NAME AND SURNAME ..... UNIVERSITY .....

Selected issues:			

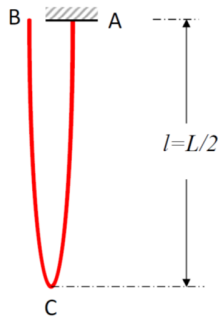
GENERAL PHYSICS COMPETITION FOR ENGINEERING STUDENTS "ION I. AGARBICEANU"

XI Edition 2023 13 May 2023

Theoretical test, Physical Section 1

Each contestant participates in the contest with 3 of the 6 subjects of their choice. On the first competition sheet, the candidate will specify under his signature the numbers of the subjects he has chosen.

1. A uniform chain (twine) of length and mass is attached to the end A as in the figure. At the moment the end B is left free from the level of the end A. Find the rate of descent of point C at the moment when the kinetic energy of the moving part is maximum. Numerical application : $L = 2lM = 2mt = 0l = 100\ cm; g = 10\frac{m}{s^2}$.



2. A room in an apartment building is heated from the initial temperature $\theta_1 = 0^0 C$ to the final temperature $\theta_2 = 20^0 C$. The volume of the room is $V = 50\ m^3$. Taking into account the external pressure $p_0 = 10^5 N/m^2$, let us find out what is the amount of heat required. Air is thought to consist of biatomic molecules.

3. A particle with mass m is at rest at the apex of a hemisphere of mass M, (see figure 1). With a small impulse, the body begins to slide, without friction, on the hemisphere. At an angle θ, to the vertical passing through the center of the hemisphere, the body detaches from the hemisphere. Consider that the hemisphere can move horizontally without friction and is initially at rest.

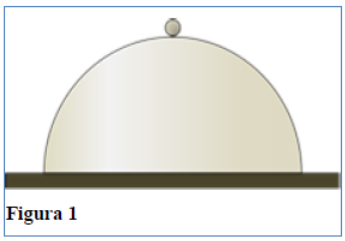
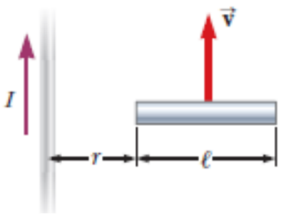


Figura 1

a) Write the equation that allows the calculation of angle q.

b) Calculate the angle θ if $M = m$.

4. A conductive bar of length l moves with constant velocity v parallel to a filiform conductor through which passes an electric current of intensity I as shown in the figure. The bar remains perpendicular to the conductor, with the nearest end at a distance . r The bar-conductor system is in vacuum (). Find the value of the electrical voltage generated between the ends of the bar. Numerical application: .$\mu_0 = 4\pi \times 10^{-7}\ H/$ $ml = 15.5\ cm; r = 0.5\ cm; v = 20\frac{m}{s}; I = 5\ A; ln2 = 0.693$



5. A quantity of ideal monatomic gas ($C_V = \frac{3}{2}R$) goes through a thermodynamic process from the initial state ($p1$, $V1$) to the final state ($p1$/3, 3V1). The graph of this process, in coordinates (p, V), is a line segment, over $p_1 = 100\text{kPa}$ and . $V_1 = 6\text{L}$ Calculate: a) the heat received by the gas during heating; (b) the heat exchanged by the gas throughout the thermodynamic process; (c) the heat received by the gas.

6. The permittivity of an inhomogeneous R-ray sphere in vacuum varies according to the law

$$\varepsilon\,(r) \;=\; \varepsilon_0 \left(\frac{r}{R} + 2 \right)$$

Calculate the electric field created by a charge Q distributed throughout the volume of the sphere.