ADVANCED PHYSICS CLUB

FEBRUARY 1, 2026

Useful resources

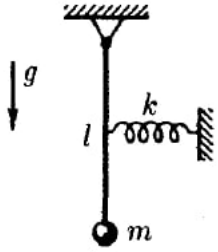
The updates, homework assignments, and useful links for APC can be found on SchoolNova's web page:
`https://schoolnova.org/classinfo?class_id=2252&sem_id=74`
The practical information about the club and contacts can be found on the same web page.

Today's meeting

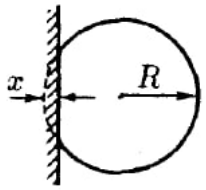
The few remaining problems on harmonic oscillations are reassigned. The new topic is gravity and Kepler's laws.

Reassigned Homework

1. A pendulum consists of a weight of mass m at the end of a light rigid rod of length l. A horizontal spring with spring constant k it attached to the center of the rod. Find the frequency of small oscillations of the system. The diagram shows the equilibrium position.



***2.** A spherical balloon is deformed as shown on the figure during a collision with a wall, so that the maximal value of the deformation x is much less than the radius R. Estimate the time of the collision. Mass of the balloon is m. The pressure inside the balloon exceeds the atmospheric pressure by Δp, the change in pressure during the collision can be neglected.



New Homework

1. Solve the following problems from the previous F = ma exams:
   (a) 17,21,25 (2010: `https://www.aapt.org/physicsteam/2010/upload/2010_Fma.pdf`)
   (b) 5, 23 (2011: `https://www.aapt.org/physicsteam/2012/upload/WebAssign-exam1-2011-1-4.pdf`)

2. a) Find the mass of the Earth knowing the free fall acceleration on its' surface $g = 9.8$ m/s^2 and its' radius $R = 6370$ km . b) Find the escape velocity for the Earth.

3. A rocket at the surface of a planet is provided with the speed exceeding the escape velocity v_e of this planet by 0.5%. When the rocket gets very far away from the planet it has speed v_f. What is the ratio $\frac{v_f}{v_e}$?

4. How long would an Earth's year be if mass of the Earth was equal to mass of the Sun and the distance between them stayed the same?

***5.** What minimal velocity should be supplied to a cosmic ship near the surface of the Earth so that it can leave the Solar System without firing its engines again? Orbital velocity of the Earth is 30 km/s. Do not account for gravity of other planets in this problem.

For the next meeting

IMPORTANT: The next club's meeting is at 3pm, online via Zoom on Sunday, **February 8**.