4.4 Ramanujan

1. Discuss orally in your class.

In what subjects is knowledge of mathematics used, at school level and college / university level ? Name them.

Did you know maths is used in music and poetry also? Can you tell how?

2. Use the letters in the word MATHEMATICIAN to make 4 letter / 5 letter and 6 or more letter words, within a time limit fixed by your teacher.

3. Sentences can be classified into three types – Simple, Complex and Compound.

- **A Simple Sentence is one that has only one Subject and one Predicate. It has only one Finite verb.**

   For example : She **went** home.

   In the morning, near my school I **saw** a snake.

- **A Complex Sentence consists of one Main Clause and one or more Dependent or Subordinate Clauses.**
   For example : She **went** home, after school **was** over.

   The boys **found** the book that **had been** lost.

- **A Compound Sentence consists of two or more Independent or Co-ordinate Clauses. They are joined by Co-ordinators.**
   For example : and, but, so, or, for etc.

   (a) He finished his work **and** he left his office.

   (b) He is poor **but** he is honest.

- **From the lesson 4.2 pick out one example of each of the following.**

   Simple Sentence : ....

   Complex Sentence : ....

   Compound Sentence : ....

Ramanujan

One morning early in 1913, Hardy found, among the letters on his breakfast table, a large untidy envelope decorated with Indian stamps. When he opened it, he found sheets of paper by no means clean, on which, in a non-English script, were line after line of symbols. Hardy glanced at them without enthusiasm.

He felt, more than anything, bored. He glanced at the letter, written in halting English, signed by an unknown Indian, asking him to give an opinion of these mathematical discoveries. The script appeared to consist of theorems, most of them, wild or fantastic looking, one or two already well-known, laid out as though they were original. There were no proofs of any kinds. Hardy was not only bored, but also irritated. It seemed like a curious kind of fraud. He put the **manuscript** aside and went on with his day's routine.

After lunch he **loped off** for a game of real tennis in the university court. (If it had been summer, he would have walked down to Fenner's to watch cricket.) In the late afternoon, he strolled back to his rooms. That particular day, though, while the timetable wasn't **altered**, internally things were not going according to plan. At the back of his mind, getting in the way of his complete pleasure in his game, the Indian manuscript **nagged away**. Wild theorems. Theorems such as he had never seen before, nor imagined. A fraud of genius? A question was forming itself with **epigrammatic clarity**: is a fraud of genius more probable than an unknown mathematician of genius? Clearly the answer was no. Back in his rooms in Trinity, he had another look at the script. He sent word to **Littlewood** (probably by messenger, certainly not by telephone, for which, like all mechanical **contrivances** including fountain pens, he had a deep distrust) that they must have a discussion **after hall**.

Before midnight they knew, and knew for certain. The writer of these manuscripts was a man of genius. That was as much as they could judge, that night. It was only later that Hardy decided that Ramanujan was, in terms of natural mathematical genius, in the class

of **Gauss** and **Euler** : but that he could not expect, because of the defects of his education and because he had come on the scene too late in the line of mathematical history, to make contribution on the same scale.

The following day Hardy went into action. Ramanujan must be brought to England, Hardy decided. Money was not a major problem. Trinity had usually been good at supporting unorthodox talent (the college had been the same for **Kapitsa** a few years later). Once Hardy was determined, no human agency could have stopped Ramanujan, but they needed certain amount of help from a superhuman one.

Ramanujan turned out to be a poor clerk in Madras (Chennai), living with his wife on twenty pounds a year. He was usually strict about his religious observances, with a mother who was even stricter. It seemed impossible that he could break the ban and **cross the water**. Fortunately his mother had the highest respect for the goddess of **Namakkal**. One morning Ramanujan's mother made a **startling** announcement. She had a dream the previous night, in which she saw her son seated in a big hall among a group of Europeans and the goddess of Namakkal had commanded her not to stand in the way of her son fulfilling his life's purpose. This, say Ramanujan's Indian biographers, was a very agreeable surprise to all concerned.

In 1914, Ramanujan arrived in England. So far as Hardy could detect (though in this respect I should not trust his **insight** far) Ramanujan, despite the difficulties of breaking the caste laws, did not believe much in **theological doctrine**, except for a vague **pantheistic benevolence**, any more than Hardy did himself. But he did certainly believe in ritual. When Trinity put him up in college within four years he became a fellow. There was no ''**Alan St. Aubyn**'' **self-indulgence** for him at all. Hardy used to find him ritually changed into his pyjamas, cooking vegetables rather miserably in a frying pan in his own room.

Their association was a strangely touching one. Hardy did not forget that he was in the presence of a genius, but genius that was, even in mathematics, almost untrained. Ramanujan had not been able to enter Madras (Chennai) University because he could not matriculate

What did the two English Mathematicians realise by midnight?

Gauss : German mathematician

Euler : Swiss Mathematician

What were the two drawbacks in Ramanujan's career?

Kapitsa : Soviet physicist and Nobel Laureate

What superstition did Ramanujan's mother believe in?

cross the water : travel across the sea / ocean

Namakkal : district in Tamilnadu

startling : surprising

What surprised everyone, one morning?

insight : deep understanding

theological doctrine : set of beliefs about God and religion

pantheistic benevolence : an attitude of mind to do kind things, born out of many Gods

Alan St. Aubyn : Fellow of Trinity

self-indulgence : doing something for one's own pleasure and satisfaction

amiable : pleasant and friendly

baffling : strange and difficult

come to terms with : accept gradually

rigour : harsh, difficult condition or concepts

sentimental : full of emotions

ironic : opposite of what is expressed

What did Hardy have to teach Ramanujan?

Why does he call it an unusual experience?

a Fellow : an award, title and honour given by the Royal Society (England)

conveyance : (here) a vehicle

Can you work out the sum of cubes in two different ways which equals 1729?

What is exceptional about the number 1729?

in English. According to Hardy's report, he was always **amiable** and good-natured, but no doubt he sometimes found Hardy's conversation outside mathematics more than a little **baffling**. He seems to have listened with a patient smile on his good, friendly, homely face. Even inside mathematics they had to **come to terms with** the difference in their education. Ramanujan was self-taught : he knew nothing of the modern **rigour**, in a sense he didn't know what a proof was. In an uncharacteristically **sentimental** moment, Hardy once wrote that if he had been better educated, he would have been less 'Ramanujan'. Coming back to his **ironic** senses, Hardy later corrected himself and said that the statement was nonsense. If Ramanujan had been better educated, he would have been even more wonderful than he was. In fact, Hardy was obliged to teach him some formal mathematics as though Ramanujan had been a scholarship candidate at Winchester. Hardy said that this was the most singular experience of his life. What did modern mathematics look like to someone who had the deepest insight, but who had literally never heard of most of it ?

It is good to remember that England gave Ramanujan such honours as were possible. The Royal Society elected him **a Fellow** at the age of thirty (which, even for a mathematician, is very young). Trinity also elected him a Fellow in the same year. He was the first Indian to be given either of these distinctions. He was amiably grateful. But he soon became ill.

Hardy used to visit him, as he lay dying in hospital at Putney. It was on one of those visits that there happened the incident of the taxi-cab number. Hardy had gone out to Putney by taxi as usual, his chosen mehod of **conveyance**. He went into the room where Ramanujan was lying. Hardy, always clumsy about introducing a conversation, said, probably without a greeting and certainly as his first remark : "The number of my taxi cab was 1729. It seemed to me rather a dull number." To which Ramanujan replied : "No, Hardy !

It is a very interesting number : It is the smallest number expressible as the sum of two cubes in two different ways".

It was difficult, in war-time, to move Ramanujan to a kinder climate. He died of tuberculosis, back in

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Madras (Chennai), two years after **the war**. As Hardy wrote in the *Apology*, his roll-call of mathematicians : '**Galois** died at twenty-one. **Abel** at twenty-seven, Ramanujan at thirty-three, **Riemann** at forty. I do not know an instance of a major mathematical advance **initiated** by a man past fifty'.

- **the war :** World War I (1914-18)
- **Galois :** French mathematician
- **Abel :** Norwegian mathematician
- **Riemann :** German Mathematician
- **initiated :** started

◆ *Name all the famous mathematicians mentioned in this write-up.*

ENGLISH WORKSHOP

1. **(A) Use the following words / phrases to make sentences of your own.**

   - enthusiasm
   - lope off
   - fraud
   - clarity
   - amiable
   - come to terms with
   - conveyance

   (B) The following words can be used as Nouns as well as Verbs.

   (Visit / honour / report / watch / form / surprise.)

   Make pairs of sentences of your own, using them as a Noun in one and as a Verb in the other.

   For example : (i) She gave a <u>smile</u> – Noun.

   (ii) Babies <u>smile</u> when they see their mother – Verb.

2. **Say WHY. . . . . .**

   (a) Ramanujan's letter bored and irritated Hardy, at first.

   (b) Hardy invited Littlewood for a discussion.

   (c) Mother agreed to send Ramanujan to England.

   (d) Hardy and Ramanujan could not talk freely with each other.

   (e) Ramanujan had to be hospitalized.

   (f) Ramanujan found the number 1729 very interesting.

3. **Read the text and enlist the achievements and honours of Ramanujan, received in England.**

4. Voice - Active and Passive

The form of a verb shows whether the doer of an action is in the Subject (Active voice) or the Subject has an action done to it (Passive voice).

For example : The thief stole the jewels. (Active voice).

The jewels were stolen by the thief. (Passive voice)

Note : While changing from the Active to the Passive voice, the verb form includes be + past participle.

In a sentence, when the doer of an action is significant, we use the Active voice. In the Passive voice the doer of an action may not be mentioned.

For example : The thief was caught. (*by the police*)

(A) Underline the verbs in the following sentences and state whether the sentences are in the Active or the Passive voice.

(a) England gave Ramanujan great honours.

(b) A large untidy envelope was decorated with Indian stamps.

(c) The timetable was not altered.

(d) She saw her son in a big hall.

(e) Hardy corrected his statement.

(f) Ramanujan was brought to England.

(B) Change the voice in the following sentences.

(a) Hardy taught Ramanujan.

(b) He knew nothing of the modern rigour.

(c) Sheets of paper were found in it, by Hardy.

(d) Hardy was bored by that manuscript.

(e) Trinity supported unorthodox talent.

(f) He could not break the ban.

5. Identify whether the following are Simple, Complex and Compound sentences.

(a) When he opened it, he found sheets of paper.

(b) He glanced at a letter.

(c) Hardy was not only bored but he was also irritated.

(d) Ramanujan turned out to be a poor clerk.

(e) If Ramanujan had been better educated, he would have been even more wonderful than he was.

(f) Ramanujan was self-taught : he knew nothing of the modern rigour.

6. **Interview Question.**

   A brilliant student from your school has won a Mathematics Quiz at the National Level.
   Frame questions to interview him / her when the school felicitates him / her. Follow the steps given below.

   (1) Greeting

   (2) Introduction of the interviewee and achievements

   (3) 2 or 3 questions about the growing years

   (4) 4 to 6 questions about the achievements

   (5) 2 or 3 questions about future plans and prospects

   (6) Expression of thanks and good wishes

7. **Summary**

   - **Read the first three paragraphs on Page 92. (From......... 'One morning .... upto .... a discussion after hall)**

   - **Re-read the same noting down only the important points.**

   - **Rewrite the important points in your own simple language, in you notebook.**

   - **Make certain that your summary is less than half the length of the original passage.**