HW Assignment №32: Pendulums and Oscillation

Instructions: Please solve each problem on a separate piece of paper and submit them stapled with your name and student ID written in the right-hand corner of each page. Remember to show your work in order to get full credit for each problem.

1. If the bob of a simple pendulum made of iron is replaced by a wooden bob of the same size, how will the pendulum's time period be affected?
2. A simple pendulum with a hollow bob has a certain time period. It is filled with water and a small hole is made at the bottom of the bob. How will the time period be affected over time?
3. A mass is attached to a string on a frictionless, horizontal surface. When it is set into oscillation, its period is T. An equal mass collides head on with this mass and the two masses stick together. What is the new oscillation period?
4. A spring-mass system with parameters m and k is oscillating vertically. A second spring-mass with 3 times the mass is set up beside the first. If the two systems are to oscillate in unison, what must be the spring constant of the second system?
5. How could you increase the period of a simple pendulum by a factor of 2?
6. A given simple pendulum on Earth has a period of T. What will the period of the same pendulum be on the Moon where the gravity is 1/6 that of Earth's?
7. A mass M is attached to a spring on a frictionless, horizontal surface and set into oscillation. A smaller mass sit on top of the first one and moves with it without slipping. Describe the static friction force exerted on the smaller mass.
8. A mass m is attached to a spring with a constant k, hung vertically, and allowed to come to rest. Supporting the mass from below so that the spring cannot stretch further, a student adds a second mass $2m$ to the first mass. The support is then removed. What is the amplitude with which the system begins to execute vertical oscillation?
9. Two equal masses m connected by a light string are currently at rest. One of the masses is connected by a spring with a constant k to a fixed point directly above it. At $t=0$, the string is cut, and the mass connected to the spring begins to oscillate. Determine the period of the oscillation. Determine the amplitude of the oscillation. Determine the maximum speed of the mass. How much is the spring stretched when the mass is moving at half its maximum speed?
10. Suppose you are an astronaut and need to find the acceleration due to gravity on an asteroid using a pendulum. The period of the pendulum is 20 seconds and the length of the pendulum is 10 cm. What is g?