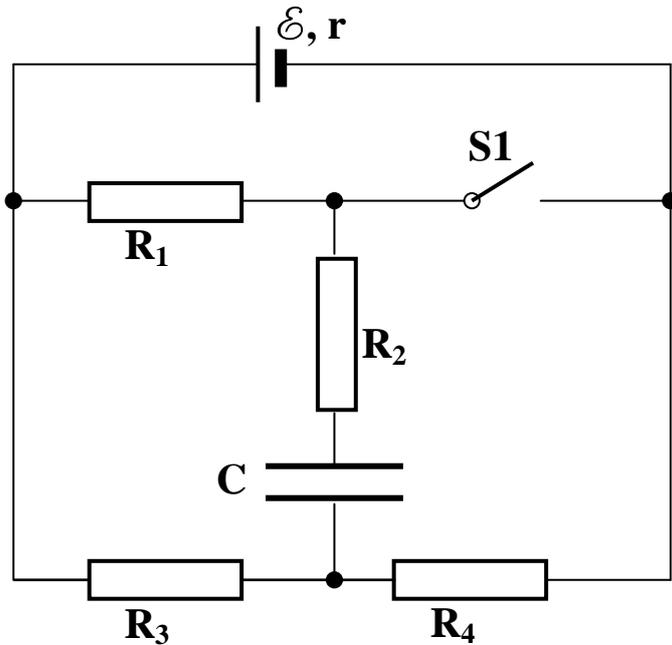


Form 12

1. Problem

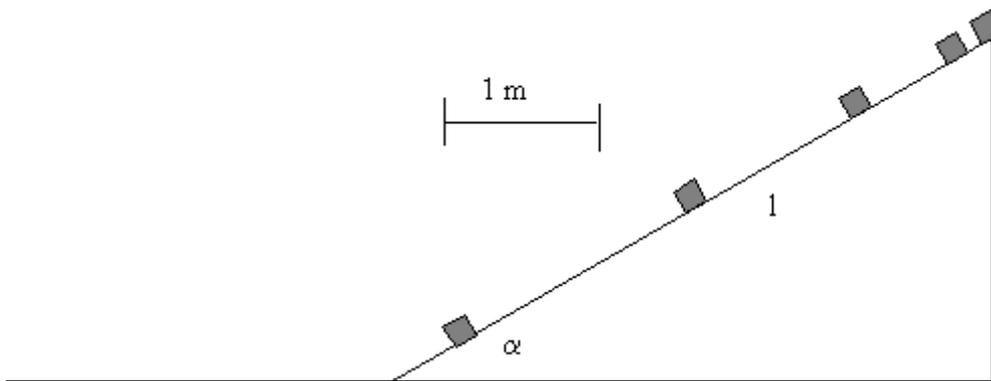
In the circuit given below the EMF of the battery $\mathcal{E} = 21 \text{ V}$, its internal resistance $r = 10 \Omega$, capacitance of the capacitor $C = 1,0 \text{ mF}$ and corresponding resistances: $R_1 = R_4 = 100\Omega$, $R_3 = 50 \Omega$, $R_2 = 1 \text{ k}\Omega$.

At the initial state switch S1 is closed. Calculate the electric charge q which goes through resistance R_2 if the switch S1 is open.



2. Problem

At the top of inclined plane small box is released. Mass of the box is 2 kg. Positions of the box after each $t_0 = 0,5 \text{ s}$ since release are shown in the picture. G can be assumed equal to 10 m/s^2

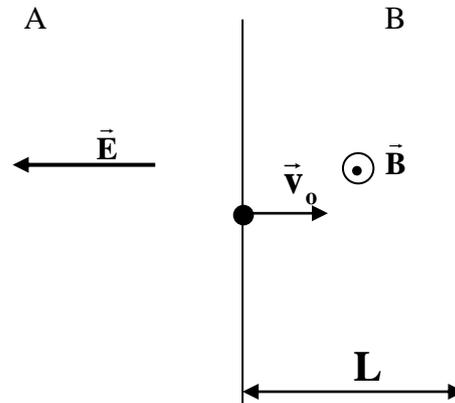


- By doing measurements in the picture, determine the length of the plane and angle α .
- Determine acceleration of the box.
- What is the time in which the box reaches the end of the plane and what is its final speed?
- What is the ratio of mechanical energies at the beginning of the motion and at the end of the inclined plane (use the lower end of the plane as the reference point)?
- What is coefficient of dynamic friction between the box and inclined plane surface?
- What is the distance made by box on horizontal surface if the coefficient of friction between box and horizontal surface $\mu_2 = 0,2$?

3. Problem.

Uniform magnetic field with induction of $B=10$ mT is directed perpendicular to the sheet plane towards us. Magnetic field exists in the $L = 0,6$ m wide region of space. Perpendicular to magnetic field a) electron, b) proton with initial velocity $v_0 = 1 \cdot 10^6$ m/s is shot into magnetic field. At the same moment when particle enters the magnetic field, electric field $E = 10$ V/m is switched on (direction is shown in the picture). Absolute value of charge of electron and proton $q = 1,6 \cdot 10^{-19}$ C, mass of electron $m_e = 9,1 \cdot 10^{-31}$ kg, mass of proton $1,67 \cdot 10^{-27}$ kg.

- A. Calculate the potential difference of electric field required to accelerate the particle a) electron, b) proton to its initial speed.
- B. Calculate the radiuses of the paths of electron and proton in magnetic field. Calculate the deviation angles after crossing magnetic field region and motion time in the magnetic field region and in electric field.
- C. Draw the paths of the particles and characterize its motion



4. Problem

Rectangular cork with length $h = 5$ cm floats vertically in the lake. Cork is suddenly pulled by the fish, and it starts to oscillate vertically. Concentric waves spread from the cork in all directions on the water surface.

- A. Verify if the oscillations are harmonic.
- B. Calculate the oscillation period.
- C. Calculate the speed of the waves on the water surface if the distance between the tops of the two consecutive waves is 30 cm.
- D. Will the oscillations of the cork be harmonic if the shape of it would be spherical?

Water resistance and surface tension can be neglected.