PHYS1312 Fall 2024

Honors General Physics I

Written Homework II

Upload a pdf version of your solution to Canvas on or before
Wed Oct 2, 2024, 11:59pm

WARNING: You are encouraged to work on the homework in groups. But you should write up your own solution. **Anyone who copies homework or whose homework is copied will get zero point.**

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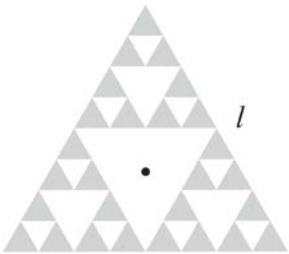
1. Generalize the scaling argument on P. 7 of Lecture 4 notes to the case where the spring constants are not the same, $k_1 \neq k_2$, and find the effective spring constant.

   Hint: divide a mass m into m_1 and m_2 such that when hung by springs with constants k_1 and k_2 will have the same extension.

2. Moment of inertia of an object with fractal dimension by scaling argument

   A **Sierpinski gasket** is an object of fractal dimension $\log_2 3 \approx 1.58$, i.e., its area $\sim l^{1.58}$. Starting from an equilateral triangle of sides l, remove the central inverted triangle. Do the same to each remaining upright equilateral triangle, then repeat the same process forever. Show that the moment of inertia about a perpendicular axis through the center of mass (centroid) is $\frac{1}{9} m l^2$.

3. Alternative solution to the girl walking on canoe problem

   On P. 6 of Lecture 7 notes we solved the problem by identifying the CM location as an invariant. There exists another invariant in the same problem because the time taken by the process (the girl walking from one end to another) is the same when measured on the shore and on the canoe. Use this invariant to show that the canoe has moved a distance 1.29 m as measured on the shore.