INSTITUT SAINT JEAN

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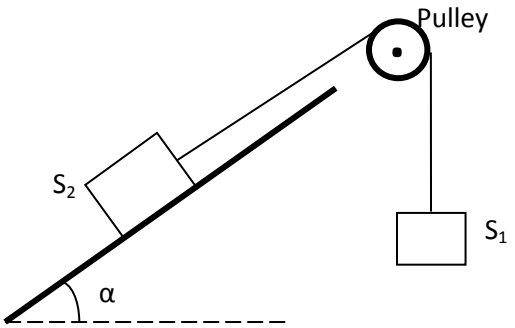
COMPETITIVE ENTRANCE EXAMINATION
SERIE : GCE/AL

PHYSICS EXAMINATION
Duration : 2 Hours

EXERCISE 1 : (5 pts)

A particle S_1 of mass m_1 is connected to another S_2 of mass m_2 by a rigid inextensible string of negligible mass, passing over a pulley of moment of inertia J_Δ. The particle S_2 moves on a smooth plane incline at angle α to the horizontal, pulled by the particle S_1. The acceleration due to gravity is of constant magnitude g .

1- Indicate the forces acting on S_1 ; S_2 and the pulley. **1.5 pt**
2- State the theorem of the moment of inertia. **0.5 pt**
3- Write the equations of motion of S_1 and S_2 showing the tensions T_1 and T_2 on each portion of the string in terms of the linear acceleration ***a*** of the particles. **1.5 pt**
4- Write the equation of motion of the pulley in terms of the tensions on each portion of the string. **0.5 pt**
5- Deduce the expression of the linear acceleration ***a*** of the particles in terms of α, g and J_Δ. **1 pt**



EXERCISE 2 : (5pts)

A photoelectric cell is illuminated with monochromatic light of wavelength 412 nm. The stopping potential 1.25V and the saturation current has a value of 1. 60 μA

1- Sketch the characteristic graph i = f(U) of the cell and precise some reference points. **0.5 pt x 2**
2- Calculate the maximum speed of an electron emitted from the cathode. **1pt**
3- Deduce the work-function of cesium and the threshold wavelength of cesium. **1pt**
4- When the speed with which an electron arrives the anode of the photocel is 2.5×10^3 km.h^{-1}, Calculate the potential difference U_{AC} between the anode and the cathode. **1pt**
5- Calculate the number of electrons emitted per minute photoelectric cell is saturated. **1 pt**

Given : $C = 3 \times 10^8 m.s^{-1}$; $e = 1.6 \times 10^{-19} C$; $h = 6.62 \times 10^{-34} J.s$.

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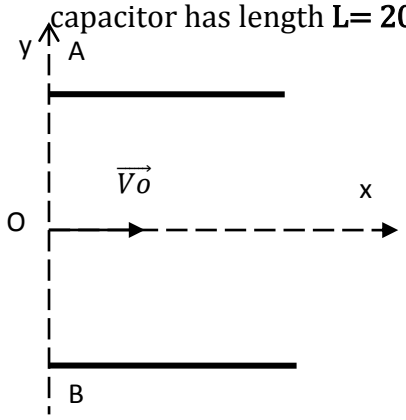
EXERCISE 3 : (5pts)

A beam of O^{2-} ions penetrates the region between the two plates A and B of a parallel plate capacitor at a point O in its centre with a horizontal velocity $\overrightarrow{Vo}$. The plates of the capacitor has length **L= 20cm** and are separated by a distance **d = 12cm** and U_{AB} **= -2kV**.



1- Draw the electric field vector between the plates A et B, and justify its direction. **0.5pt**
2- From analyses of the motion, deduce the velocity vector and acceleration of the ions between the plates A and B. **1pt**
3- Deduce the expression of the equation of the path or trajectory of the ions. **1pt**
4- Determine the coordinates of the point S where the ions live the capacitor. **1pt**
5- Calculate the deviation Y on a screen situated at **D= 1m** from O. **1.5pt**

Note : ***The weight of the ion is negligible compared to the electrostatic force on it.*** Given : $e = 1.6 \times 10^{-19}$ C

EXERCISE 4 : (5 pts)

In YOUNG double slit device, the distance between the slits F_1 and F_2 is a= 2 mm and the distance from the slits to the screen is D= 1.5m. A point source of monochromatic light (λ= 675 nm) placed on the central axes of the system, illuminates the slits.

1- Draw a diagram of the set up showing the two beams from the slit F_1 and F_2, indicating the zone of interference on the screen S. **1pt**
2- What will be observed on the interference zone on the screen? **0.5pt**
3- Define « interfringe distance » , states its formula and calculate its value. **1pt**
4- Calculate the distance L from the fifth dark fringe on the positive side and the third bright fringe on the negative side. **1pt**
5- The set up is now illuminated with a dichromatic light of wavelengths λ_1=420 nm and λ_2= 540 nm.
  a- What do you observe on the screen? **0.5pt**
  b- What is the distance from the centre of the screen to the point where there is the first coincidence between the bright fringes of λ_1 and λ_2 ? **1pt**