Fórmulas de parede de Leiden

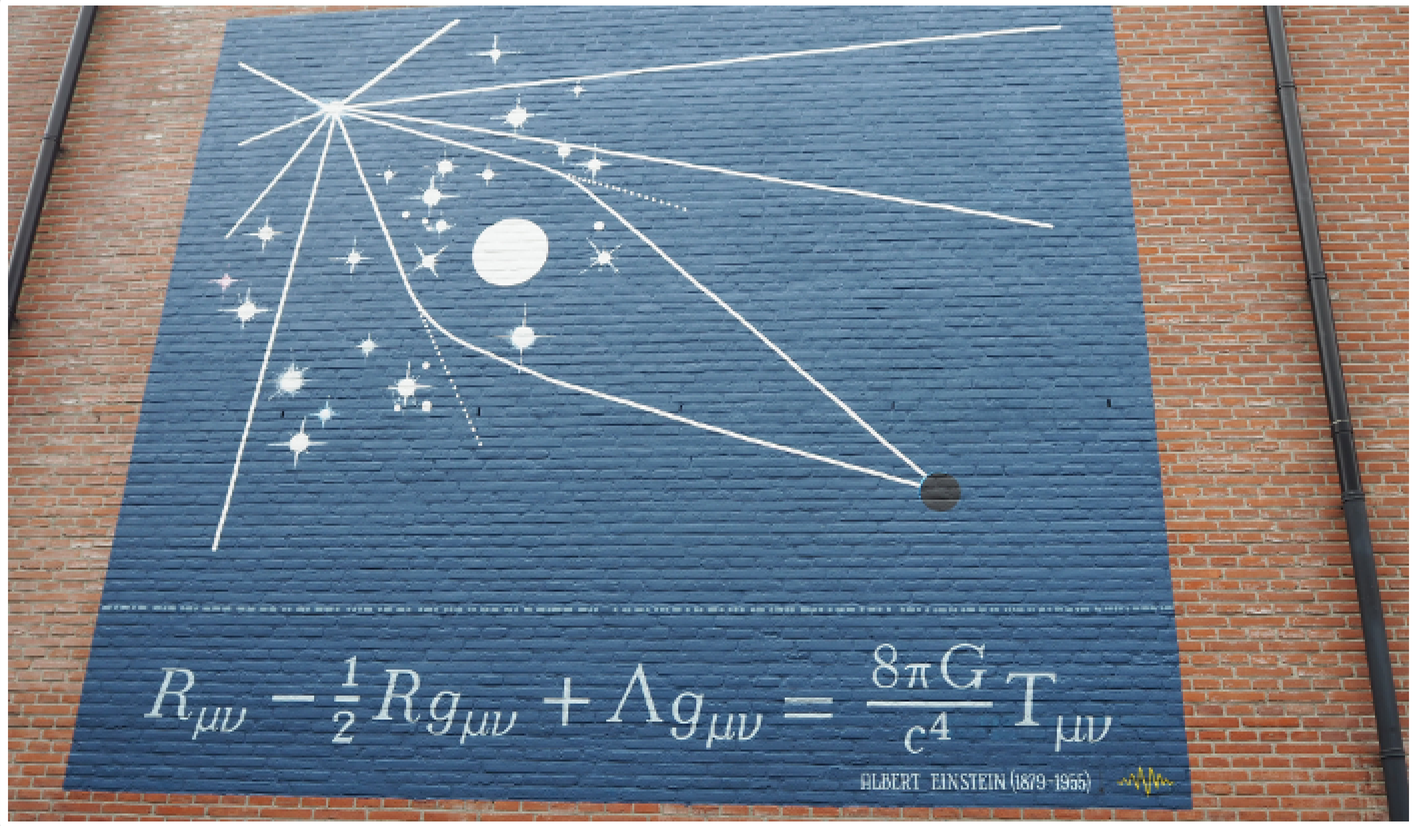
Leiden tem uma rica história de descobertas físicas. Por exemplo, Kamerlingh Onnes, Lorentz e Zeeman ganharam o Prêmio Nobel por suas descobertas de supercondutividade e o efeito Zeeman, enquanto a lei de Snell de refração, descoberta na década de 1600, foi incorporado em livros de estudo em todo o mundo. Os físicos Sense Jan van der Molen e Ivo van Vulpen, inspirados nos maravilhosos poemas de parede da fundação TEGENBEELD, no centro da cidade de Leiden, se esforçaram para que fórmulas famosas se exibissem nas paredes. Eles perceberam que você pode sentir a beleza de uma fórmula mesmo sem compreendê-la completamente, assim como sentimos o peso das palavras na poesia estrangeira, mesmo que possamos lê-los. Os artistas da TEGENBEELD uniram-se de todo o coração ao esforço, projetando e pintando ilustrações originais para cada fórmula. No final,o projeto envolverá cerca de dez fórmulas de parede, incluindo as sete que já estão em vigor.
Este projeto inspirou projetos de fórmula de parede em outras cidades, incluindo Utrecht. Ir para www.utrechtsemuurformules.com (https://muurformules.sites.uu.nl/) ver as fórmulas de parede de Utrecht.

Você pode fazer um passeio a pé por Leiden usando as fórmulas de parede como seu guia:

Áudio Tour

(https://izi.travel/en/7ee9-muurformules-leiden/nl)

Este projeto foi inspirado pelo Poemas de leiden wall (https://muurgedichten.nl/en) e é implementado pelos mesmos artistas da Stichting TECEN-BEELD.



(images/upgrade_muurformule.JPG)

Equação de campo de Einstein

Mapa

Albert Einstein (1879-1955)

Explicação: Einstein propôs que cada objeto (de uma maçã a um planeta) curva o espaço ao seu redor. Isso significa que os objetos se atraem - a famosa lei da gravidade - mas também dobram a luz. A luz estelar, portanto, passa por um corpo celeste pesado em um caminho curvo. A fórmula de Einstein - as chamadas equações de campo da teoria da relatividade geral - descreve como o espaço é deformado (lado esquerdo) por um objeto dentro desse espaço (lado direito). Wiki (https://en.wikipedia.org/wiki/Einstein_field_equations)

Componente leiden: Einstein era um professor extraordinário em Leiden e frequentemente residia aqui para colaborar com seus colegas de Leiden. Embora ele não tenha deduzido essa fórmula em Leiden, o terceiro componente - a constante cosmológica 'A' - é uma consequência direta das discussões com o professor de Leiden, Willem de Sitter.

(images/Snellius_zon.jpg)

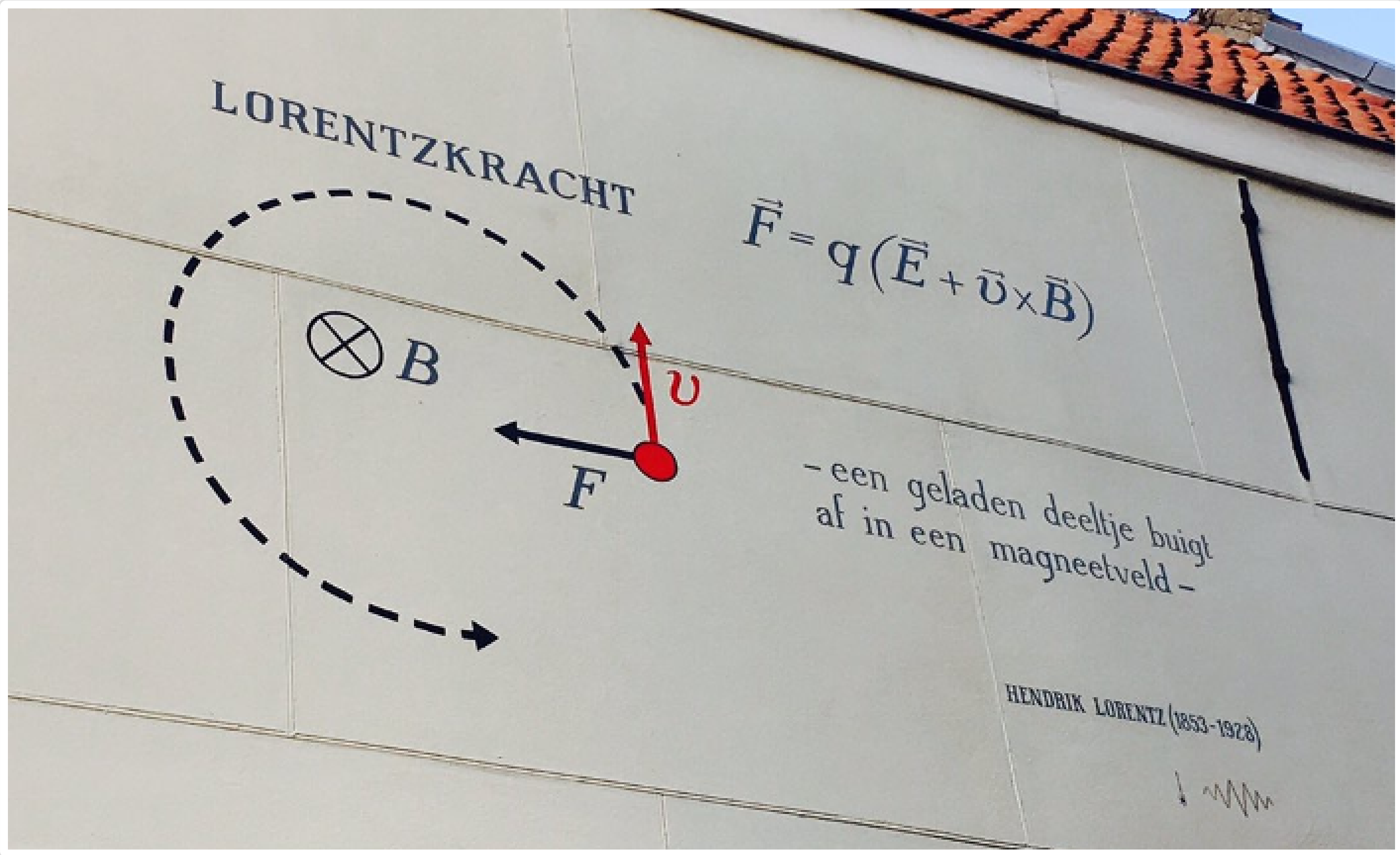
Lei de snell

Mapa

Willebrord Snel van Royen (Snellius) (1580-1626)

Explicação: Um raio de luz muda de direção na transição para um meio diferente, por exemplo, do ar para a água. Isso cria a ilusão de ótica de um canudo estalado em um copo de limonada. Os índices de quebra (n) dos respectivos meios determinam o ângulo (??) de deflexão. Wiki (https://en.wikipedia.org/wiki/Snell's_law)

Componente leiden: Snell era professor em Leiden. Ele fez pesquisas em várias disciplinas científicas, incluindo geometria e óptica. Ele usou a triangulação para medir a circunferência da Terra e desenvolveu sua famosa lei de refração.



(images/IMG_0273.JPG)

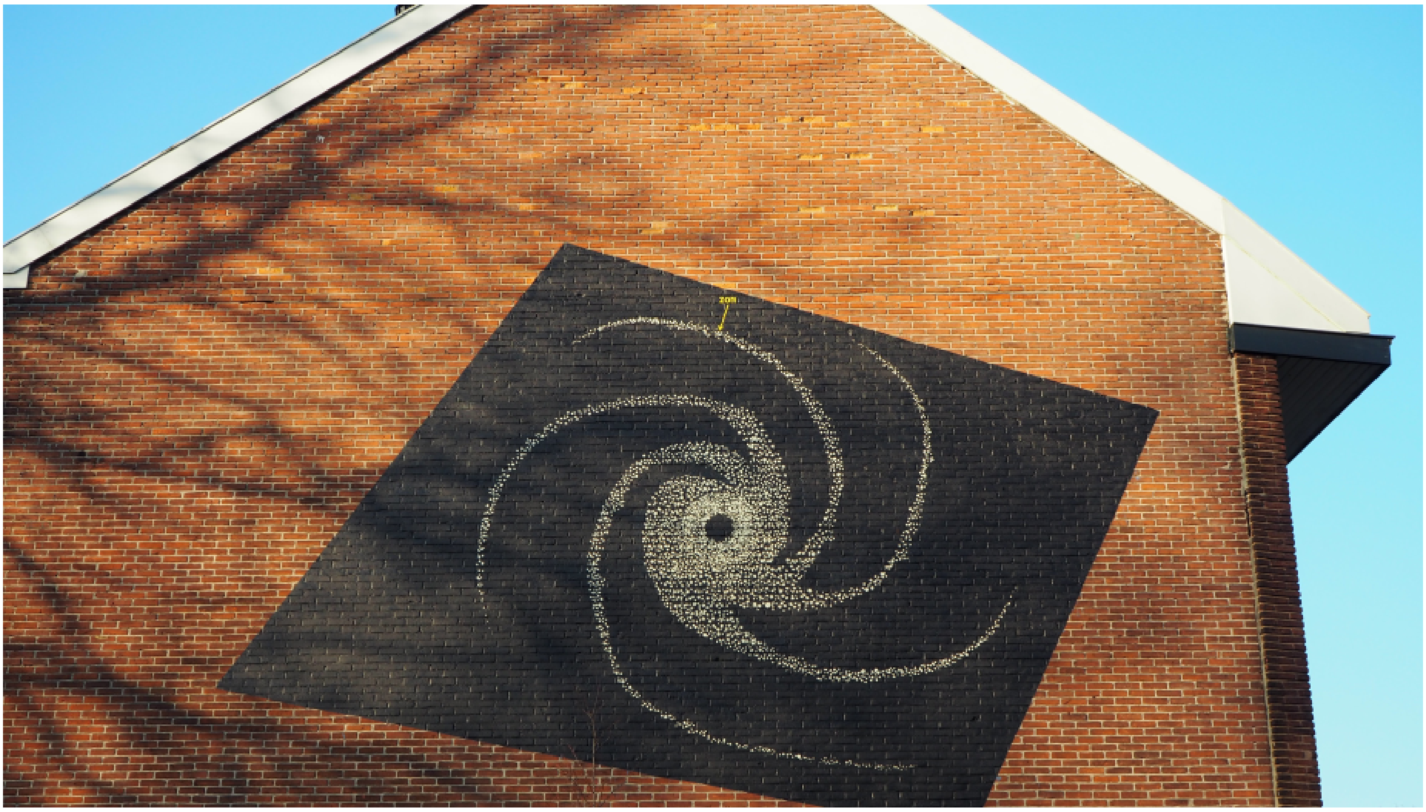
Força de lorentz

Mapa

Hendrik Lorentz (1853-1928)

Explanation: The Lorentz force (F) deflects a charged particle (q) within a magnetic field (B). Within an electric field (E), the particle additionally experiences an acceleration. Wiki (https://en.wikipedia.org/wiki/Lorentz_force)

Leiden component: Lorentz was a physics professor in Leiden. He made a number of important discoveries here. He deduced for instance that objects become smaller as they reach the speed of light (Lorentz contraction) and described together with Pieter Zeeman the Zeeman effect, for which they received the Nobel Prize in 1902. He had already predicted this effect before with his Lorentz force.



(images/oort.jpg)

Oort constants

Map

Jan Oort (1900-1992)

Explanation: A minus B gives the Sun's angular velocity ($v_{\ominus}/R_{\ominus}$) around the center of the Milky Way. A plus B gives the decrease in speed ($-[dv/dR]_{R_{\ominus}}$) of nearby stars as they are farther away from the center. This value turned out to be surprisingly low, and launched the search for the mysterious 'dark matter', which continues to this day. Scientists can determine the values of A and B from observations, contrary to their individual components. Wiki (https://en.wikipedia.org/wiki/Oort_constants)

Leiden component: Oort was an astronomy professor in Leiden. He discovered predicted the existence of the Oort cloud--a giant collection of small space objects revolving around the Sun in an orbit about 100,000 times as large as Earth's. Moreover, he formulated the Oort constants, from which he calculated the period of our Sun's orbit around the center of the Milky Way: more than 200 million years.

(images/lc.jpg)

Lorentz contraction

Map

Hendrik Lorentz (1853-1928)

Explanation: The actual length of an object is the original length at rest (L_0) times a factor smaller than one, which is related to its speed (v). The faster an object travels, the smaller this so--called (inverse) Lorentz factor, and therefore the shorter its length. Or vice versa: the faster an observer is travelling, the smaller all stationary objects get. Einstein used the Lorentz contraction in his theory of special relativity. Wiki (https://en.wikipedia.org/wiki/Length_contraction)

Leiden component: Lorentz was physics professor in Leiden. Apart from the Lorentz contraction he made a number of other important discoveries. He described the Zeeman effect together with Pieter Zeeman, for which they received the Nobel Prize in 1902. Earlier, he discovered the Lorentz force, which provides a theoretical explanation for the Zeeman effect.

(images/spin3.jpg)

Electron spin

Map

Samuel Goudsmit (1902-1978) -- George Uhlenbeck (1900-1988)

Explanation: Electrons are small particles orbiting an atomic nucleus. Apart from electrical charge and mass, they possess a third property which is crucial for our understanding of their behavior: spin. The only way to correctly describe spin is through quantum mechanics. However, you can imagine the concept by thinking of an electron that rotates--indeed spins--around its axis. The magnitude of an electron's spin is given by $\hbar$ times a half. ($\hbar$ is Planck's constant divided by 2π.) The special phenomenon here is that electrons only come in two versions: they either rotate clockwise (spin down, or Sz=-1/2*$\hbar$), or counterclockwise (spin up, or S_z=+1/2*$\hbar$). Wiki (https://en.wikipedia.org/wiki/Spin_(physics))

Leiden component: Samuel Goudsmit and George Uhlenbeck obtained their Master's and PhD degrees at Leiden University. Together they realized that electrons must have the property of spin, and that this can only take up two values (up and down).

(images/Huygens_Bruno_4020_aangepast.jpg)

Huygens' Pendulum Formula

Christiaan Huygens (1629-1695)

Explanation: Huygens' pendulum formula describes the connection between the length of a pendulum and the time that it takes to swing from left to right and back. This period, Huygens discovered, is only determined by the length of the pendulum and gravity. Wiki (https://en.wikipedia.org/wiki/Christiaan_Huygens#Pendulums)

Leiden component: Christiaan Huygens studied law and mathematics at Leiden University from 1645 to 1647. In 1673, he published the formula that relates the period of the swing to the length of the pendulum. Accurate timing had become very important for astronomy, navigation and also phyics itself. Huygens actually took a patent on his pendulum clock.

(images/VdWaalsLeiden2020.jpg)

Van der Waals state equation

Johannes Diderik van der Waals (1837-1923)

Explanation: The Van der Waals equation describes the link between temperature (T), pressure (p) and volume (V) of a gas. R is the gas constant, and n is the number of gas molecules, expressed in moles. An equation that did this already existed, but it couldn't explain a number of measurements and phenomena, such as the condensation of fluid from a gas. The improved Van der Waals state equation could. Van der Waals reasoned that the atoms or molecules in a gas occupy a certain volume. This is the term nb in the equation. Also, the particles can 'feel' each other: they attract or repel each other. These forces, later coined Van der Waals-forces, are accounted or by the term an^2/V^2. Wiki (https://en.wikipedia.org/wiki/Van_der_Waals_equation)

Leiden component: Van der Waals described the equation in his PhD thesis 'Over de Continuïteit van den Gas- en Vloeistoftoestand' (On the Continuity of the Gas and Liquid State), which he defended in 1873 at Leiden University. In 1877, he was the first physics professor at the University of Amsterdam.

(images/Douwe-Breimer-voor-de-muurformule.jpg)

Pharmacokinetics

Map

Douwe Breimer

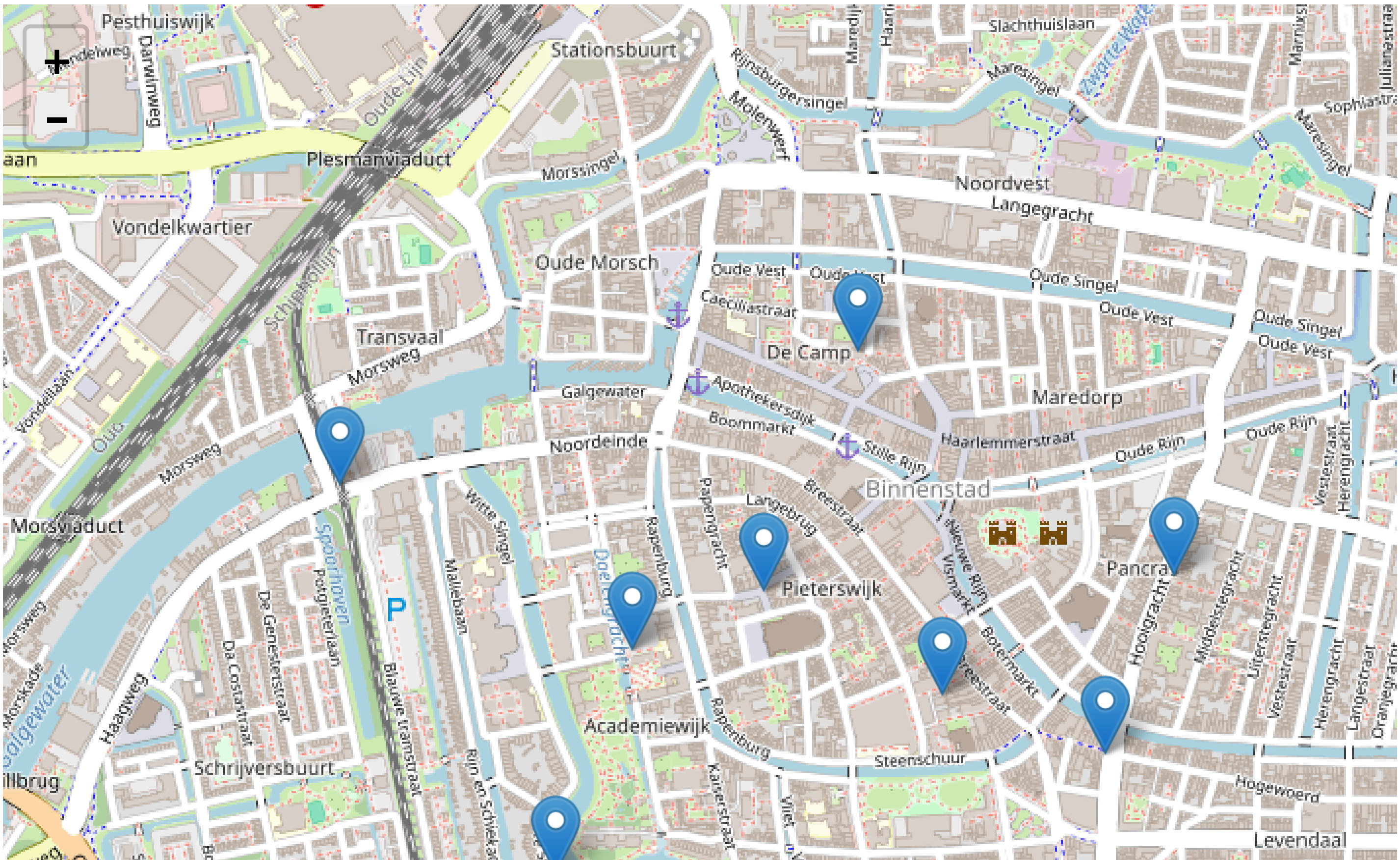
Pharmacokinetics

Medicines work because the molecules in a tablet bind to certain proteins or enzymes in cells. The cells change their function and this is how medicines can lower the blood pressure or the cholesterol or can kill bacteria that cause an infection. For that to happen the molecules must be there in the right amount and at the right spot. The molecules in a pill are released when the tablet breaks apart in the stomach and are then absorbed in the blood. Liver and kidneys remove the molecules and all of this happens at a speed that is different for each medicine. Hence, the concentration of medicine will first go up and then go down. A pill taken next day will lead to a similar curve. This process can be described with this equation. When certain properties of the medicine are known and if you know how much must be in the blood for the medicine to work (therapeutic level) you can calculate the dose.

Leiden connection

To use equations like this one very precise measurements of the concentration of medicines in the blood must be possible. These techniques became available in the 1970?s and in Leiden Douwe Breimer and his group performed crucial research on the mathematical description of the time course of the concentration of medicines in blood and other body fluids, a field called pharmacokinetics. This research is still the basis of much of the work of the Leiden Academic Centre for Drug Research (LACDR (https://www.universiteitleiden.nl/en/science/drug-research)) and the Centre for Human Drug Research (CHDR (https://chdr.nl/)). Professor Breimer was rector of Leiden University from 2001 to 2007.

Leiden Map




Gortestraat
Plantsoen
Plantsoen