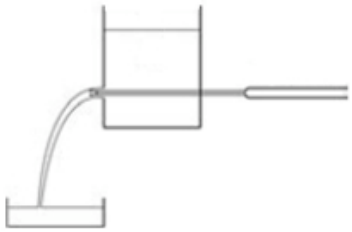
Problems for the New Zealand Young Physicists' Tournament, 2010

1. Electromagnetic cannon
A solenoid can be used to fire a small ball. A capacitor is used to energize the solenoid coil. Build a device with a capacitor charged to a maximum 50V. Investigate the relevant parameters and maximize the speed of the ball.

2. Grid
A plastic grid covers the open end of a cylindrical vessel containing water. The grid is covered and the vessel is turned upside down. What is the maximal size of holes in the grid so that water does not flow out when the cover is removed?

3. Liquid light guide
A transparent vessel is filled with a liquid (e.g. water). A jet flows out of the vessel. A light source is placed so that a horizontal beam enters the liquid jet (see picture). Under what conditions does the jet operate like a light guide?



4. Sand
Dry sand is rather 'soft' to walk on when compared to damp sand. However sand containing a significant amount of water becomes soft again. Investigate the parameters that affect the softness of sand.

5. Shrieking rod
A metal rod is held between two fingers and hit. Investigate how the sound produced depends on the position of holding and hitting the rod?

6. Rotating spring
A helical spring is rotated about one of its ends around a vertical axis. Investigate the expansion of the spring with and without an additional mass attached to its free end.

7. Kelvin's dropper
Construct Kelvin's dropper. Measure the highest voltage it can produce. Investigate its dependence on relevant parameters.