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RESEARCH ON THE PENDULUM USING SYSTEM DYNAMICS

Formulation of the problem. One of the possibilities of system dynamics is its use to perform virtual laboratory work in physics. The methodology of conducting virtual laboratory work requires the use of interactivity with the mandatory implementation of the principles of an active approach to learning. At the stages of work, the student should be faced with the task of conscious choice of means of work - virtual devices from the available list, the conditions of the experiment, calculation formulas, and so on. It awakens the curiosity and creativity of students, provides motivation for learning [1].

The unconditional advantage of the virtual laboratory is the ability to record and store the progress of experiments in electronic format, display and process data on any smartphone, laptop, interactive display. Disadvantages include the lack of the Internet and the impact of computer work on children's health.

Presentation of the main material. Research of a thread pendulum. The filament pendulum simulator can be found in the search engine at https://exchange.iseesystems.com/public/isee/pendulum-story/index.html#page1 [2].

Think about what happens when you connect a small ball to the end of a string? When to pull the ball a short distance from the equilibrium position and release? It will begin to sway back and forth. This system is called a simple pendulum, and the type of motion is a simple harmonic motion. The system assumes that the mass of the ball is concentrated at a point, and the mass of the thread is negligible.

In this model, we investigate the effect of thread length, ball mass, and initial position on pendulum motion, ignoring the effects of friction and air resistance. You can then examine the oscillations of the pendulum, taking into account the friction and driving force.

Instructions for the experiment

1. Home page: existence of a pendulum (balls on a thread)
2. The Experiment window contains:

- ❖ regulator of change of weight of a ball from 0 kg to 2 kg,

- ❖ regulator of change of length of a thread of a pendulum from 0 m to 2 m,
- ❖ regulator of change of initial position of a ball -0.2m to 0.2m,
- ❖ "Gravity" button,
- ❖ "Add friction" button,
- ❖ "Add driving force" button
- ❖ graph of the dependence of movement on time
- ❖ graph of speed dependence on movement

Controllers, buttons are connected by the equations of the model "Pendulum", which allows you to see changes in physical quantities on graphs.

3. Changing the controls will change the curves on the graphs. Each change is displayed in a different color. The "Add Friction" buttons and the "Add Driving Force" button will change the curves on the graphs again.

4. Analysis of the obtained curves depending on the change in the values of the regulators.

Example

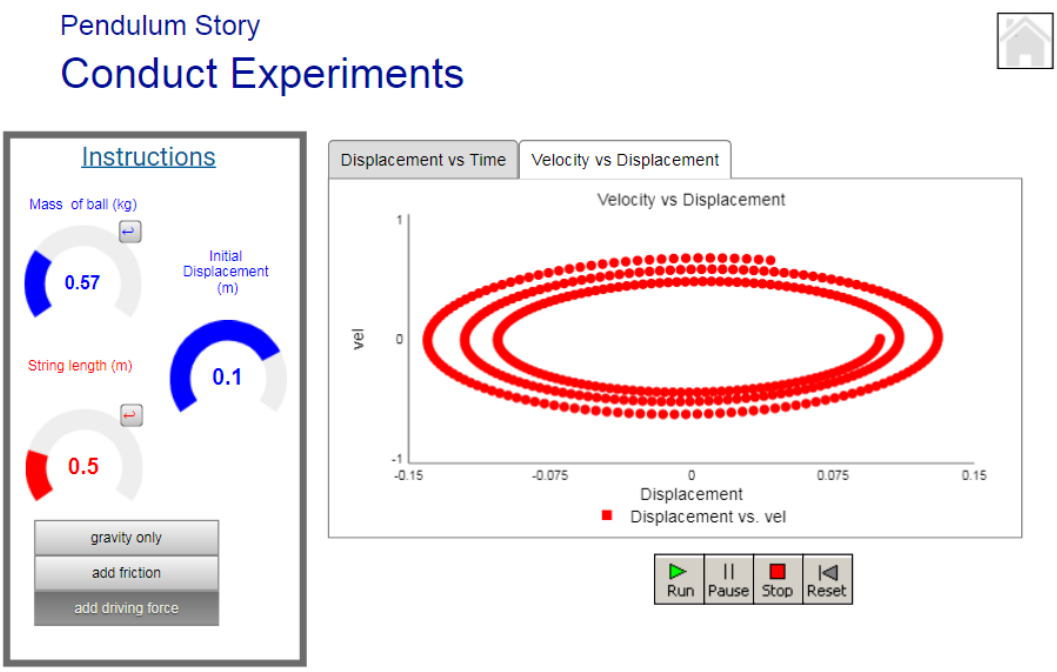

Figure 1. The change in speed from the movement of the pendulum

Figure 1 shows the change in speed from the movement of the pendulum for a ball weighing 0.57 kg, the length of the pendulum thread 0.5 m, with an initial displacement of 0.1 m and with the addition of driving force.

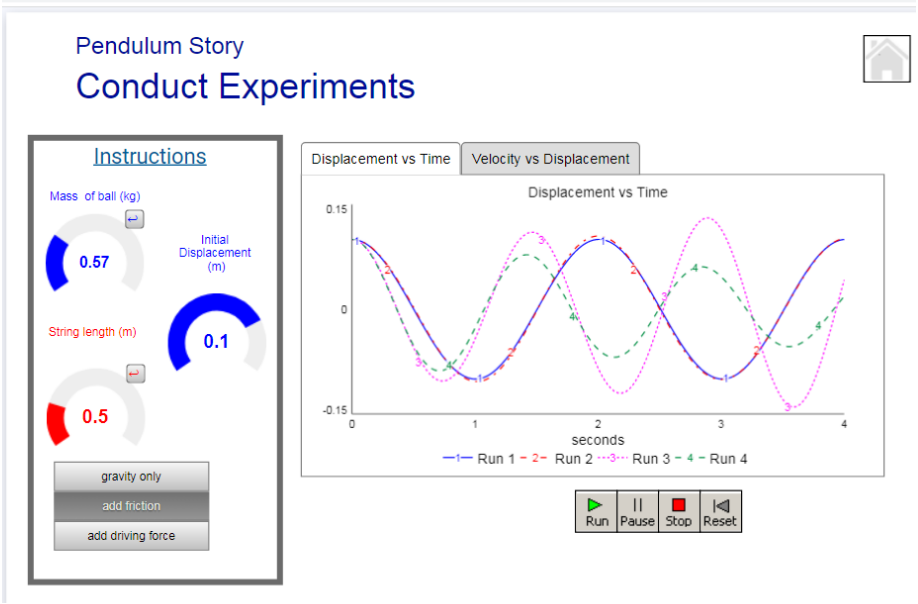

Figure 2. The dependence of movement on time shows:

1- The movement of the pendulum only with "gravity", a ball weighing 1 kg, a thread length of 1 m, an initial displacement of 0.1 m

2- Pendulum motion only with "gravity", ball weighing 0.57 kg, thread length 0.5 m, initial displacement 0.1 m

3- Pendulum movement only with "Add friction", ball weighing 0.57 kg, thread length 0.5 m, initial displacement 0.1 m

4- Pendulum movement only with "Add driving force", ball weighing 0.57 kg, thread length 0.5 m, initial displacement 0.1 m

5- Save the results for testing by the teacher.

Conclusion. Thus, it is possible to perform laboratory work on the study of the filament pendulum in grades 7-8, integrating Physics, English and Computer Science. Such an experiment is of particular value during distance learning. And the visual presentation of the obtained results will stimulate students to study physics.

References

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2. Pendulum Story. Conduct Experiments: https://exchange.iseesystems.com/public/isee/pendulum-story/index.html#page3

3. Computer Science. Computer Engineering. Computer Technology: Textbook for Students of Higher Educational Institutions / Ed. O. I. Pushkar – K.: Publishing Center "Academy", 2002. – 246 p.

4. Diana Fisher Bookset: https://www.iseesystems.com/store/books/diana-fisher-set/