

Prelims 1 Answer Key:

Section 1

- 1) Indian Institute of Science (IISc) Bangalore, Satish Dhawan **(1 mark+1 mark)**
- 2) Shanti Swarup Bhatnagar/ Bhatnagar Prize **(1 mark)**
- 3) Leonardo Da Vinci/ Da Vinci **(1 mark)**
- 4) Stalactites and Stalagmites (Stalactites- Downward growing and Stalagmites-Upward growing) **(1 mark+1 mark)**
- 5) Magnus Effect **(1 mark)**
- 6) Insulin, World Diabetes Day/ Diabetes Blue Circle **(1 mark+1mark)**
- 7) William Shakespeare and the Four moons of Jupiter **(1 mark+1 mark)**
- 8) James Webb Space Telescope/ James Webb **(1 mark)**
- 9) Tyndall Effect **(1 mark)**
- 10) Term: Painting the Mice, Scientist: William Summerlin **(1 mark+1 mark)**

Section 2

- 11) Double Moonbow (or Moonbow), Alexander's band **(1 mark+1 mark)**
- 12) Pythagoras Theorem **(1 mark)**
- 13) Wilson Greatbatch and Pacemaker **(1 mark+1 mark)**
- 14) X- Varicella Zoster, Y- Chicken Pox, Z- Ramsay Hunt Syndrome, Reason: Justin Bieber (He announced that he is affected with Ramsay Hunt Syndrome recently) **(0.5 marks +0.5 marks +0.5 marks +0.5 marks)**
- 15) A- Cardioid, B- Nephroid **(1 mark+1 mark)**
- 16) The Hindu-Arabic/ Arabic Numeral System **(1 mark)** or Numeral system/number system **(0.5 marks)**
- 17) Radium Girls **(1 mark)**
- 18) Sad Doll Disease/ Crying doll disease **(1 mark)**
- 19) A- Justine O Schmidt/ Schmidt, B- Pain **(1 mark+1 mark)**
- 20) JJ Thomson (He does not have an element in the Periodic table in his name, all others have) **(0.5 marks+0.5 marks)**

Section 3

- 21) Event: Merging of black holes, detected as gravitational waves by LIGO. (1 mark+1 mark)
- 22) Discovery of Bose Einstein Condensate, Satyendra Nath Bose (1 mark+1 mark)
- 23) Thistle flower and Encyclopedia Britannica (1 mark+1 mark)
- 24) Mandelbrot Set, Sea Horse Valley (1 mark+1 mark)
- 25) Belly Dance (Belly Dancer's Syndrome), Antoine Van Leeuwenhoek (1 amrk+1 mark)
- 26) Shakuntala, India's first private commercial imaging satellite. (1 mark+1 mark)
- 27) Genes of Drosophila (2 marks) or Drosophila (1 mark)
- 28) Travelling Salesman Problem (2 marks)
- 29) Victoria Boliviana (2 marks) or X-Victoria (1 marks) and Y-Bolivia or Boliviana (1 mark)
- 30) T-shirt plastic bags/covers (2 marks)

Detailed answers with explanations

Section 1:

1) Indian Institute of Science, Bangalore. Satish Dhawan.

The Indian Institute of Science (IISc) is a public, deemed research university for higher education and research in science, engineering, design, and management. It is located in Bengaluru, in the Indian state of Karnataka. The institute was established in 1909 with active support from Jamshedji and thus is also locally known as the "Tata Institute." It is ranked among the most prestigious academic institutions in India and has the highest citation per faculty among all the universities in the world. It was granted the deemed university status in 1958 and the Institute of Eminence status in 2018.

Satish Dhawan is a familiar name for all Indians due to the Satish Dhawan Space Centre at Srihari Kotta, Andhra Pradesh. He was a mathematician and aerospace engineer widely regarded as India's father of experimental fluid dynamics research. He was the third chairman of ISRO in 1972 and was the director of IISc during 1962-1981.



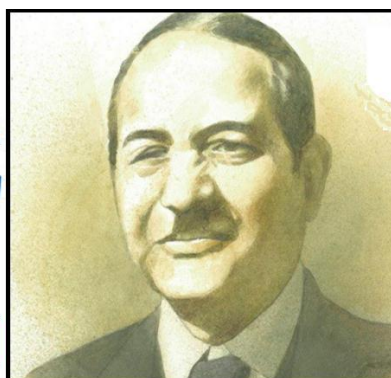
Satish Dhawan Space Centre and the Main Building of IISc are in the image.

2) Shanti Swaroop Bhatnagar Award.

The Shanti Swarup Bhatnagar Prize for Science and Technology is among India's highest multidisciplinary science awards. It was instituted in 1958 by the Council of Scientific and Industrial Research (CSIR) in honor of Shanti Swarup Bhatnagar, its founder director, and recognizes excellence in scientific research in India.

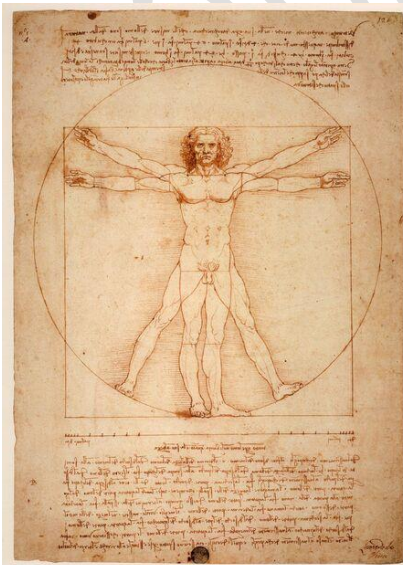
Sir. K.S Krishnan was the first recipient in the Physical Science category in 1958 and was the co-discoverer of Raman Scattering. Currently, this award is given in 7 categories.

Sir Shanti Swaroop Bhatnagar (February 21, 1894 – January 1, 1955) was an Indian colloid chemist and academic and scientific administrator. The first director-general of the Council of Scientific and Industrial Research (CSIR), he is revered as the "father of research laboratories" in India. He was the first Chairman of the University Grants Commission (UGC).



3) Leonardo da Vinci

Leonardo di ser Piero da Vinci (April 15, 1452 – May 2, 1519) was an Italian polymath of the High Renaissance who was active as a painter, draughtsman, engineer, scientist, theorist, sculptor, and architect. While his fame initially rested on his achievements as a painter, he also became known for his notebooks, in which he made drawings and notes on various subjects, including anatomy, astronomy, botany, cartography, painting, and paleontology.]



Famous works by Leonardo da Vinci; The Vitruvian Man and Mona Lisa respectively.

4) Stalactites and Stalagmites.



Stalactite and Stalagmites elongated forms of various minerals deposited from solution by slowly dripping water. A stalactite hangs like an icicle from the ceiling or sides of a cavern. A stalagmite appears like an inverted stalactite, rising from the floor of a cavern. They are basically mineral deposits that occur in regions devoid of many forms of weathering, allowing their growth.

5) Magnus effect



A cricket ball swings due to the Magnus effect. It occurs when there is a pressure difference on two diametrically opposite sides of the ball. This happens because of the wind velocity being in one direction and the ball having a motion in a manner such that the net velocity of the ball is high on one side and the newt velocity of the ball is low on the other. Via Bernoulli's principle, there develops a pressure difference that leads to a swing.

[Watch this video by Veritasium for an intriguing demo](#)

6) Insulin, third image is the diabetic blue circle.

You are familiar with the disease diabetes and the hormone insulin. Insulin is a hormone produced by the pancreas. This question sheds light on the efforts of two doctors in the 1920s, a milestone in modern medicine. The first image shows the dog's pancreas used for the experiments of extracting insulin and discovering its role in diabetes mellitus by Charles Best and Frederick Banding in 1921. The Nobel prize of 1923 in Medicine was awarded for the discovery of insulin.

The second image shows the notebook used for the experiments. The third image is the diabetic blue circle, a universal symbol to represent diabetes, and was introduced in 2006. November 14 is World Diabetes Day.



7) William Shakespeare and the 4 Moons of Jupiter.

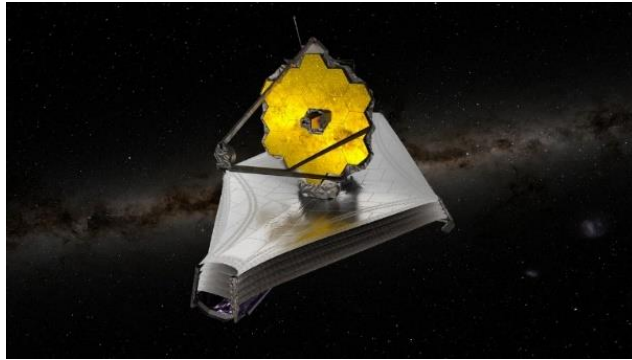
You do not need any description of the great William Shakespeare (Yes, he shares his birth year with Galileo). He is widely regarded as the most excellent playwright in the English language and the world's greatest dramatist. He is often called England's national poet and the "Bard of Avon."

There is a scene in his drama, Cymbeline where, Jupiter, the God, descends onto Earth and is surrounded by four little ghosts which is associated with the four moons of Jupiter, one of Galileo's first and greatest discoveries through the telescope.



8) James Webb Space Telescope

James Webb Space Telescope is a space telescope designed primarily to conduct Infrared astronomy. As the largest optical telescope in space, its vastly improved infrared resolution and sensitivity allow it to view objects too old, distant, or faint for the Hubble Space Telescope. This is expected to enable a broad range of investigations across the fields of astronomy and cosmology, such as observation of the first stars and the formation of the first galaxies and detailed atmospheric characterization of potentially habitable exoplanets. It is named after the former NASA administrator James. E. Webb leads into the controversy explained in the question. James Webb Space Telescope became famous after giving the deepest, sharpest infrared image of the universe to date.

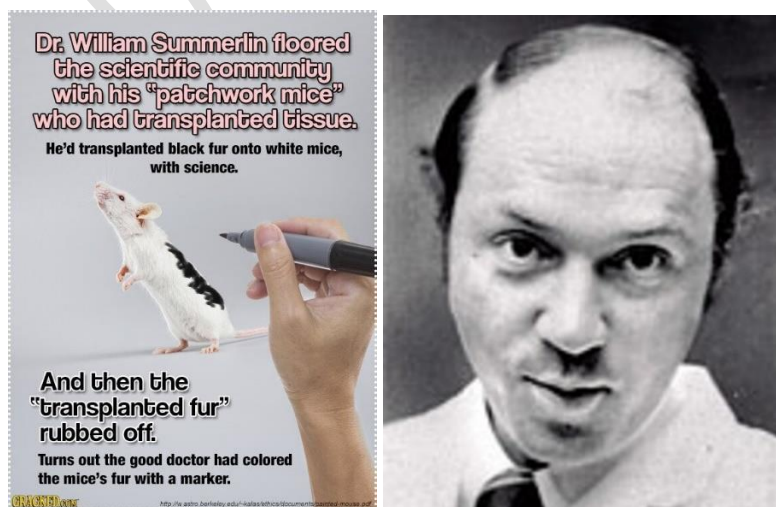


9) Tyndall effect



Did you ever notice the following phenomenon on a foggy morning? This is due to the Tyndall effect. The Tyndall effect is light scattering by particles in a colloid or a very fine suspension (e.g., Fog, Dust particles, etc.). This is named after John Tyndall, known for discovering the Greenhouse Effect. Tyndall effect is the principle responsible for blue eyes.

10) Painting the mouse and William Summerlin.



[Read the detailed story here](#)

Section 2:

11) Double Moon Bow and Alexander's Band

A moonbow or a lunar rainbow 'is a rare optical phenomenon caused when the light from the moon is refracted through water droplets in the air' On one of these days; people also spotted a double lunar rainbow called a 'moonbow' spread across the sky on a clear night.

The phenomena of a moonbow or a double moonbow generally occur in a sky with no pollution, a full moon when clouds pass by. The droplets in the cloud get refracted by the light coming from the moon, generating this phenomenon.

Alexander's Band: The dark band occurs due to the deviation angles of the primary and secondary rainbows. Both bows exist due to an optical effect called the angle of minimum deviation. The refractive index of water prevents light from being deviated at smaller angles. The minimum deviation angle for the primary bow is 137.5° . Light can be deviated up to 180° , causing it to be reflected right back to the observer. The light deviated at intermediate angles brightens the inside of the moonbow.

The minimum deviation angle for the secondary bow is about 230° . The fact that this angle is greater than 180° makes the secondary bow an inside-out version of the primary. Its colors are reversed, and light that is deviated at greater angles brightens the sky outside the bow.

Between the two bows lies an area of unlit sky referred to as Alexander's band. The light reflected by raindrops in this region of the sky cannot reach the observer, though it may contribute to a moonbow seen by another observer elsewhere.



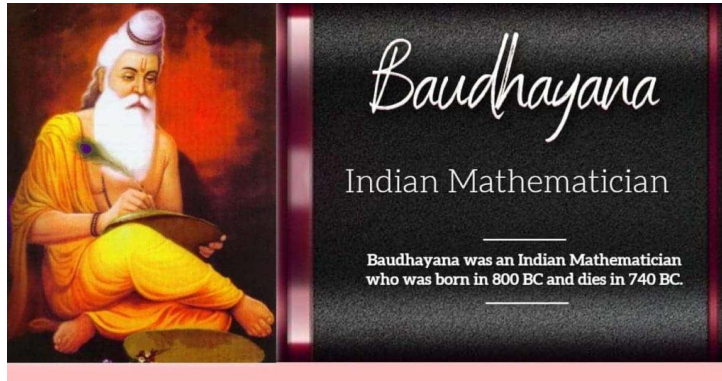
12) Pythagoras Theorem

We all know about this theorem, one of the most fundamental in Euclidean geometry. It is also, arguably, the theorem with the greatest number of mathematical proofs. The Boudhayana sulbasutra states:

*dīrghachaturasyākṣaṇayā rajjuh pārśvamānī, tiryagmānī,
cha yatprthagbhūte kurutastadubhayān karoti.*

A rope stretched along the length of the diagonal produces an area that the vertical and horizontal sides make together. The diagonal is the hypotenuse to the right triangle produced by the sides. So,

$\text{Diagonal}^2 = \text{Vertical}^2 + \text{Horizontal}^2$, equivalent to the modern formulation of the theorem.



13) The instrument is the Pacemaker, and the scientist-engineer involved is Wilson

Greatbatch. Greatbatch was a New York-based electrical engineer who pioneered lithium ion and mercury oxide-based batteries for artificial pacemakers. As described in the question, his discovery was based on serendipity - an electrical component was erroneously replaced in his machine to monitor heart sounds. Surprisingly, he found that the device now produced pulses similar to ideal heartbeats.

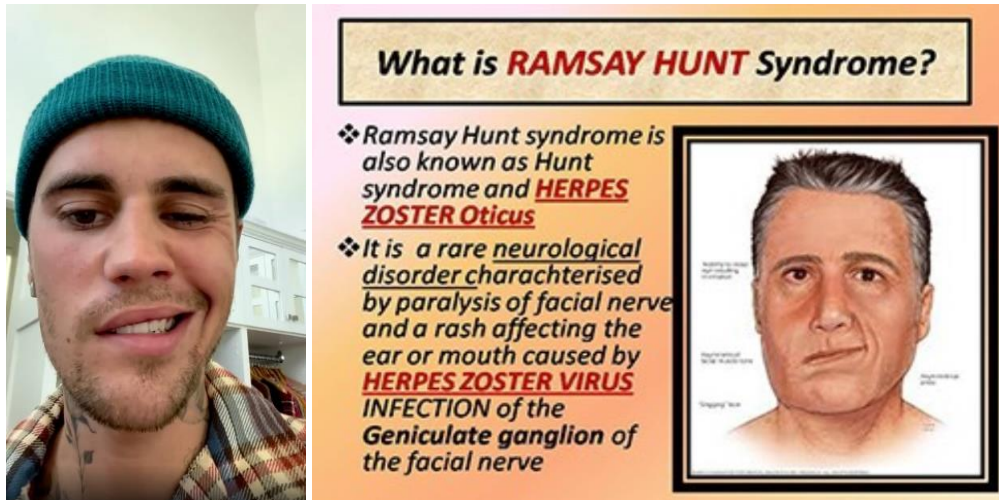
His medical corporation Greatbatch Inc. was a widespread producer of pacemaker batteries and was eventually taken over by Medtronic corporation of USA.



14) X- Varicella Zoster, Y- Chicken Pox, Z-Ramsay Hunt Syndrome; this became famous after Justin Bieber revealed he had been diagnosed with a condition called Ramsay Hunt Syndrome, which has fully paralyzed the right side of his face.

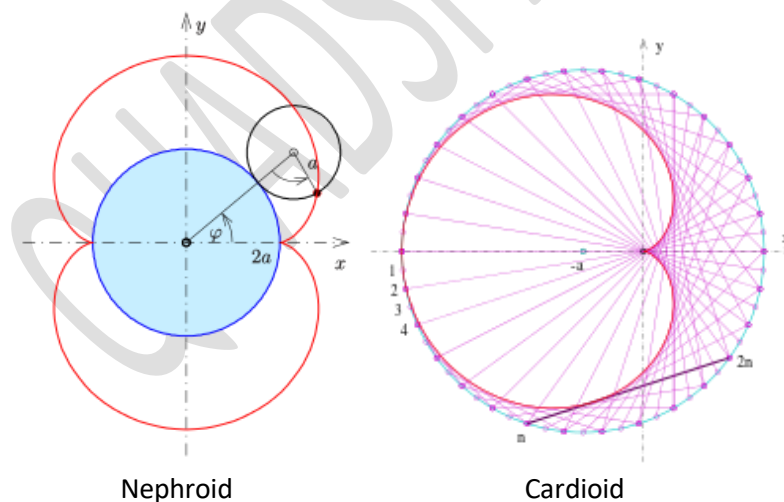
Ramsay Hunt syndrome was first described in 1907 by James Ramsay Hunt.

The varicella-zoster virus that causes Ramsay Hunt syndrome is the same virus that causes chickenpox and shingles. The virus is believed to infect the facial nerve near the inner ear in people with this syndrome. This leads to irritation and swelling of the nerve. The condition mainly affects adults. In rare cases, it is seen in children.



15) Cardioid (Heart) and Nephroid (Kidney).

The prefix Cardio- is related to the heart, and Nephro- is associated with the kidney.



16) The Hindu-Arabic/Arabic Numeral System.

The Europeans used the Roman numerals, which were for most of its history non-standardized, and only went up to 3999. Indian mathematicians invented them in the 6th or 7th century. They were introduced to Europe through the writings of Middle Eastern mathematicians, especially al-Khwarizmi and al-Kindi, about the 12th century.

0123456789

17) Radium girls



[Read their horrific story here](#)



18) Crying doll disease/Sad doll disease.

The disease is not something humans are afflicted by; rather, it is the Crying doll disease or Sad doll disease. In the 1990s, museum curators observed the limbs shriveling and yellowing, and red spots the size of coins starting to appear in dolls from the 1940s and 1950s. The reaction was later triggered by traces of cellulose, acetic acid (vinegar), and sulphuric acid in the polymer used to make the dolls. These contaminants, especially the acids, begin to dissolve the iron fixings present in the eyes of the dolls, forming iron salts which in turn catalyze the destruction of the polymer. This produces more acetic acid, which dissolves yet more iron, accelerating the progression of the disease and helping spread it to nearby dolls.

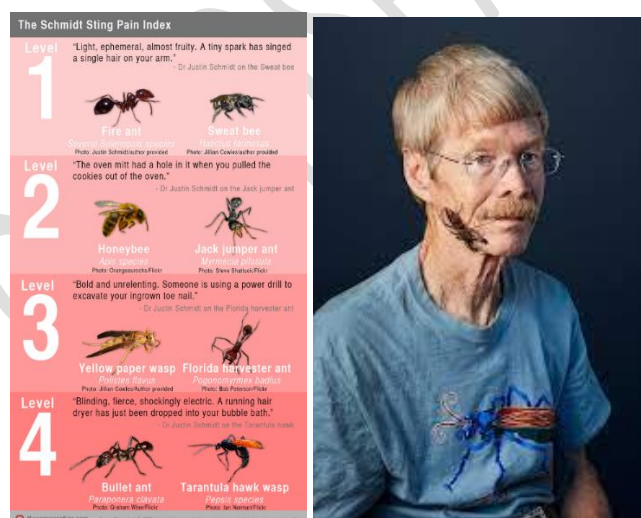


19) A - Justin O. Schmidt and B - Pain

Scientist A here is Justin O. Schmidt. A paper he published in 1983 had a table that included a column that rated the pain (B) from insect stings: within the order Hymenoptera. The ratings started at 0, which was for stings completely ineffective against humans, and went up to 4 for the most painful stings.

Dr. Schmidt refined the scale over time, with one of the most prominent in 1990, when he classified the stings of 78 species across 41 genera in the order Hymenoptera.

In September 2015, he was co-awarded the Ig Nobel prize in Physiology and Etymology alongside Michael Smith for their research on Hymenopterans.



20) JJ Thomson (He does not have an element in the Periodic table in his name. All others have)

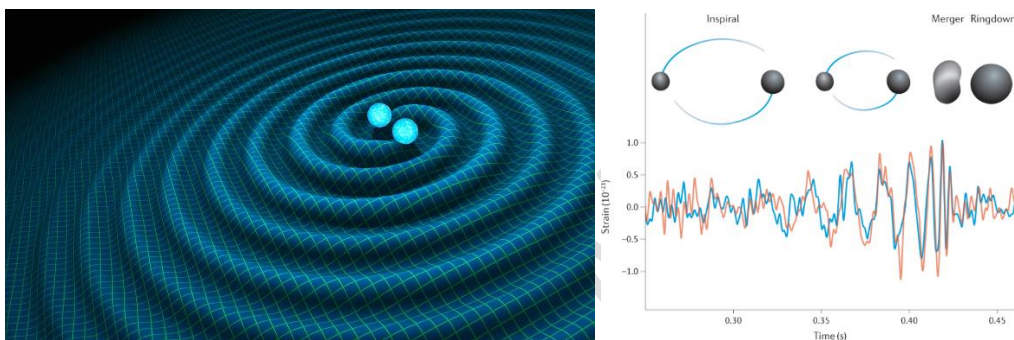
	Scientist	Element	Atomic Number	Symbol
A	Glenn T Seaborg	Seaborgium	106	Sg
B	Marie Curie	Curium	96	Cm
C	Lise Meitner	Meitnerium	109	Mt

Read more about these scientists. A question for you, **which among these elements got its name when the scientist was alive?**

Section 3:

- 21) Gravitational waves sent out from a pair of colliding black holes have been converted to sound waves, as heard in this animation.

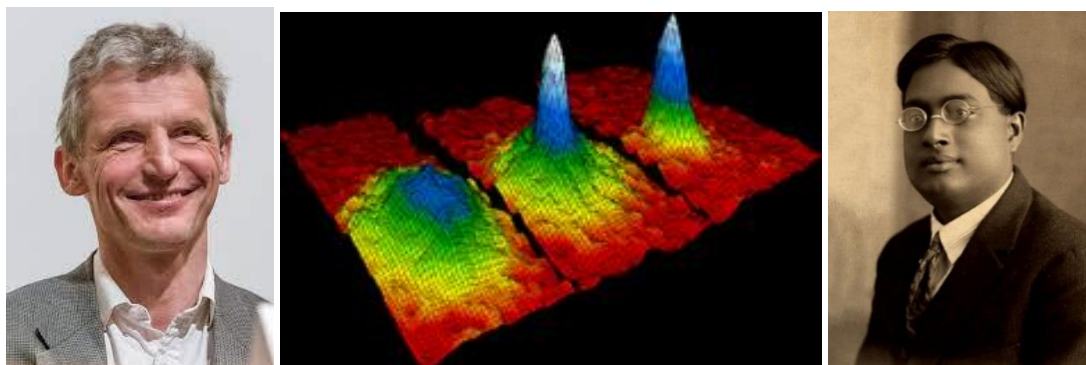
[Watch the video, read its description](#)



- 22) Discovery of Bose Einstein Condensate (5th state of matter) and Satyendra Nath Bose.

This is from a speech named "The Story of Bose-Einstein Condensate" by the Physics Nobel prize winner of 2011, Wolfgang Ketterle, at MIT. He explains his journey of discovering or practically realizing the Bose-Einstein Condensate. For this, he attained microkelvin temperature through LASER cooling techniques, and in 1995, they observed the presence of Bose-Einstein Condensate. He even said we observed the coldest matter in the universe. He mentions the theoretical contribution of Indian Physicists SN Bose and Albert Einstein, after whom this state of matter is named.

This speech details the struggles of a young scientist while searching for the mysteries in this universe. [Watch the full speech here.](#)



23) We are talking about the **thistle flower**.



It serves as the logo of Encyclopædia Britannica. Britannica is among the longest-running in-print encyclopedia in the English language.

The scientific apparatus is the thistle funnel. It consists of a shaft of the tube, with a reservoir and funnel-like section at the top, and is used to transfer exact quantities of liquid. It is commonly used in school laboratories to demonstrate osmosis.

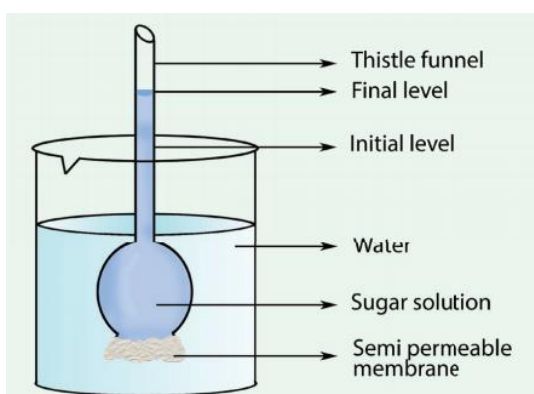
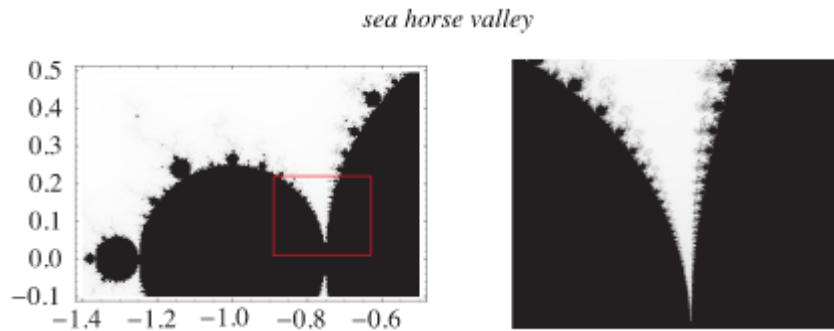


Figure 11.6: Thistle Funnel Experiment

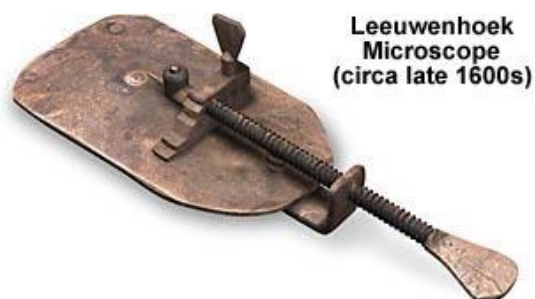
- 24) **Sea horse valley** is a name given to the portion of the **Mandelbrot set** cantered around $-0.75 + 0.1i$.



- 25) **Belly Dancer's Syndrome and van Leeuwenhoek.**

Belly dancer's dyskinesia (BDD) is an extremely rare manifestation consisting of involuntary and repetitive rhythmic movements of the abdominal wall. It was first described by Antoine van Leeuwenhoek in 1723 when he experienced the symptoms. Since then, various names have been proposed for this disorder, including Leeuwenhoek's disease, diaphragmatic myoclonus, diaphragmatic tremor, diaphragmatic flutter, and moving umbilicus dyskinesia, abdominal myoclonus, and respiratory myoclonus.

Antoine van Leeuwenhoek is known as "the Father of Microbiology" and one of the first microscopists and microbiologists. Van Leeuwenhoek is best known for his pioneering work in microscopy and his contributions toward establishing microbiology as a scientific discipline.



- 26) **Shakuntala satellite** (from Pixxel company). **India's first private commercial imaging satellite**



Indian startup Pixxel launches 'Shakuntala' satellite with Musk's SpaceX

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The famous Indian mentioned in the question is the human computer, Shakuntala Devi.



27) The connection is – these are the names of *Drosophila* genes:

- Halloween (set of genes causing abnormal exoskeleton development)
- Van Gogh (causes swirling of hair on the wing, like van Gogh's painting style)
- Swiss Cheese (the brain of mutants with holes, similar to Swiss Cheese)

[Read more about weird gene names in *Drosophila*.](#)

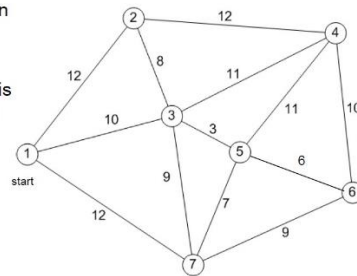
Drosophila melanogaster, or the fruit fly, is widely used as a model organism in genetic studies. This is due to their short life span, the smaller number of chromosome pairs, and easily distinct sexes.



- 28) **The travelling salesman problem** asks the following question: "Given a list of cities and the distances between each pair of cities, what is the shortest possible route that visits each city exactly once and returns to the origin city?". The problem was first formulated in 1930 and is one of the most intensively studied problems in optimization. It is used as a benchmark for many optimization methods.

The Traveling Salesman Problem

- The salesman must travel to all cities once before returning home
- The distance between each city is given, and is assumed to be the same in both directions
- Objective - Minimize the total distance to be travelled



- 29) **Victoria Boliviana (XY). Victoria Boliviana is the largest water lily in the world.**

Queen Victoria ruled the United Kingdom for 63 years. And Bolivia is a South American Country which is situated near the equator.

Specimens of this species have remained unrecognized as distinct entities for a long time, although they were present in collections. Bolivian seeds were donated to the Royal Botanic Gardens Kew in 2016. Based on this material, genetic studies were made, which resulted in recognition of this third Victoria species as a separate and distinct entity



- 30) **T-Shirt Plastic bag/ Covers.**

Sten Gustaf Thulin (1914–2006), a Swedish package designer, created the plastic shopping bag. Although most modern distributors refer to Thulin's design as the "T-shirt bag," it is unclear how the bag got its name. One explanation is that if you attempt to wear one, it looks and wears like a t-shirt with the sleeves cut off. Thulin specialized in package design and experimented with different materials to hold, ship, and preserve consumer goods. During the early 1960s, Thulin contemplated a convenient, aesthetically pleasing, and cost-effective way to carry goods from points A to B. The design he came up with was the "Bag with the handle of weldable plastic material."

The government announced National wide single-use plastic ban in India from July 1, 2022.



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