The 33rd International Science Olympiad for Young Mathematicians, Physicists and Chemists March 5, 2021



## **Physics – Grade 10**



1. What is the equivalent resistance of the combination of resistors  $R_1 = 1 \Omega$ ,  $R_2 = 3 \Omega$ ,  $R_3 = R_4 = R_6 = 2 \Omega$ ,  $R_5 = 4 \Omega$  between points A and B of the circuit diagram as shown in the figure?



2. You decided to mark lake territory using a buoy. The height of a helicopter above a lake is 2.5 m and the buoy of density  $\rho_1 = 800 \text{ kg/m}^3$  being at rest is dropped from this height. The density of lake  $\rho_2 = 1000 \text{ kg/m}^3$ . Neglecting all dissipative forces, find: 1) velocity of the buoy near the water surface; 2) acceleration of the submerged buoy in the lake; 3) the maximum depth *s* to which the buoy sinks before returning to float on the surface. Take  $g = 10 \text{ m/s}^2$ .



- 3. You have a friend who likes to read books about vampires. He says that a silver bullets might kill these creatures. It is known that the melting point of silver is 960.8 °C. At the request of a friend calculate the initial speed of a silver bullet at 30 °C so that the heat developed when it is brought to rest will be just sufficient to melt it. Assume all the internal energy generated by the impact remains with the bullet and that no heat changes to its surroundings. Specific heat capacity of silver c = 235 J/kg·K and the latent heat of fusion  $L = 8.82 \times 10^4$  J.
- 4. Seawater is the most important water resource on the Earth, which covers  $\sim$ 70% of the earth's surface and generally considered to be most corrosive natural environment. It is known that the average depth of the ocean is about 3688 meters. On average, seawater in world's oceans has a salinity of about 3.4% by weight. If all seawater were evaporated, a salt layer *h* would form on the entire earth's surface. Calculate thickness of the salt



layer *h* if seawater density is 1028 kg/m<sup>3</sup> and average salt density is 2200 kg/m<sup>3</sup>. What would be the thickness of the salt layer *h*' if, after evaporation of the seawater, salt covered only the continental part? The radius of the Earth is  $6.37 \times 10^6$  m