



THE 2022 YOUNG MATHEMATICAL STORY AUTHOR (YMSA) COMPETITION

**THE CINDY NEUSCHWANDER AWARD
(THE 12-15 YEARS OLD CATEGORY)**

SHORTLISTED

**'Probylon The Lost Realm' by Navya Agarwal (12 years old)
at Oberoi International School JVLR (India)**

You can read the author's inspiration for the story and the judges' comments
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#YMSAMaths



PROBYLON

THE LOST REALM



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"Are you ready?" shouted Omar to his mom as he ran down the staircase excitedly, ensuring that he had packed everything in his bag. He was very excited to go to Amber's place for a sleepover. They quickly headed out and got into their car. On their way, they picked up Akito and Alicia and together they reached Amber's house. Amber was bubbling with excitement as she opened the door and escorted all her friends in.

After washing their hands and arranging their sleeping bags on the living room floor, they started discussing what to do next. "We should watch a horror movie," said Akito. Alicia replied, "Nah, it'll be much more fun to watch it at midnight. We need something to do before that". "I know, let's play a game!" Amber said, as she brought out a new game that she had recently got on her 12th birthday, "It is called Probylon, The Lost Realm".

The children opened the box in excitement. "The Earth had just been formed and a kingdom called Probylon was created. It flourished immensely under the rule of Queen Clea. She was brave, kind and wise. Everybody under her reign was happy and content. However, as she grew old and weak, her son Andras took over the throne. Due to his ignorance and lazy attitude towards the royal duties, the kingdom lost its wealth and glory, and was soon lost in time. Each



player is an explorer to have come across this forgotten realm. To revive this kingdom, the explorers need to try and build as many houses as they can.

The person who makes the maximum houses will be declared as the ruler of Probylon," Amber read out from the instruction manual, "The kingdom is divided into various territories or blocks and each of them is assigned a number from 2-12. Each explorer begins with 2 pre-assigned houses on the game board. Everyone will take turns rolling two dice and the player with houses on the resulting sum will earn Udits (the Probylon currency) - represented by X . The Udits you earn for a particular house is indicated by the value written underneath the assigned block number. The banker gives each person their money in the form of coins. Once you have 30 Udits, you give your notes to the banker in exchange for a house, which you can place at any vacant spot on the game board. The explorer that makes five houses first, gets to rule the land".



"It sounds interesting! Let's begin quickly," exclaimed Akito, "I'll be the banker". "Banker gets last turn," winked Amber to Akito, whose toothy grin turned into a frown as he was preparing to play the first turn. Omar took the green houses, Akito took red, Amber took white and Alicia took blue. Amber rolled the dice first and got a three and two. Since Omar and Alicia already had houses on the number five, they earned 12 Udits each. As the game progressed Amber got 30 Udits and was wondering which block to place her new house on. "Placing my house on a two or twelve will help me earn maximum Udits," Amber thought as she placed her house on a twelve. Soon, Akito also earned 30 Udits and placed his house on a two, thinking the same as Amber.

A little while later, it was Omar's turn to place a house as he had accumulated 30 Udits. He was deciding which block he should position his new house on. "The objective of the game is to earn Udits to be able to make houses as fast as possible, so earning more Udits is the key", Omar thought. He looked at the board and did some calculations on a piece of paper, much to the irritation of his friends as they chided him to play his turn quickly. Finally, he decided to place his house on the number seven.

 Omar

 Akito

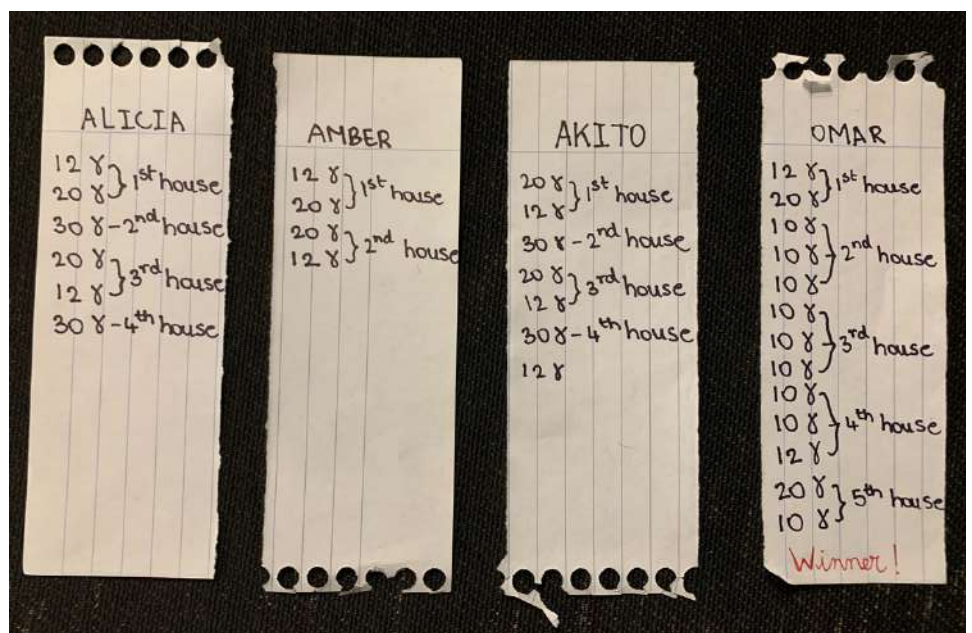
 Amber

 Alicia



"Why would you put it on seven?!" laughed Alicia, "It will only give you 10 Udits. Put it on a two or twelve, you will directly earn 30 Udits and can make a new house too!!!!" "You'll see," Omar smiled mysteriously. As the game continued, the dice kept favoring Omar's selection, earning him Udits and enabling him to place houses much faster than everybody else. Soon he had placed all of his five houses and won the game, much to everyone's surprise.

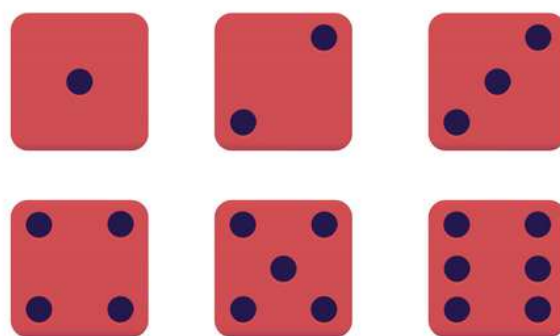
"How did you do that? You didn't even make houses on blocks which gave higher points. Rather, you went for low Udit-giving blocks," Akito asked, puzzled by the turn of events. Alicia echoed his thought, "Yes, yes! Please tell us how you did it". Omar was enjoying the spotlight but soon he saw his friends' eagerness and agreed to explain his strategy.



"You all were going behind blocks which gave higher Udits. Whereas what I noticed while playing was that the blocks which give high scores weren't expected to occur very frequently while rolling the dice. So, why should I waste a house by placing it on a block that was less likely to be rolled?" Omar expressed calmly. "Wait, are you saying that the numbers that gave higher Udits did not get rolled often which made the chances of us earning Udits from that block very slim?" Alicia exclaimed with wide eyes. "But why? How do you know which one will occur more often? Are you a fortune teller, or what?" asked an intrigued Akito. "Even better, I found out which numbers were more likely to get rolled. That's what I was calculating on that paper when you guys got irritated and urged me to play my turn faster," Omar replied, "My mom explained it to me just a few days back".

"He is going into professor-mode now!!" Amber giggled as she passed a grinning Omar a pair of fake spectacles and a coat. Getting into his attire and wearing a serious look on his face, Omar continued, "When we roll one die, how many outcomes are possible?"

"6 - 1, 2, 3, 4, 5 and 6," Alicia replied eagerly. Jack said, "Great! So, the chance of getting a particular number is $\frac{1}{6}$, and so, every number has an equal chance to be rolled". "Exactly! If every number has an equal chance of being rolled, we should just place it on the number which gives more points as well. It doesn't make much of a difference, does it?" Akito said, trying to prove his point. Omar replied, "Hang on buddy! I said that there is an equal chance of all numbers being rolled when there is one die. However, things are different with two dice".



$\{1, 2, 3, 4, 5, 6\}$

"Now can you guys tell me what is the range of the sum being rolled on two dice?" Jack questioned. "1-12," said Alicia. Amber responded, "No, it will be 2-12 because you can't get the sum as 1 when rolling two dice. The minimum sum is 2". "Precisely! And tell me how many total combinations of sum pairs can be made for all of the numbers between the range of 2-12?" Jack asked. "12," said Amber. "Nah, I think it is 36 because there are 6 numbers on the first die and 6 numbers on the second. Now, we have to multiply 6×6 as we need to find the total possible outcomes," Akito explained, beaming proudly. Omar and Alicia nodded in agreement. "Still didn't get it," Amber intervened. Alicia elaborated, "For example, if we get number 1 on dice A, there is a chance of getting 1, 2, 3, 4, 5 or 6 on dice B. This gives us 6 possible combinations. Same rule can be applied for all 6 numbers on dice A. So, there are 6×6 combinations. That's 36!"

"Now you guys are getting the hang of it. The two dice are independent events – that is, the outcome of one does not affect the other. We have figured out that there are 36 possible combinations for the 11 different outcomes. Now, we know that there are different combinations that add up to numbers between 2-12, which can be made with the two dice. We just need to find out how many sum pairs there are for each number," Jack explained. Alicia suggested, "Let's start with making a table of various possible outcomes when we roll two dice. This will help us list of combinations of numbers that add up and form values from 2 to 12".

		Dice 2					
		1	2	3	4	5	6
Dice 1	1	1+1	1+2	1+3	1+4	1+5	1+6
	2	2+1	2+2	2+3	2+4	2+5	2+6
	3	3+1	3+2	3+3	3+4	3+5	3+6
	4	4+1	4+2	4+3	4+4	4+5	4+6
	5	5+1	5+2	5+3	5+4	5+5	5+6
	6	6+1	6+2	6+3	6+4	6+5	6+6

"Okay, but what do we do with this??" questioned Akito. Omar replied, "We find the probability for each number. The higher the probability, the better. To find it, we need to..." "Hold on, what is probability?" Alicia cut in. "Let me guess. Probability is the likelihood that a certain event will occur. For example, when we toss a coin, there is an equal

probability of heads or tails occurring," Amber replied. "So, probability is basically a fancy way of saying that you guessed the numbers that would get rolled?" questioned Alicia. "No, probability isn't guessing the number; it is calculating the chance of a number being rolled," Omar continued, "...like I was saying, probability is usually denoted in the form of fractions, decimals or percentages. Let's just express it in the form of fractions for now. The denominator is the total number of outcomes". "36. We figured that out earlier," Akito intervened.

Omar replied, smiling at Akito's eagerness, "Okay, so the denominator is 36. The numerator will be different for all of the digits between 2-12. It will be the number of sum pairs we found out earlier". "That makes sense!" said Amber. "Here is the probability for each number," Omar continued as he showed his friends his working on the sheet of paper.

Digit	Probability
2	$\frac{1}{36}$ X
3	$\frac{2}{36}$ X
4	$\frac{3}{36}$
5	$\frac{4}{36}$
6	$\frac{5}{36}$ → High
7	$\frac{6}{36}$ → Highest
8	$\frac{5}{36}$ → High
9	$\frac{4}{36}$
10	$\frac{3}{36}$
11	$\frac{2}{36}$ X
12	$\frac{1}{36}$ X

"Oh, so that's what you were scribbling down earlier!" Alicia realized. "Yep. As you can see, the probability of 2, 3, 11 and 12 is really low compared to 6, 7 and 8. Even though these numbers help us earn more Udits, the chance of them being rolled is rather slim. And if the block doesn't get rolled often, the house you make on that block wouldn't earn you as many Udits," Jack concluded.



Amber quickly applied the information she just learnt and reflected on why she didn't win, "Ohhhh, now I get why I wasn't getting many points from the house I put on 12! It's because 12 was hardly being rolled on the dice".

"Let's play another round of this," Akito said excitedly. Omar asked "What about the horror movie we had decided to watch?" Alicia agreed with Akito, "This game is a lot of fun, let's just play another round of this". Amber nodded

in agreement, "Yes, yes! I am sure I will win, now that I know the winning strategy!" "Playing isn't just about winning or losing, it's about taking part and having fun. It'll be so much better now that we are all on the same page!" Omar replied with a grin, "Also, the thing to remember about probability is that it just gives likelihood and not a guarantee. So, it is not necessary that the dice will land only on the most probable numbers, it is just more likely to happen compared to the other numbers".

"Aren't we forgetting something?" Akito winked at the two girls, pointing towards the crown. Amber realized, "Oh yes! Time to crown Omar as the king!" Omar gave his broadest smile, grinning from ear to ear as his three friends crowned him as the ruler. "All hail King Omar!!" hooted Akito, Amber and Alicia in unison before all four of them doubled over with laughter.



The children played till late in the night, engaged in the wonderful game of Probylon, The Lost Realm.

Four friends are playing a board game - Probylon, The Lost Realm during a sleepover. One of them won the game by applying a rather unusual strategy. In their quest to be crowned as the ruler of Probylon, they learn an exciting new mathematical concept. Join them in uncovering the truth about this master plan while earning and spending Udits along with building houses!



About the author

I am Navya Agarwal, a 12 year old grade 7 student at Oberoi International School, JVL, Mumbai. I am an avid reader who loves math, playing board games and all things arty. I had a lot of fun writing the story as it stretched my imagination to craft a board game of my own. I experimented with combining digital medium and coffee painting for making the background and game board to give the feel of a lost realm. I wrote this story to help readers understand Probability because it is a mathematical concept that really interests me.