ADVANCED PHYSICS CLUB

DECEMBER 5, 2021

Useful resources

The updates, homework assignments, and useful links for APC can be found on SchoolNova's web page:
`https://schoolnova.org/nova/classinfo?class_id=adv_phy_club&sem_id=ay2021`
The practical information about the club and contacts can be found on the same web page.

Today's meeting

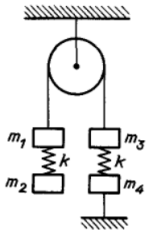
Today we started discussing Newton's laws. This assignment focuses on strings and springs.

This time again the homework is split in two parts: a simpler part 1 and a more complicated part 2. Solutions of part 1 will be discussed on the next meeting as usual. As for the solutions of part 2 we may not have time to discuss them all. We encourage you to discuss the problems in the Discord channel.

Homework part 1

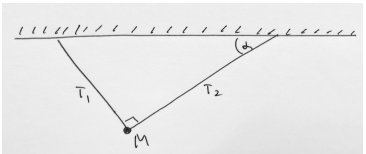
1. N springs with constants $k_1, k_2, \ldots, k_N$ are connected in a series from the ceiling. What effective spring can replace them (in the sense of having the same total stretch when a mass is hung at the bottom)? What if they are connected in parallel (they all have the same equilibrium length and support a long rod which is always kept horizontal)?

2. The system shown on the figure is initially in equilibrium. Find the accelerations of all the blocks after the string holding the block m_4 from below is suddenly cut (in equilibrium this string has some tension).



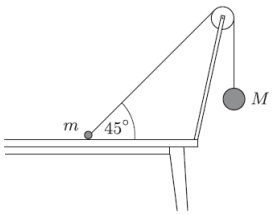
3. A chain of mass m is hung by its ends in such a way that it makes angle α with the horizon near the ends. Find the tension in the chain at the lowest point and near the ends.

4. A weight of the mass M is suspended on two strings as shown in the picture (the angle at the vertex M is the right one). Find the ratio of tensions in strings T_1/T_2.



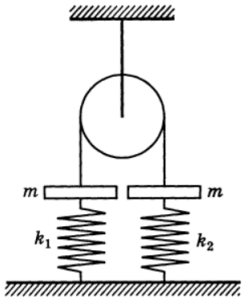
5. Heavy rod is bent at the right angle in its' middle point. Then it is hung from one of its' ends. What is the angle between the vertical direction and the upper half of the rod?

***6.** Two balls with masses M and m such that $M \gg m$ are connected by a thread going over a pulley and are initially held in equilibrium is the position shown on the figure. Then both of them are suddenly released at the same time. Will the ball m be immediately lifted above the horizontal surface? You could neglect the friction between the ball m and the plane.

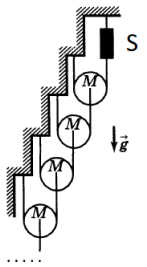


Homework part 2

***7.** In a system shown on the figure initially the springs are not deformed. Then the left block is moved down by distance x and released without initial velocity. Find accelerations of the blocks (which have the same mass) immediately after release. The left spring has a larger spring constant than the right one: $k_1 > k_2$. k_1, k_2, m, x and g are given.



***8.** A half-infinite system is made out of massless ropes and similar pulleys each of mass M. Find what force is displayed by a spring scale S.



For the next meeting

IMPORTANT: The next club's meeting is at 3:00pm, via Zoom, on Sunday, **December 12**.