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DETERMINATION OF THE GRAVITATIONAL CONSTANT BY TORSIONAL SCALES OF CAVENDISH

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ABSTRACT
By determining the gravitational constant with the torsional scales of Cavendish,it is possible to develop the students' skills in science,to preserve the traditional form of the lesson,to further increase the interest in science.
KEY WORDS: *Modern technology,modern methods,the scales of Cavendish, science and technology education.*

DISCUSSION

In the preparation of a teacher of the new century, it is very important that he has a deep knowledge of pedagogical and psychological intellectual potential, awareness of innovative educational technologies, interactive methods of teaching and effective ways to increase creativity.

Physics education requires students to have deep theoretical knowledge as well as high practical skills. In this regard, the use of quality innovative methods in education is one of the most important tasks of physics education.

Until recent years, the teaching of physics was based solely on theoretical knowledge. There have been some difficulties in applying the knowledge gained in this way to practice. The use of new innovative methods to overcome such problems is effective.

One of such innovative methods is to determine the gravitational constant with the torsional scales of Cavendish.

The following results are obtained from the experiment:

Note that the oscillation of a rotating pendulum around an equilibrium state is time-dependent

- Find the gravitational constant g by the method of determining the extreme deviation.
- Determination of the gravitational constant g by the acceleration method.

It is important to have the following theoretical knowledge to observe the experiment:

Torsion balancer-the base of the Cavendish scale consists of a light transverse rod suspended on a thin elastic net with balls of mass m2 at the ends d from the point of suspension. These two bubbles are affected by two bubbles of mass1. Although the force of impact is in the range of 10-9 N,this forse can be observed with a very sensitive gravitational torsional balance. The motion of small bubbles is detected and measured by an infrared motion detector (figure 1).

The infrared motion detector has four infrared diodes that illuminate a sunken window mounted on the transverse beam of a torsion pendulum. The light returning from the window falls on a series of phototransistors and records the vibration of a balloon of mass m2. Based on the information about the motion of a body of mass m1 and the geometry of the device,the gravitational constant can be determined using the maximum deflection method or the simple acceleration method.

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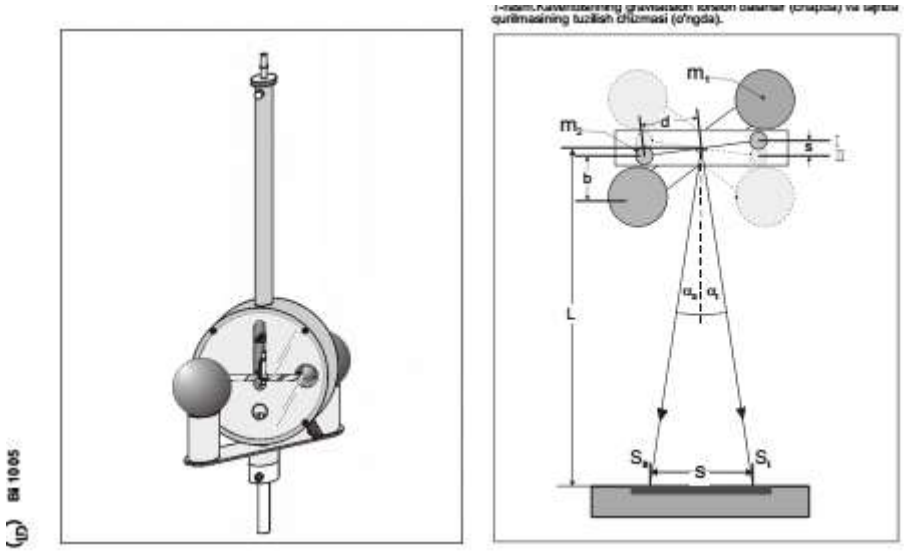

Figure-1. Cavendish's gravitational torsional balance (left) and the experimental device (right).

Device structure

1 Gravitational torsion balance	332 101
1 IQ Status detector(IRPD)	332 11
1 Optical rail,standard cross section 1m	460 32
1 Optical drive 60-50	460 373
1 Optical drive 90-50	460 374
1 Tag stem,25 cm	300 41

Experimental device

Measurement results can only be satisfactory if the critical torsional balance is adjusted on demand. In addition,the interaction between the objects must not be disturbed by the external vibrationsof the pendulum. Torsion is very sensitive to external mechanical influences on the pendulum body. Convections caused by temperature differences in the torsion balance body can also cause torsional pendulum oscillations. Choose a solid wall for the experimental device. For the experiment,choose a place where there is no wind,which is not exposed to direct sunlight. Do not strike the base when twisting the base of the balls or installing lead balls. Figure 2 shows an overview of the experimental device. Gravitational torsion balance start-up assembly:

- Assemble the desktop for the experiment as shown in Figure 2 (see also instructions 332 101 and 322 11)
- Install the optical rail with the gravitational torsion balance.
- Adjust the gravitational torsional balance so that the axis of the sphere is large enough
- Loosen the grip mechanism of the torsion pendulum so that the needles at the ends of the pendulum,suspensions are in the middle of the hole so that the pendulum can rotate freely.
- Let the torsion pendulum hang for one or more days. Reset to zero if necessary.

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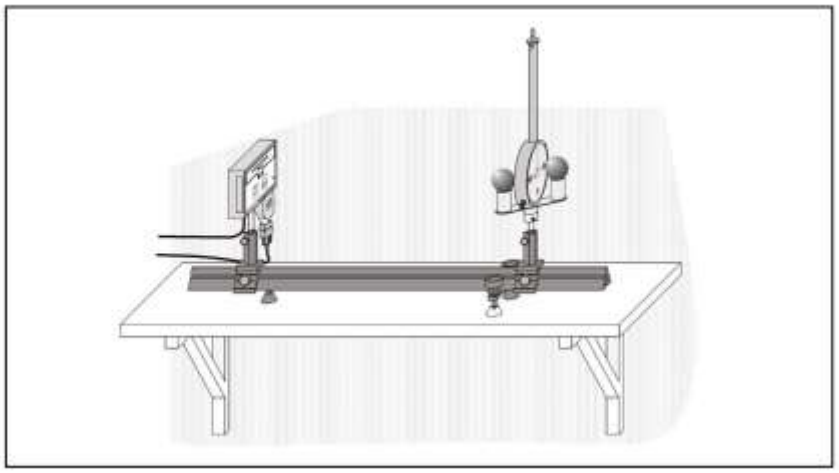
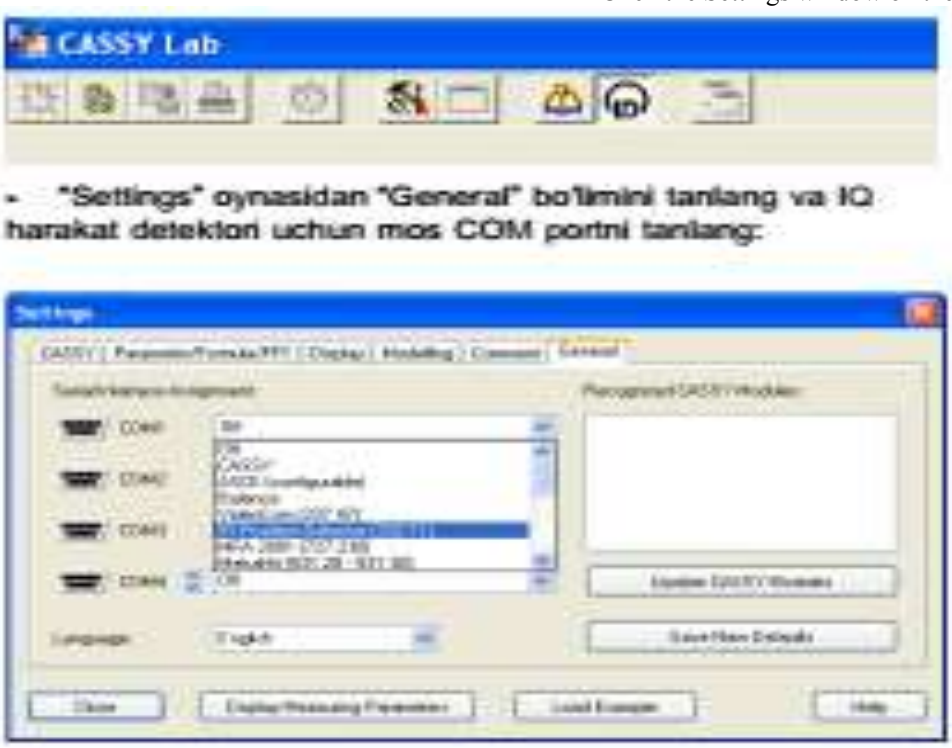


Figure 2. experimental device. A table assembly of a gravitational torsion balancer that electronically records vibrations with an IR motion detector.

Recording vibrations

- Connect the IR detector to the computer via the RS232 interface port
- Install and run the program if the computer is not installed yet (configure the CASSY Lab user interface)
- Click the Settings window on the toolbar:



-
- In the "Settings" window,select "General" and select the appropriate COM port for the IR motion detector:

During the experiment

Initial preparation:

- In order for the pendulum to remain calm in any equilibrium position,the device must be free from external shocks and impacts for at least two hours. Note: For optimal adjustment,the optimal balance is at a distance of about 20 mm and 50 mm. if this is not the case,the rotating scales will tilt at a small angle. In this case,this step will need to be repeated several times.
- If the rotating pendulum has not be used for a long time with the locking screw

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loosened,it may take a long time to bring it into equilibrium.

Therefore,it is possible to record the time dependence of the extinction of oscillations around the equilibrium position of the rotating pendulum,and to determine the maximum deviation of the gravitational constant g. the knowledge taught using the same innovative methods will make a huge contribution to the development of our country.

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