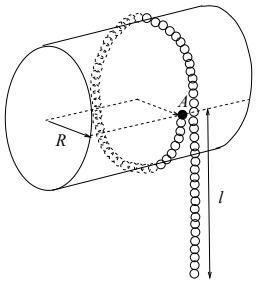
Eötvös 2000

1) A small-gauge rope is tied to a fixed cylinder with a radius R, a smooth surface, and a horizontal position, by fixing one end of it on the cylinder's surface at a point A at the same height as the cylinder's axis, and then passing the rope once over the cylinder. What should be the minimum length of the vertically hanging part l so that the rest of the rope is flush with the cylinder's surface everywhere?



2) Boil water in a test tube with an open top. Just before the last few drops boil away, the test tube is suddenly sealed airtight. Then the temperature at the top of the test tube is slowly raised to 200 °C, while ensuring, by cooling if necessary, and by heating if necessary, that the temperature at the bottom of the test tube remains at 100 °C.

   What will be the vapor pressure in the test tube?

3) Monochromatic light is incident perpendicular to an diffraction grating. The grating has adjacent slits spaced a distance d apart, with alternate wider and narrower slits. (For example, the width of the odd-numbered ones is a, that of the even-numbered ones is b, where $b < a$ and both are much smaller than d). Sketch the far-field diffraction pattern if $b \ll a$, or if $b \approx a$.