KAMA challenge 2015

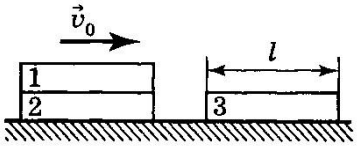
PHYSICS

Questions to amusing experiments in physics

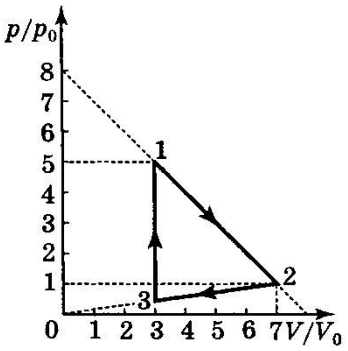
1. What physical phenomenon occurred in the first experiment?
2. Write down the inequality underlying the second experiment.
3. What machine model appeared in the third experiment?
4. What is in the first black box?
5. On what physical phenomenon the experiment with the first black box is based?
6. What is in the second black box?
7. What force caused the tube to roll along the second box?
8. Who magnetized the stand rod?
9. What phenomenon occurred in this experiment?
10. Who discovered this phenomenon?

Theory exercises

1. Board 1 is placed on an identical board 2 as shown. Both boards slide along a smooth icy surface at speed v_0 and collide with an identical board 3, the upper surface of which is covered with a thin layer of rubber. Boards 2 and 3 stick together after the collision. What is the length l of each board, if it is known that board 1 stops its motion relative to boards 2 and 3 due to friction after it fully slides from board 2 on top of board 3? All boards are solid. The coefficient of friction between boards 1 and 3 is μ. Friction between boards 1 and 2, and friction between boards 2 and 3 and ice may be neglected.

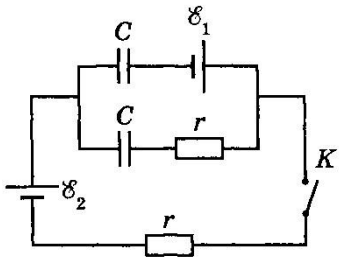


2. In a heat engine, ν moles of monoatomic ideal gas undergoes a cyclic process consisting of processes 1-2 and 2-3, where gas pressure p is linearly dependent on gas volume V and on isochoric process 3-1. p_0 and V_0 are known. Find: 1) gas temperature and pressure at point 3; 2) work A done by the gas for one cycle; 3) the heat engine efficiency.



3. Fully charged capacitor C is discharged through an element with unknown voltage-current characteristic. The current in the circuit depends on time as , where I_0 and a are positive constants. The capacitor is fully discharged at time $t_0 = I_0/a$. Find the element's voltagecurrent characteristic.

4. In the circuit shown in the figure, the switch K is open and no current flowing. Find: 1) currents through batteries $\mathcal{E}_1$ and $\mathcal{E}_2$ immediately after the switch K is closed; 2) the change in electrostatic energy ΔW of the system after currents are cut off; 3) work A_1 and A_2 done by batteries $\mathcal{E}_1$ and $\mathcal{E}_2$ for the entire process; 4) the amount of heat Q released by resistors after the switch K is closed.



Experimental task

Exercise: Calculate the length and thickness of toilet paper.

Equipment: A roll of toilet paper without package and a tube inside, a piece of the same paper 1 meter long.