Problems for the 5th Canadian Young Physicists' Tournament 2021

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Adapted from the Problem for IYPT 2021

Group 1 (Day 1)

Problem A. Circling Magnets

Button magnets with different diameters are attached to each end of a cylindrical battery. When placed on an aluminium foil the object starts to circle. Investigate how the motion depends on relevant parameters.

Problem B. Irreversible Cartesian Diver

A simple Cartesian diver (e.g. an inverted test tube partially filled with water) is placed in a long vertical tube filled with water. Increasing the pressure in the tube forces the Cartesian diver to sink. When it reaches a certain depth, it never returns to the surface even if the pressure is changed back to its initial value. Investigate this phenomenon and how it depends on relevant parameters.

Problem C. Bead Dynamics

A circular hoop rotates about a vertical diameter. A small bead is allowed to roll in a groove on the inside of the hoop. Investigate the relevant parameters affecting the dynamics of the bead.

Problem D. Spin Drift

When a ring is set to roll in a parabolic bowl, interesting motion patterns may arise. Investigate this phenomenon.

Problem E. Wilberforce Pendulum

A Wilberforce pendulum consists of a mass hanging from a vertically oriented helical spring. The mass can both move up and down on the spring and rotate about its vertical axis. Investigate the behaviour of such a pendulum and how it depends on relevant parameters.

Group 2 (Day 2)

Problem F. Wind Speed

Let an electric current flow through a coil. When cold air flows over the coil, the coil's temperature will decrease. Investigate how the temperature drop depends on the wind speed. What is the accuracy of this method of measuring the wind speed?

Problem G. Guitar String

A periodic force is applied to a steel guitar string using an electromagnet. Investigate the motion of the guitar string around its resonance frequency.

Problem H. Dynamic Hydrophobicity

When a drop of liquid impacts on a horizontally moving surface, the droplet may be reflected or not, depending on the speed of the surface. Investigate the interaction between a moving surface and a liquid drop.

Problem I. Rebounding Capsule

A spherical ball dropped onto a hard surface will never rebound to the release height, even if it has an initial spin. A capsule-shaped object (i.e. Tic Tac mint) on the other hand may exceed the initial height. Investigate this phenomenon.

Problem J. Hand Helicopter

A simple hand helicopter can be made by attaching rotor blades to one end of a vertical stick. The helicopter moves upwards when the stick is twisted at a high enough speed and then let go. Investigate how the relevant parameters affect the lift-off and the maximum height.

Problem Selection Committee:

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