$$f(a,b) \equiv \sum_{n=-\infty}^{\infty} a^{n(n+1)/2} + b^{n(n-1)/2}$$

$$\sqrt{\frac{e^x \pi}{2x}} = 1 + \frac{x}{1 \times 3} + \frac{x^2}{3 \times 5} + \frac{x^3}{3 \times 5 \times 7} + \frac{x^4}{3 \times 5 \times 7 \times 9} + \cdots$$

Srinivasa Ramanujan
(1887 - 1920)

"Our country has produced only one mathematician of the first rank after Bhaskaracharya eight hundred years ago. This was Ramanujan and he was unable to pass even the first year of college. India gave him birth, starvation, tuberculosis, and a premature death. It is to the everlasting credit of the English mathematician Hardy that he recognized the merit of one who was considered half made by the Indians, had him brought in England, trained him, and brought out his splendid ability."
–D. D. Kosambi

The life story of this Indian genius, who won worldwide fame in mathematics despite his poor family background and lack of formal education, is legendary among professional mathematicians.

Ramanujan was born on 22 December 1887 in Erode, about 400 km from Madras. His father Srinivasan was a low-paid clerk in a sari shop. The family was poor. Even the necessities of everyday life were hard to come by. His mother, Komalathammal was strong willed and determined to see her son come up in life. From her Ramanujan imbibed the deep spirituality that characterised his adult life. He was raised in nearby Kumbhakonam, which was his mother's native place.
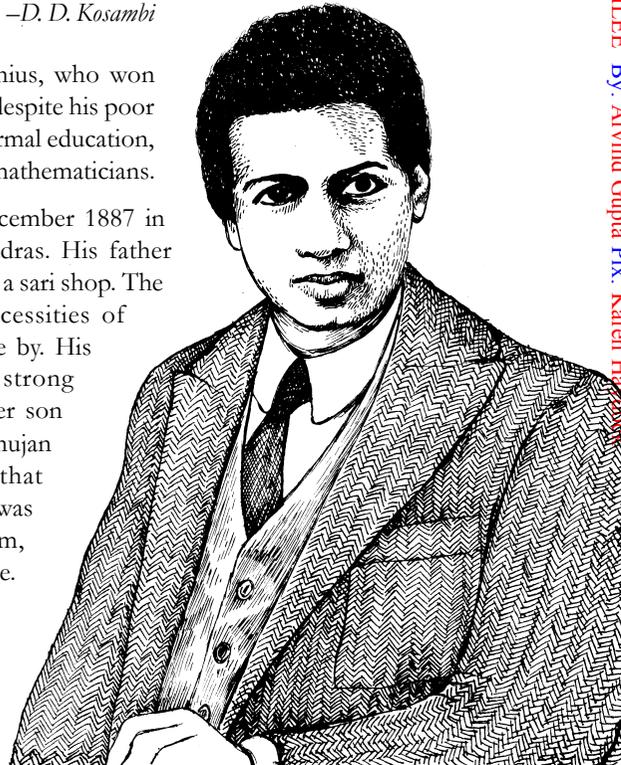
His mathematical talent began manifesting itself when he was about ten. He could learn the subject effortlessly by himself and even clear the doubts of students much senior to him. In high school, he studied G. S. Carr's *A Synopsis of Elementary Results in Pure Mathematics.* This book later became famous in the mathematical world because it influenced Ramanujan's unique style of jotting down his results, without explaining his methods. He later attended college hoping to pass the exam required to enter the University of Madras. But he was so absorbed in mathematics that he neglected other subjects and failed the exam. He never earned a bachelor's degree.

The next few years were really miserable for Ramanujan. He tried his hand at giving private tuitions. But he did not even succeed in this. While teaching mathematics he would jump several steps and lapse into higher reaches of the subject. The students found him utterly incomprehensible, though they respected him for his obvious genius. This phenomenon plagued Ramanujan all his life. His originality was beyond the pale of most mathematicians. They always wondered whether he was a genius or just a clever poser!

The famous *Notebooks of Ramanujan* had their origin in this period. He had a particular fascination for numbers. Every rational number was his friend. He did not realise the need for rigorous proof, which was the forte of Western mathematics. His genius was an intuitive genius. He would arrive at the final solution with a prodigious mental leap but would not care to set down the steps to the solution. Two generations of mathematicians have pored over his note books, trying to prove his formulations. Even now they have not been fully worked out.

Ramanujan was by now over twenty, and in the eyes of his elders 'shiftless and lost in a world of his own'. His mother resolved to infuse "responsibility" into him by the classic Indian method - she decided to get him married! Since implicit obedience to elders was then the rule, Ramanujan married Janaki Ammal, eleven year his junior on 14 July 1909. This forced him to seek a job to support his family. In 1912, he found a clerk's
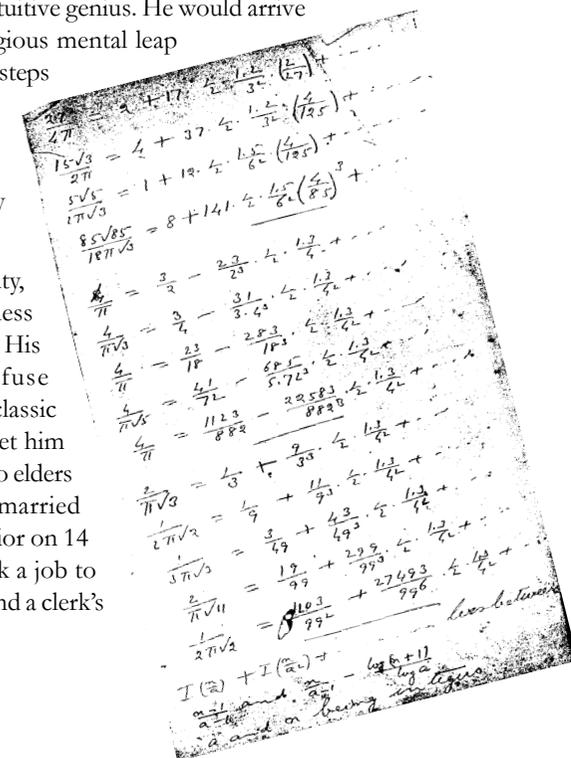
position in the accounts section of the Madras Port Trust. Its chief accountant Narayana Rau, was a mathematician. Both he and Sir Francis Spring, the chairman of the Port Trust, took a keen interest in Ramanujan's mathematical talents.

$$\frac{\sqrt{\ln x}}{x} S(x)$$

The famous Landau Ramanujan constant,
K = 0.7642236535892206629906987...
The equation, as shown here, is very, very slow to approach K!

Ramanujan sent his work to mathematicians in England for evaluation. But given his lack of formal education, he was not taken seriously and his letters *went largely ignored.* In 1913, however, Ramanujan sent an intriguing letter to G.H. Hardy, an eminent mathematics professor at Trinity College, Cambridge. In this letter, he listed about 120 mathematical theorems without showing the details of the proofs. *"I had never seen anything like them before,"* Hardy wrote later. "*A single look at them was enough to show that they could be written by a mathematician of the highest class. They must be true because, if they were not true, no one would have the imagination to invent them".* Hardy was deeply impressed and was instrumental in bringing Ramanujan to Cambridge for further study.

Initially Ramanujan's deeply religious family objected to his crossing the seven seas and going abroad. According to some, his mother had a dream in which the Goddess Namagiri commanded her not to stand in the way of her son's goals. Thereafter, the family relented and Ramanujan arrived at Cambridge in 1914. His research
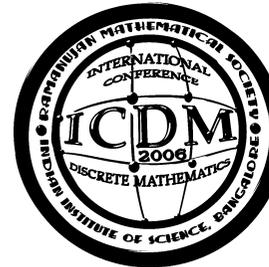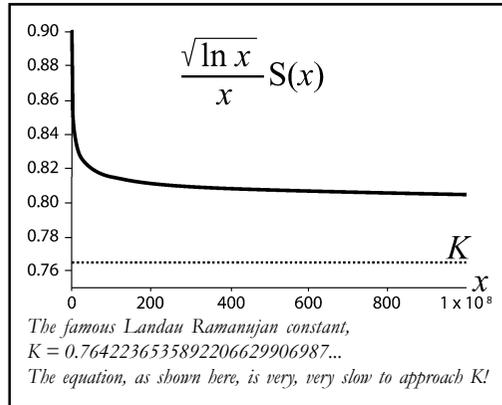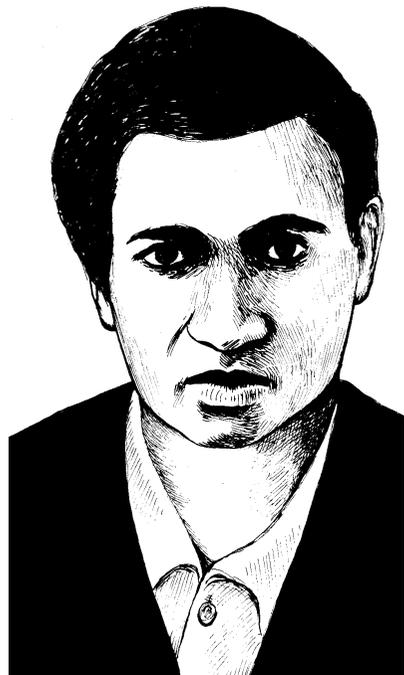
flourished and he published many exciting new results on topics such as the number theory, infinite series and indefinite integrals. One of the most spectacular results in mathematics is the Hardy-Ramanujan formula derived in 1917 for the number of partitions of an integer. A striking characteristic of Ramanujan's work is the mysterious mix of symbols and formulas. He believed that the Goddess Namagiri appeared in his dreams to guide and inspire his work.

Ramanujan was awarded a Bachelor of Science degree by Cambridge in 1916 and was made a Fellow of the Royal Society (FRS) in 1919. Being a strict vegetarian he would cook his own food. Perhaps due to the intense pressure of work and lack of a proper diet, he contracted tuberculosis in England and was admitted to a nursing home. Hardy visited him there and remarked, *"I thought the number of my Taxicab was 1729, it seemed to me a rather dull number."* 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."* Nowadays, this is referred to as *The Taxicab Problem* and integer solutions to the equation

$$i^3 + j^3 = k^3 + l^3$$

are called Ramanujan numbers. Many eminent mathematicians have devoted their lives trying to decipher Ramanujan's work from his notebooks.

Ramanujan returned to India in 1919 and died in Kumbhakonam the next year. He was richly lauded for his achievements. In 1962, the Indian Government issued a postage stamp commemorating his 75th birth anniversary.

A prize for young mathematicians from developing countries has been created in the name of Ramanujan by the International Centre for Theoretical Physics (ICTP), in cooperation with the International Mathematical Union, who nominates members of the prize committee.