

# Jain Mathematics Tournament

Season Two



*A Young Jains of America Initiative*

If anything in these problems has offended you or gone against the teachings of Bhagwan Mahavir, we sincerely ask for forgiveness. Micchami Dukkadam.

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## Problem 1

According to Jainism, the maximum time a living being can focus on a single thought (*dhyana*) is one *muhurta* (48 minutes or  $2^{24}$  *avalikas*). However, the meditation can be resumed after every 48 minute interval. **Assume for this problem that the break between every period of one *muhurta* is one *avalika* (miniscule time unit).**

Now let us suppose there is a fictional monk named *Arhum Swami* who is preparing to enter a *samadhi* state (superconscious state) for a period of continuous *sadhana* (spiritual practice) for  $2^{35}$  *avalikas*. Assume *Arhum Swami* always exhausts the full one *muhurta* period and takes no breaks besides the 1 *avalika* pause. Now suppose the *resting heart rate* of *Arhum Swami* is initially 60 bpm and decreases by 2% every minute of meditation, but stays constant during the 1 *avalika* pause. **What is the total number of heart beats during the entire period of continuous *sadhana*?**

### Problem 1 Clarifications

- For fractional heart rates ( $< 1$  bpm), you don't need to worry about the exact time the heart will beat. You should focus on computing the value that the total number of heart beats **approaches**.
- Assume the heart rate stays constant throughout each minute and drops immediately by two percent at the next minute.

### Further Reading

- Tattvartha Sutra - Chapter 9, Lines 27 and 28

## Have questions or concerns?

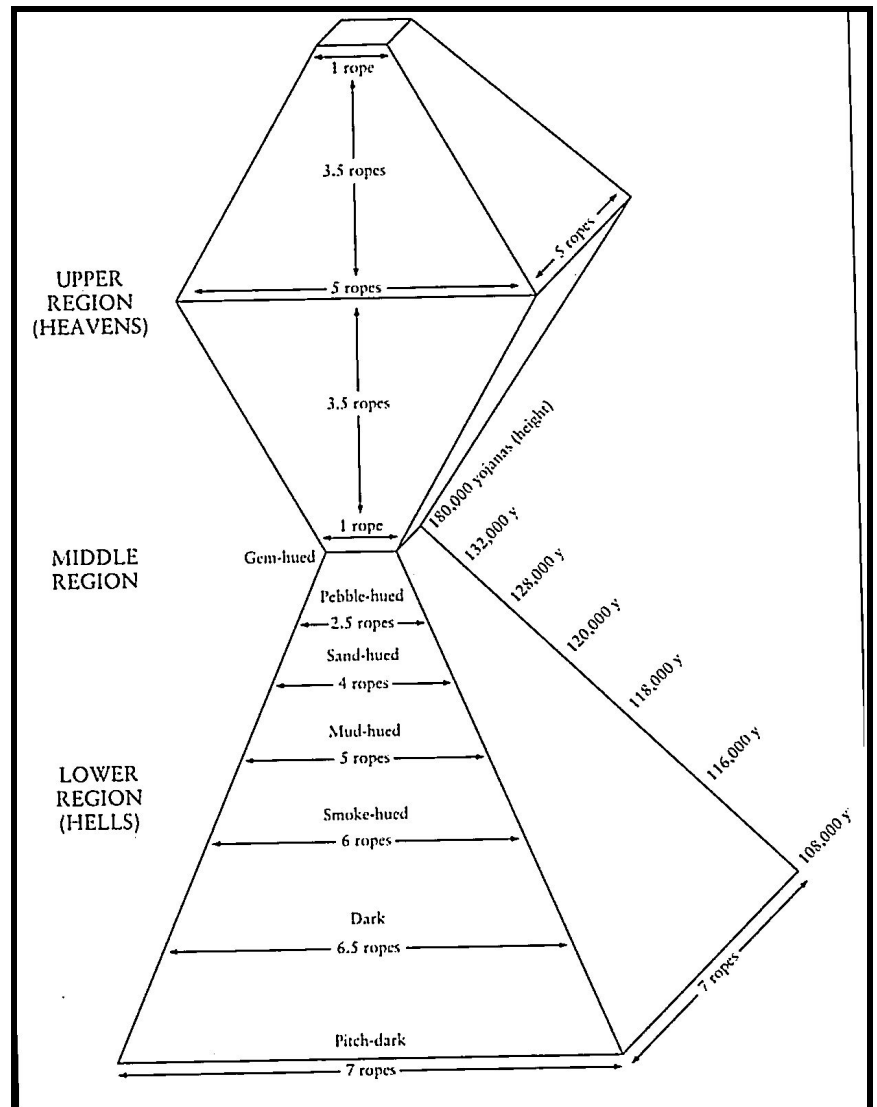
Please contact Anish Visaria at [jmt@yja.org](mailto:jmt@yja.org) if you have any further questions.

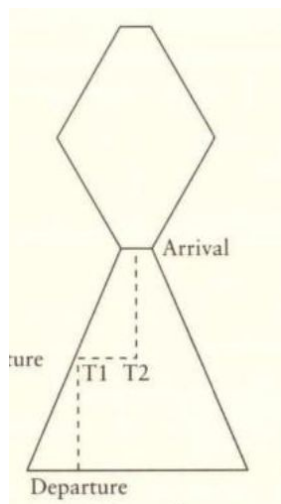
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## Problem 2

One of the most interesting parts of Jainism is the idea of *transmigration*. *Transmigration* is when the soul leaves the current body, that has exhausted its lifespan, and travels to its new body. However, there are several rules recorded as to how a soul may transmigrate. We will only look at two rules in this problem: **(1) a soul can only move in a straight line along the rows of the space units (x-y-z plane) when travelling between regions** and **(2) the worldly soul may make up to three turns during transmigration**. The following

image represents the Jain universe as per the description in the *Tattvartha Sutra*. The lengths are measured in *ropes* or *rajjus*, an extremely large astronomical unit. Now let us suppose there is a soul that is currently on the bottom of the lowest *narak* (pitch-dark hell) that will transmigrate to the exact center of the middle region. If this soul makes **exactly two** turns in transit, then it would first go directly up and turn once after hitting the *transcosmic boundary* of the lower region. When making the first turn, the soul will move in a straight line to a location directly underneath the center of the middle region (in this case). Then the soul's second turn will take the soul directly up to its destination. This is illustrated in the figure below.





It is important to note that the **soul can travel freely when travelling within a realm (cross-section), but it will always be optimal (straight-line)**. This is demonstrated when this soul makes the first turn toward the center (underneath the destination).

Given this information, assume there is some other soul that travels exactly as described making two turns, travelling from the depths of the pitch-dark hell to the center of the middle region. **If this soul can start at any point along the base of the lowest hell, what is the maximum possible distance the soul can travel to its destination (center of middle region) making exactly two turns?**

### Problem 2 Clarifications and Tips

- Determine the value that this maximum possible distance approaches, if there is no definitive maximum case (this shouldn't require calculus).
- The soul will always travel in a straight line when in transit with minimal turns, including when travelling within a realm (cross-section). This means the soul can travel diagonally within a realm, but must travel along the rows of space when going up and down the regions.
- The total volume of the Jain universe is 343 cubic ropes (or *rajjus*).
- In the diagram of the Jain universe, you can ignore the distances in yojanas on the side (they are describing the depths of each sub-universe).

### Further Reading

- Tattvartha Sutra - Chapter 2, Lines 26 to 31

## Have questions or concerns?

Please contact Anish Visaria at [jmt@yja.org](mailto:jmt@yja.org) if you have any further questions.

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## Submission

The submission link is [http://bit.ly/jmtsubmissions\\_s2](http://bit.ly/jmtsubmissions_s2). You must submit your work along with your answer for your submission to be counted. Remember, only the **FIRST** perfect submission will be awarded, so it is advised to submit as soon as you solve the problems.

**Submission Deadline: Sunday, March 29th @ Midnight EST**

## Guidelines

- You are free to use any resources, **but the thinking must be done by you.**
- Collaboration is not allowed and will result in disqualification.
- Please submit work that is legibly handwritten or typed.
- Anyone is welcome to work on the questions, but to be eligible for an award you must be between 14 and 29 years old, and not an active member on the YJA Executive Board or Convention Committee.

## Scoring & Awards

- All problems are weighted equally in the tournament, unless otherwise stated.
- The **FIRST** person to submit a perfect submission (correct answers to both problems) will be eligible to receive an Amazon gift card.
- The top non-zero scorers (ties broken by the time of submission) will be recognized on YJA social media channels.

## References

- *That Which Is*, Umāsvāti, Nathmal Tatia (1994, HarperCollins Publishers)
  - *Tattvartha Sutra*, Umāsvāti, Manu Doshi (2007, JAINA)
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