**Physics**

You can use computers during solving the tasks!

1. **The chock and cubes**. There are two identical cubes on a horizontal surface. The mass of each cube is M. Heavy chock with the mass m is injecting between the cubes with an apex angle. What are the accelerations of cubes? Ignore the friction.
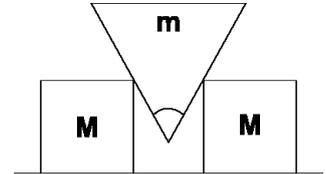

2. **Boat in the rapid river.** The boat can sail in still water at a rate of $v = 3$ m / s. Waterman wants to cross the river of constant width along the shortest path. In what direction relative to the bank, he must pull if the speed of water in the river $u = 4$ m / s? The speed of water in the river is the same everywhere.

3. **The electric circuit.** An electric circuit consisting of a finite number of elements is shown on the picture. The resistance of each resistor is 1 ohm. Calculate the sequence number of unit N, from which the addition of any number of new units will not change the overall resistance of the circuit between the terminals more than 5%.
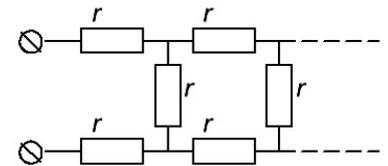
4. **A moving away stone.** At what angle to the horizon a stone have to be thrown so that the distance between the thrower and the stone will be increasing all the time while the moving?

5. **The air ballon.** Estimate to what temperature the air inside the balloon volume of 500 m³ needs to be heated so that he could lift a person weighing 70 kg? Weight of the ball shell is 30 kg.

6. **Distribution of the balls.** A device, which is a box with a transparent front wall, is shown on the picture. The pins are driven in the back wall in staggered order and form a triangle. The balls are thrown into the box from above. Each of the balls with equal probability can turn either right or left facing with a pin at each layer. The bottom part of the box is divided by 15 partitions. Determine what percentage of the total number of the balls will fall in the center (eighth) section, if the total number of the balls is large enough.
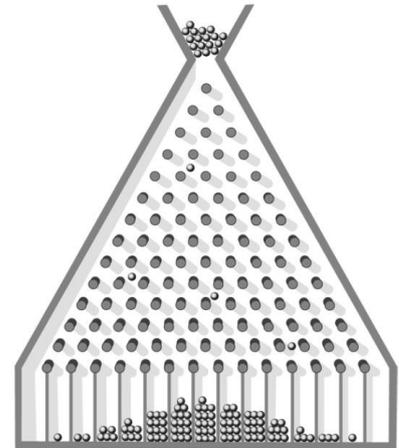
7. **The sphere with two charges.** There is a small ball of mass m with a charge $+q$ inside smooth non-conducting sphere of radius R. What charge Q must be placed in the bottom point of the sphere so that the ball is helding at the top? The polarization of the sphere can be ignored.

8. **The heat engine.** A cycle the heat engine consists of two isochors and two isobars, the working fluid is an ideal monatomic gas. Find the efficiency of this heat engine if the centre of the bottom isobar and left isochor lie on the isotherm corresponding to a temperature T_1 and the centre of the upper isobars and right isochors lie on the isotherm corresponding to a temperature T_2.