

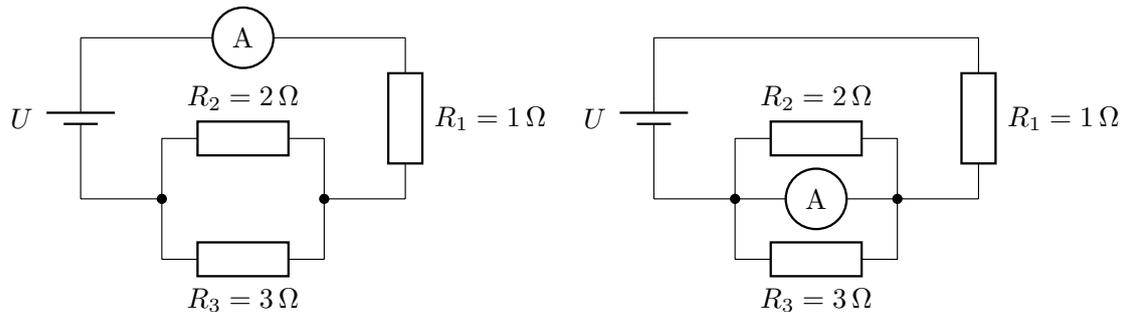


**The 28th International Science Olympiad for Young  
Mathematicians, Physicists and Chemists**  
November 3, 2015  
Physics - Form 10



1. An electrical circuit contains an ideal voltage source with voltage  $U = 11\text{ V}$ , three resistors and an ideal ammeter. The ammeter can be connected to the circuit in two different ways, depicted on the figures below.

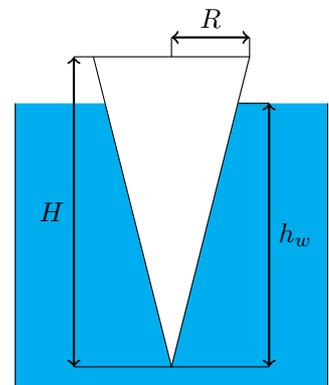
- a) What is the current  $I_1$  through the ammeter in the circuit depicted on the left? (2 points.)  
b) What is the current  $I_2$  through the ammeter in the circuit depicted on the right? (4 points.)



2. Two motorcyclists started moving from a standstill and both traveled  $s = 150\text{ m}$  in  $t = 15\text{ s}$ . The first motorcyclist had constant acceleration for the first half of the time, after which he moved with a constant speed. The second motorcyclist had constant acceleration for the first half of the distance, after which he stopped accelerating.

- a) What was the acceleration of the first motorcyclist  $a_1$  while he was accelerating? (5 points.)  
b) What was the acceleration of the second motorcyclist  $a_2$  while he was accelerating? (5 points.)

3. A cone with uniform density  $\rho_c$ , height  $H = 40.0\text{ cm}$  and base radius  $R = 10.0\text{ cm}$  floats in water as depicted in the figure on the right. The height of the submerged part of the cone is  $h_w = 34.0\text{ cm}$  and the density of water is  $\rho_w = 1000\text{ kg/m}^3$ . The cone is prevented from falling over at all times.



- a) What is the mass of the cone  $M$ ? (4 points.)  
b) What is the density of the cone? (2 points.)  
c) The cone is placed into a liquid with unknown density  $\rho_u$ . This time the height of the submerged part of the cone is  $h_u = 36.8\text{ cm}$ . What is the density of the liquid? (4 points.)

4. An ideal calorimeter contained water ice. Both the amount of ice and its initial temperature were unknown. First  $M_1 = 3\text{ kg}$  of hot water with temperature  $T_w = 80^\circ\text{C}$  was poured into the calorimeter. After thermal equilibrium was reached all of the ice had melted and the temperature of water was  $T_1 = 5^\circ\text{C}$ . Additional  $M_2 = 22\text{ kg}$  of water with temperature  $T_w$  was then poured into the calorimeter. The final temperature of water was  $T_2 = 65^\circ\text{C}$ . The latent heat of ice is  $L = 334\text{ kJ/kg}$ , specific heats of water and ice are  $c_w = 4.2\text{ kJ/(kg}\cdot\text{K)}$  and  $c_i = 2.0\text{ kJ/(kg}\cdot\text{K)}$  respectively. The melting temperature of ice is  $T_m = 0^\circ\text{C}$ .

- a) What was the initial mass of ice  $M_0$ ? (7 points.)  
b) What was the initial temperature of ice  $T_0$ ? (7 points.)