| COMPETITIVE ENTRANCE EXAMINATION INTO HTTTC BAMBILI | |
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| **CYCLE:1stCYCLE**<br>**LEVEL: 1st**<br>**OPTION: INDUSTRIAL**<br>**PAPER: PHYSICS** | **Session: 2010** |
| **DURATION: 3hrs** | |

***Execise1***

A- One consider a vertical wire with one end fixed to a support which supports the other end in the middle, a uniform rod $AB$ of mass $M = 50g, length\ L = 15cm$. The constant torsion wire is $C = 5x10^{-4}Nrad^{-1}$.

Fixed at each end of the stem, is a small sphere of mass $m = 10kg$ with a negligible radius in front of $L$. Together they can oscillate horizontally without friction around the wire.

1) Calculate the moment of inertial $J$ of the stem-spheres with respect to the axis of rotation. Recall that moment of inertia, $J_0$, from the axis of rotation from the middle of the homogeneous rod of mass $M$ and length $L$ is $J_0 = \frac{Mp^2}{12}$.
2) One keeps away, in the horizontal plane, the system of its equilibrium position. Demonstrate that the movement is sinusoidal and calculate the period $T$ of the oscillations.
3) Position and moving away without inertial speed. Calculate the angular velocity and kinetic energy $w_c$ when passing through its position. Deduce the work $T$ of the torque force torsion wire when $\theta$ varies from, $0\ to\ \theta_m$ .

B) The system is placed between the plates of a vertical capacitor plane separated by a distance $d = 0.20m$. the potential difference between the plates is $U_0 = 10kV$.

We admit that, at every moment the electric field $E$ created betwteen the plates is uniform. The stem blocking is perpendicular to the plate, balance and the torsion of the wire is therefore worthless. One charges, one of the spheres by a quantity of electricity $+q$ and the other by, $-q$.

We assume that $+q\ and\ -q$ do not disturb the electric field, $E$.

1) Determine the electric field vector $E$ between the armatures of the capacitor plane.
2) In rejecting the system's equilibrium position, it starts oscillating with a period $T$ different from $T_0$.

b) Calculate the moment resulting from the forces applied when the stem makes an angle $\theta$ with the position of equilibrium. From a diagram show which sphere is positively charged, taking into account the direction of the electric field that the candidate choose arbitrary. Calculate the moment due.

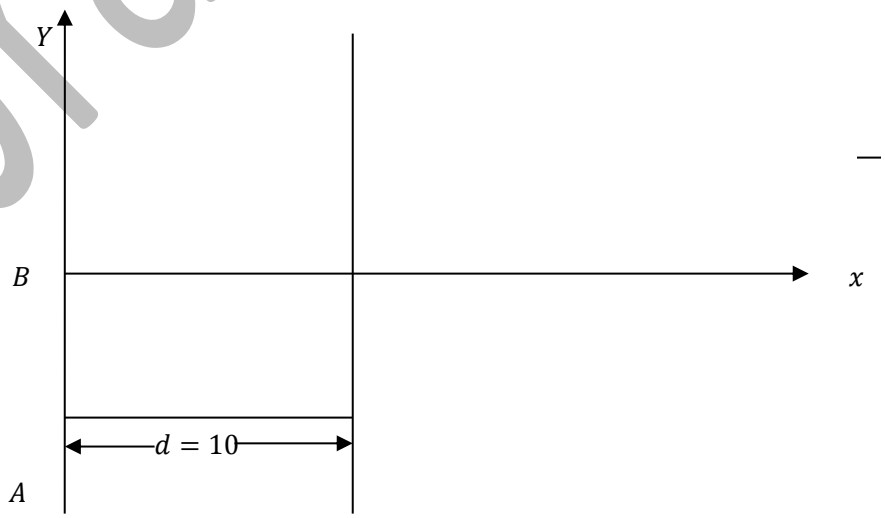
c) Express the period $T$, in terms of $q, E, L, C\ and\ J$ for the low amplitude oscillations.

3) We measure a period of $3.16s$. Deduct from this experience the absolute value of electric charges carried by the spheres.
4) The mobile has been removed from its equilibrium for an angle $\theta_m = \frac{\pi}{2} rad$ , and leaves without initial speed. What is the kinetic energy during the transition from its equilibrium position?
   The electric field and the charges are identical to the previous question.

### *Exercise 2*

A particle of charge, $= 2x10^{-11}c$ , penetrates at 0 in a region where there is an electrostatic field $E = 10Vm^{-1}$. One gives, $= 10ms^{-2}$ .

1) Knowing that the mass of the particle is $m = 3x10^{-2}kg$ and its spontaneously starts moving as soon as it's abandoned at 0 without initial speed.
   a) Compare the potentials of plates $A\ and\ B$.
   b) Represent on the figure below the force to which the potential is submitted, the signs of the plates and the electric field $E$ between the two plates.
   c) Calculate and compare the intensities of the forces acting on the particle.
   Conclude.



2) Establish the equation of the particle by neglecting the weight of the particle in the orthogonal reference $(0, I, J)$ assumed Galilean. One will take the moment when the particle leaves point 0 as the origin of dates.
   Note: At $t = 0$ , $V = 0$.
3) Knowing that $d = 10cm$, with what velocity does the particle arrives the plate?
4) Deduce the reason why this system can be called accelerator of particle.

### *Exercise 3*

Starting from rest a mobile moving straight acquires the speed of $10ms^{-1}$ after $25m$ course. It then travels $50m$ with this speed and stops at $125m$ from its starting point. One supposes the movement of the first and the third phase as uniformly varied.

1) Calculate the acceleration of the mobile as each phase.
2) Is considered that at the time $t = 0$, the mobile begins its movement. Calculate the start date of each phase.
3) Write the honary equation of motion on each phase. Deduce the date of arrest