LABORATORY WORK № 2

Oscillations of a spring pendulum

Purpose of the laboratory work

1. Experimental study of spring pendulum vibrations and introduction to methods for determining the parameters of mechanical vibrations.
2. Determination of the spring constant.

Experimental equipment, instruments and accessories

The laboratory stand includes a vertical support structure with guide slots 1, as well as a set of springs and a movable carriage 2, in the hole of which an additional load can be fixed.

Devices and accessories include an optical sensor 4, a computer with the necessary software.

Basic calculation formulas:

Using two different loads m_1 and m_2, then the spring constant is estimated from the corresponding periods T of natural vibrations (dynamic method):

$$k = 4\pi^2(m_2 - m_1)/(T_2^2 - T_1^2)$$

Описание лабораторной установки

To assess the spring constant using the dynamic method, a spring pendulum is used, which is a carriage (cart), Fig. 1-2, suspended on a spring (Fig. 1-3).
to conduct the experiment, the load suspended on the spring must be released and allowed to oscillate freely. To measure the oscillation period, an optical sensor is used, which is set so that the flag on the carriage intersects the optical axis of the sensor when the pendulum oscillates.
The set has two springs of different stiffness, and the carriage weight M attached removable additional weights weight m.

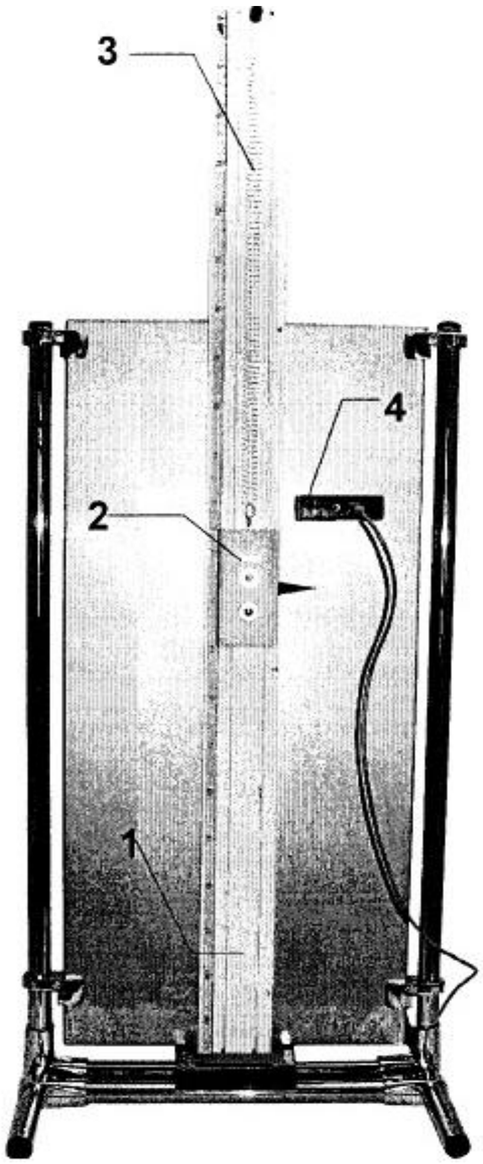
The procedure of conducting laboratory work

1. Write down the mass of the carriage M and the mass of the additional load m:

m=50±1 g.	M=104±2 g.

1. Assemble the laboratory unit by fixing the end of one of the springs to the top of the support structure, and attaching the carriage without a load to the other end. Place the optical sensor in the path of the carriage plate.
2. Connect the optical sensor to the computer's USB port.

3. After turning on the computer, run the program "physics Workshop". On the device panel, select the appropriate experiment scenario (Alt+C)



4. Start the measurement for the selected sensor (Ctrl+S)and immediately, immediately after starting, lightly push the spring carriage along the guide.

5. After a few swings of the pendulum, stop the measurement (Ctrl+T).

6. Process the received data in accordance with the scenario, for which:

* select an area with multiple overlap pulses to view it in detail and zoom in (Alt+left mouse button);

* measure the period of oscillation of the pendulum along the leading or trailing edges of adjacent even (or odd) overlap pulses by placing a yellow (left mouse button) and green marker (right mouse button) on the corresponding edges of the overlap pulse.

7. Perform period measurements 5 times using different fronts of different pulses. Record the measurement results in table 2.

8. Attach an additional load to the carriage. Repeat steps 5-8 for the weighted pendulum. Record the measurement results in table 2.

9. Replace the spring with another one from the supplied kit. Then perform the experiment again according to points 5-9. Record the measurement results in table:

Spring 1.

i, №	period of the pendulum without load T_{i1}, s	Average period of the pendulum without load $\langle T_1 \rangle$, s	m_1, kg	Period of the pendulum with load T_2, s	Average period of the pendulum with load $\langle T_2 \rangle$, s	m_2, kg
1						
2						
3						
4						
5						

Spring 2.

i, №	period of the pendulum without load T_{i1}, s	Average period of the pendulum without load $<T_1>$, s	m_1, kg	Period of the pendulum with load T_2, s	Average period of the pendulum with load $<T_2>$, s	m_2, kg
1						
2						
3						
4						
5						

4. Processing of measurement results.

Using the results obtained, determine the average values of the oscillation periods for each spring both for an empty cart with a mass of M and for a load with a total mass of M+m or M+2m, using the formula:

$$k = 4\pi^2(m_2 - m_1)/(T_2^2 - T_1^2)$$

As a rule, (m_2-m_1) appeared to be either m or 2m (50 or 100).

5. Write down the results of calculations of spring constants k_1, k_2.