

# Problems for the 7<sup>th</sup> Canadian Young Physicists' Tournament 2023

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Adapted from the [Problem for IYPT 2023](#)



## A. Fractal Fingers

The effect of fractal fingering can be observed if a droplet of an ink-alcohol mixture is deposited onto diluted acrylic paint. How are the geometry and dynamics of the fingers influenced by relevant parameters?

## B. Oscillating Sphere

A light sphere with a conducting surface is suspended from a thin wire. When the sphere is rotated about its vertical axis (thereby twisting the wire) and then released, it starts to oscillate. Investigate how the presence of a magnetic field affects the motion.

## C. Siren

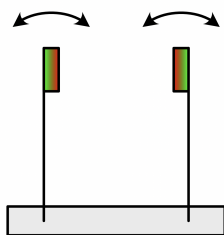
If you direct an air flow onto a rotating disk with holes, a sound may be heard. Explain this phenomenon and investigate how the sound characteristics depend on the relevant parameters.

## D. Coloured Line

When a compact disc or DVD is illuminated with light coming from a filament lamp in such a way that only rays with large angles of incidence are selected, a clear green line can be observed. The colour varies upon slightly changing the angle of the disc. Explain and investigate this phenomenon.

## E. Magnetic-Mechanical Oscillator

Secure the lower ends of two identical leaf springs to a non-magnetic base and attach magnets to the upper ends such that they repel and are free to move. Investigate how the movement of the springs depends on relevant parameters.

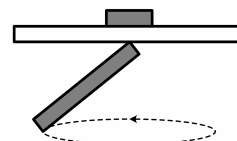


## F. Faraday Waves

A droplet of less viscous liquid floating in a bath of a more viscous liquid develops surprising wave-like patterns when the entire system is set into vertical oscillation. Investigate this phenomenon and the parameters relevant to the production of stable patterns.

## G. Euler's Pendulum

Take a thick plate of non-magnetic material and fix a neodymium magnet on top of it. Suspend a magnetic rod (which can be assembled from cylindrical neodymium magnets) underneath it. Deflect the rod so that it touches the plate only with highest edge and release it. Study the motion of such a pendulum under various conditions.



## H. Oscillating Screw

When placed on its side on a ramp and released, a screw may experience growing oscillations as it travels down the ramp. Investigate how the motion of the screw, as well as the growth of these oscillations depend on the relevant parameters.

## I. Ponyo's Heat Tube

A glass tube with a sealed top is filled with water and mounted vertically. The bottom end of the tube is immersed in a beaker of water and a short segment of the tube is heated. Investigate and explain the periodic motion of the water and any vapour bubbles observed.

## J. Arrestor Bed

A sand-filled lane results in the dissipation of the kinetic energy of a moving vehicle. What length is necessary for such an arrestor bed to entirely stop a passively moving object (e.g. a ball)? What parameters does the length depend on?

## Problem Selection Committee:

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Bryan Balkissoon	Crescent School
Marisca Vanderkamp	University of Toronto Schools
Alex Sorgente	Oakville Trafalgar High School
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