such as that in (a)?
- (a) Each base occurs with probability 1/4. The probability of an A in position 1 is 1/4, of A in position 2 is 1/4, of A in position 3 is 1/4, of T in position 4 is 1/4, and so on. There are 9 bases. The probability of this specific sequence is (1/4)⁹ = 3.8 × 10⁻⁶.
- (b) Same answer as (a) above.
- (c) Each specific sequence has the probability given above, but in this case there are many possible sequences which satisfy the requirement that we have 4 A's, 2 T's, 2 G's, and 1 C. How many are there? We start as we have done before, by assuming all nine objects are distinguishable. There are 9! arrangements of nine distinguishable objects in a linear sequence. (The first one can be in any of nine places, the second in any of the remaining eight places, and so on.) But we can't distinguish the four A's, so we have overcounted by a factor of 4!, and must divide this out. We can't distinguish the two T's, so we have overcounted by 2!, and must also divide this out. And so on. So the probability of having this composition is

$$\left[\frac{9!}{4!2!2!1!}\right] \left(\frac{1}{4}\right)^9 = 0.014.$$

Solution Manual For Ikoku

Judd E. Hollander



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Table of Contents Solution Manual For Ikoku

- 1. Understanding the eBook Solution Manual For Ikoku
 - The Rise of Digital Reading Solution Manual For Ikoku
 - Advantages of eBooks Over Traditional Books
- 2. Identifying Solution Manual For Ikoku
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
- 3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Solution Manual For Ikoku
 - User-Friendly Interface
- 4. Exploring eBook Recommendations from Solution Manual For Ikoku
 - Personalized Recommendations
 - Solution Manual For Ikoku User Reviews and Ratings
 - Solution Manual For Ikoku and Bestseller Lists
- 5. Accessing Solution Manual For Ikoku Free and Paid eBooks

- Solution Manual For Ikoku Public Domain eBooks
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- Solution Manual For Ikoku Budget-Friendly Options
- 6. Navigating Solution Manual For Ikoku eBook Formats
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 - Adjustable Fonts and Text Sizes of Solution Manual For Ikoku
 - Highlighting and Note-Taking Solution Manual For Ikoku
 - Interactive Elements Solution Manual For Ikoku
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 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Solution Manual For Ikoku
- 9. Balancing eBooks and Physical Books Solution Manual For Ikoku
 - Benefits of a Digital Library
 - $\circ\,$ Creating a Diverse Reading Collection Solution Manual For Ikoku
- 10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
- 11. Cultivating a Reading Routine Solution Manual For Ikoku
 - Setting Reading Goals Solution Manual For Ikoku
 - Carving Out Dedicated Reading Time
- 12. Sourcing Reliable Information of Solution Manual For Ikoku
 - Fact-Checking eBook Content of Solution Manual For Ikoku
 - Distinguishing Credible Sources
- 13. Promoting Lifelong Learning
 - Utilizing eBooks for Skill Development

- Exploring Educational eBooks
- 14. Embracing eBook Trends
 - Integration of Multimedia Elements
 - Interactive and Gamified eBooks

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