Le pendule simple tp physique pdf

TP single pendulum - the term S I) study of the T period of vibration: establishing the difference between a paraper that can affect the T period. Performan experiments to establish the impact of these parameters. Establishing a relationship giving a clean period T0 II ) the impact of m: We use a n glgeable mass wire of 41cm to measure the mass m and T of 200 g, we mapped the pendulum to the value of 'm and we er, we measured the time of 10 vibrations: T-t / 10. This gives more precision to the results 10 15 20 25 30 T s 1.35 1.35 1.36 1.37 for small vibrations < 20, the T period is pointed out to be dying of m mass III: 40 cm wire and about 15 (small) one always measures 10 cossations. A small mass of 5 g is attached to a wire that can hang different masses at the end. m in g 55 105 155 205 205 T s 1.35 1.36 1.36 1.36 is not known not to rely on 1.36 T mass. IV) the influence of the L-length of the wire: the mass of 100 g is used and the angle is about 15 we measure 10 vibrations. A long 1.30 m wire is first used and dried on the stem of hanging to shorten it. As the L length of the wire increases, the T period increases. Tracking T2 according to the L T period is called your period T0. T0-2 π (L/g) ©Science Montblanc TP describes the study of two mechanical oscillators: elastic pendulum and single pendulum. You will get the vibration of the elastic pendulum thanks to ™ smartphone and phyphox software so that you can measure the characteristics of the pendulum very accurately. As for simple pendulums, the study of that period allows us to measure the field of gravity and explain the nonlinear effects. The elastic pendulum consists of a negligible mass spring with a fixed end and the other is connected to a free moving mass. Here we limit ourselves to the study of vertical elastic pendulum. Remember that when the spring is long or compressed, it exerts booster power. The elastic tension given by Huke's law is called: 'Start', 'Straight', 'ell_0 T-k', 'Excessive', 'Apocalypse Equation', 'End Equation' relationship, spring's stiffness constant ell_0, spring's stiffness constant, N.m-1. The strength of the spring, the spring stiffness constant balance expressed according to the length of the spring, the length is the result of the competition between weight and elastic booster strength. When the mass escapes from the equilibrium position, it is a 'start' equation (ell_-eq-ell_0 tp_pendules_1) it is the result of the force of the 'soybean', 'over-arrow' u_x-k (ell_0), 'overwork' u_x On the basis of dynamics, this force induces acceleration (gualar - a- over-the-gulo- F/ m). If the displacement of M is referred to as 'start'm in relation to balance, 'ddot x'mg-k('ell_0') 'label'eq:tp_pendules_2 'end' equation' by adding 'eqref'eq:tp_pendules_1 and 'eqref'eq:tp_pendules_2, One obtained the following equation: 'Start' -ell_-text-eq-kx' elastic pendulum kidney obeys differential equations: 'Start' equation 'start' omega_0 quad text 'omega_{0}'s 'sqrt'k's''''s 'quad's'-rad.'s''s'-1) 'quad'heart chute', 'tp_pendules_3 end', 'cycle' is characterized by a magnetic oscillation oscillation. The solution to this differential equation is written as 'A'cos-left'('omega_{0}-varphi-right)' and has two integrated constants based on initial conditions. As the opposite of the figure shows, the system begins to vibrate indefinitely with amplitude. Because these vibrations are cyclical, the duration of the vibration (T_0) (s) and frequency (f_0) (Hz) are defined. 'Box' T_0 'dfrac' omega_0 'sqrt'dfrac'm'k'quad 'hspace'2cm f_0', 'box', 'dfrac' omega_0 '2'ft'T_0 'dfrac{1}', 'T_0', 'dfrac{1}'3 self-frequency depends on the characteristics of the elastic pendulum (k). Experimental device experimental device boils the following: a spring of constant rigidity hanging to be attached unknown; Smartphones with ™ popo-ex app for smartphone acceleration; Support that the smartphone is stored and attached at the end of spring; Regressi software for data processing™ a pc equipped with it. Today, smartphones have become a real mobile mini-lab with the concentration of sensors. In this TP, the accelerometer of the smartphone is used to study the movement of the elastic pendulum. Phyphox™ software allows you to recover three accelerations depending on the three axes connected to your smartphone. For this TP, let's look at the next acceleration x. The three axes connected to the device and smartphone. Smartphones already have phyphox™ applications. If you have a smartphone, you can search for this app by downloading the . If attached to the spring and then set to vertical motion, the smartphone gains acceleration (a_x-ddot x). Sometimes deriving a relationship called 'eq-eq:tp_pendules_3' is a 'start' a_x omega_0 'Quad' omega_{0} 'sqrt'k'm', 'quad[-mathrm-rad.''s'] 'label-eq:tp_pendules_7 'end equation' acceleration follows the same differential equation as stretching. In other words, acceleration vibrates harmoniously f_0 frequency. The goal is to estimate the stiffness of the spring by observing the length of when the mass is attached. This is a static measure. Measure the empty length of the elastic pendulum ell_0 ell_0-pm-delta. Place your smartphone in the holder and measure the total mass. Attach the entire spring. When the balance is reached, it measures the length of the spring ell_ ell_. Deduce the value of spring stiffness consistently (don't forget to spread uncertainty). We are trying to make sure that the dynamics of the pendulum fit well with the dynamics of the harmonic oscillator, which is controlled by the differential equation 'eqref:tp_pendules_3'. As a bonus, you can access the very exact value of your own pulse (omega_0). Other settings of The Pippo™ (zoom-click) open the Physics Force app ™ your smartphone. Select acceleration (without g), then go to the menu and run timeTouch. Select the 5-s time frame and 5-s duration of the experiment. Attach the holder and smartphone to the spring and secure the entire. Then start the argument: you have 5 seconds to spread the pendulum a little and let go. The device then records acceleration for 5 seconds, depending on the three cartesian directions over time. When the registration is complete, the data export data (export data - CSV (decimal point depending on coma) is emailed. Save files on your PC to the Recovery (access to email via ENT) folder. Run regression™ and then open the CSV file. The measurement table appears. First, remove what you are not interested in: then remove the columns associated with y and z acceleration. Then change the title time to t and replace linear acceleration X with X. Using the tool of regression™ measure the duration of the vibration. Inferring the estimation of their pulse .A. omega_0. Modeling: You can adjust differential equations in a set of regression™ experimental points. In the modeling window, enter the following model: X-premium(t) -a-X-where a is set to adjust. Click Make adjustments. The software may not be adjusted. In this case, you must provide a value that is close to the optimal value for the setting. Use clean pulse estimates to get the settings to know properly, and then adjust them. Software Sinusity that needs to be adjusted very well to experimental data. Printing (curves and modeling). In the modeling results, the value of the curing constant is deduced. Does it match the value obtained by static measurements? Discuss. The impact of friction can emphasize attenuation over a longer argument period. Repeat the previous task to change the collection time: Select a duration of 60s. For modeling, we need to add the effects of friction, which is the ingredient that has been ignored so far. During that exercise, the mass is rubbed by air. Because speed is important, all of these forces are higher. To simplify, we consider proportionality to speed: 'soybean'. By postponing this power in the balance of power, a new differential equation is found: 'start', 'ddot x'2-lambda', 'dot x'omega_0', x-0 'label'eq:tp_pendules_4 'end' equation is a constant called a coefficient. If the latter is not too high (as is here), there is a vibration that weakens the amplitude exponentially over time. We're talking about pseudo-periodic vibrations. Mathematically, we start 'equation' x (t) -A-e-lambda, t'cos ('omega t'phi') 'label' tp_pendules_8 'end' equation 'end' equation 'omega-sqrt'omega_0 '2-lambda'). As you can see, the duration of the vibration (pseudo-period) increases depending on the number of depreciation. Preparation: If the pendulum movement is dominated by the equation 'eqref-eq:tp_pendules_4', what is the differential equation where vertical acceleration is solution a_x d? It is pointed out tau_ the time when the amplitude of cushion vibrations is halved. '1/2'dfrac'ln 2'lambda' modeling in 'eqref:tp_pendules_8' to 'tau_'] model: Suggesta model of differential equations. Depreciation --lambda.) - How amplitude of vibration is half? Simple pendulum theory of simple pendulum power is formed by simple pendulum study simple pendulum to exert itself on a simple pendulum and projection base: an inseparable thread of negligible mass and length; And the mass ball attached to the end of the wire theta_0. Determines the equation scanated at the angle at which the wire is made at its current vertical position. To do this, you can create a few simple hypotheses: the laboratory store is supposed to be Galilee; The ball is equated to a point. M receives only two forces: the weight of the soybean and the tension of the wire (in accordance with the basic principles of dynamics, the frenet database (formed by the tangent vector ('soybean')') is towardthe moving direction and the general vector toward the pendulum suspension point, the speed and acceleration vector is written. . , 'Overlitlow' Tau- 'Quad text', 'quad'a'frac'mathrm' now project PFD on the frenet base: 'Start' - 'Sort' to text - 'tau', 'text': 'quad m', 'overset' center dot'-seta-m,' 'sin'theta'equadiff', 'overtext' :'Quad m', 'overset', 'center dot' 2 'T-m' equation 'eqref' tension' allows us to get the tension of the thread, The equation 'eqref'equadiff' gives us differential equations of movement: 'start' equations, 'boxes' omega_0 ddot'ata'sin 'theta'- 0 'quad' text 'omega_0'2 'dfrac'g', 'quad' heartsuit 'label'eq:tp_pendules_5 the term 'end equation' makes the differential equation slant. For small angles, for small vibrations, one can equate 'teta' and 'god'. Then the differential equations are 'start equations', 'ddot', 'omega_0', 'teta', '0 'final equations', and the differential equations of harmonic oscillators that have already occurred in the study of the elastic pendulum are recognized. Therefore, we know that the solution is a type of 'theta_0', cos omega_0: the pendulum vibrates periodically with the duration of the 'dfrac' omega_0 '2'2-pi-sqrt'frac', omega_0 'label'eq:tp_pendules_6 'final equation T_0'. We neglect here. For large amplitude vibrations at large angles, the action deviates from the harmonic oscillator due to the presence of nonlinear terms (theta'). As a result, the vibration is no longer sinusital and the duration of such vibration depends on the amplitude theta_0 of the vibration. Borda's formula is an approximate formula that provides a period of vibration for amplitude that does not exceed '60 'circ': 'Start' equation T-T_0 'left 'left', theta_0-2-{16} right) quad text with theta_0 text in radian-label-borda-end-experiment device to measure half the period of a single pendulum (click to expand) the sepulchre is composed of a large wire-dangling steel ball. Barrier Place it on top of the pendulum when there is balance. Graduated cardboard can be used to find the initial angle theta_0 of vibration. The time barrier provides access to the value of the half-term because the stopwatch is triggered on the first pass and then stopped on the second pass at the beam level. Be careful to get good results, pay attention to the following two points: For greater accuracy, the IR beam of the optical barrier must be cut by the wire, not the ball! Positioning of the time barrier is important at the equilibrium position level of the pendulum. Also to overcome some prejudice, we measured twice in the half-term: first spread the pendulum to the right of the barrier and then spread to the left. First measurement of g: We use software (regressi™) to perform statistical analysis of a series of measurements. However, it is important to know how to perform these calculations by hand. Here is a series of measurements obtained for: 2,832. 2,815 ; 2,863 ; 2,859 ; 2,842 statistical processing (see type A uncertainty using student methods, see form on the website) and the value of uncertainty when measuring '(T') is 95%. Note the length of the pendulum on the mat; Measures the initial angle of 2.5 degrees, the half-period of the left (T_1), and the right (T_2). Repeat the procedure five times. Enter a regression™ T_2 T_1 measure, create a T_1 T_2) in the regression, and then create a size. Go to the Statistics menu. Select the size in the option and then ask you to display the average and confidence intervals at an average 95% confidence level (ICM95%); 68% uncertainty is given to the length measurement: 'sigma_'5'10'3', 'mathrm'm'). In the previous two questions, the value of the gravitational field is calculated at a 95% confidence level. The table indicates Ren's 'g'9,81', 'mathrm'm.se'). Discuss. Here we check borda's law, we test the evolution of the period according to the initial angle theta_0 of vibration. Measures range from 2.5 to 25 degrees (jump 2.5 degrees) T_2 for different values of measurement (T_1) and 'theta_0'. Enter the measure in the regression™ and then create greatness. To specifically inform the previous operation of the type of uncertainty of the '(T') (it is necessary to double-click on the head of the 'T' to freeze the size). Also, re-enter the uncertainty about the 'theta_0' called 'Sigma' ('theta_0') '0.5'. Create an 'X-theta_0' that expresses 'theta_0' Radians. Then draw '(T) based on 'X'. Uncertainty is raised to 95% (see options) and orders are carefully scaled. Modeling: Enter a relationship in the modeling window, and then adjust it. Is Borda's law confirmed? It helps to model the value and uncertainty of the pendulum T_0. Question 2.3.4 Compare to what's in the comments. Deduce the new value of 'g'pm'delta g'. Is the result more accurate? a smartphone with a ★★★ Pipos app™; Smartphone holder; Spring-hanging-fixed rod; The rules are graduating in millimeters; Scale (precision ± 1g) single, large pendulum; Optical door timer - power supply; huge reporter; A computer with regression software. Regression.