ENTRANCE EXAMINATION : E.A.M.A.C. LEVEL : TECHNICIAN AND SUPER TECHNICIAN SESSION 2013	TEST OF PHYSICS DURATION : 3 HOURS

Exercise N°1 (5 marks)

A spring with no jointed whorls, of stiffness k, and negligible mass is suspended to a vertical support by one of its ends. A solid S of mass m is fixed on the other lower end of the spring. The spring lengthens of x_0 and a position of equilibrium is reached. From its equilibrium position, the spring is stretched by making the solid going down vertically, then it is released. It is noted that S carries out oscillations on both sides of its equilibrium position of amplitude a and period T_0. At the passage of the solid at its equilibrium position ,the chronometer is activated locating if it goes up or down. The chronometer is stopped at the end of 20 oscillations. The experimental results are as follows:

m (g)	20	40	60	80	100
x_0 (cm)	4.0	8.1	12.2	16.2	20.2
Duration of 20oscillations	8.2	11.5	13.90	16.06	17.91

1) Why the duration of 20 oscillations is measured instead of one? (0.5 marks)

2) In fact the amplitude of the movement is not constant in the time. Why? (0.5 marks)

3) Establish the relation between x_0, g_0 (intensity of the gravity), m and k. (0.5 marks)

4) $T_0 = 2\pi\sqrt{(m/k)}$ is theoretically established.

a) Expose a method that allows determining the value of k. (0.5 marks)

b) Establish the relation giving T_0 according to x_0 and g_0 (1 marks)

c) Calculate T_0^2 by placing the values in a table. (0.5 marks)

d) Plot $x_0 = f(T_0^2)$. (1 marks)

e) Deduce g_0 from the curve. (0.5 marks)

Exercise N°2 (5 marks)

An experiment of luminous interferences using the slits of Young is carried out. Two punctual sources F_1 and F_2 synchronous and coherent are obtained from a device. F_1 and F_2 are separated by a distance a=0.75mm. A screen E orthogonal to the mediator plan of F_1 and F_2 is placed at a distance D = 2m of meddle I of F_1F_2.The monochromatic light emitted by the sources has as a wavelength λ in the air.

1) Schematize the experimental device. (0.5 marks)

2) What is observed on the screen E? Justify the name of nonlocalised fringes. (0.5 marks)

3) Establish the expression of the difference in path between the luminous vibrations interfering at the point M of the screen E such as OM = x. (1 marks)

4) Knowing that the point M defined by OM = 9.43mm is located in the middle of the 6th brilliant fringe, the central fringe being noted zero, deduce the wavelength λ of the light used. (1 marks)

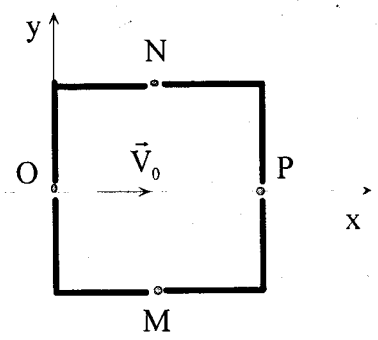
5) A glass strip of parallel face of index of refraction n=1.52 and weak thickness e is applied to the source F_1 .

a) Establish the expression of the new difference in path δ'. Is the inter-fringe modified? (1 marks)

b) A displacement of 8.25mm of the central fringe is observed. Justify the direction of displacement, and calculate the thickness e of the strip. (1 marks)

Exercise N°3 (5 marks)

In the following device prevails a high vacuum. The force of gravity is neglected compared to the other forces.



A homokinetic beam of protons H^+, initially accelerated by a tension applied between two plates A and C, penetrates in O with a speed V_0 = 800km/s in an enclosure of square section of dimension 2r = 50cm where openings O M P N are located at the middles of the sides. $m_p=1.67.10^{-27}$kg; $q = 1.6.10^{-19}$C for the proton are given.

1) a) What should be the sign of the potential difference $U = V_A-V_C$? Make a diagram. (0.5 marks)

b) Calculate in joule and electron volt the kinetic energy of a proton which crosses the opening O . (0.5 marks)

2) In this enclosure prevails a uniform magnetic field $\vec{B}$ so that the protons describe at the speed $\vec{V_0}$ a quadrant of radius r before leaving by the opening M.

a) Give the expression of the force $\vec{F}$ which is exerted on a proton of speed V_0 in the magnetic field B. (0.5 marks)

b) Specify the direction and the sense of $\vec{B}$. (0.25 marks)

c) Establish the expression of the value of the magnetic field B according to V_0, q, m_p and r. Calculate numerically B. (1 marks)

3) The previous magnetic field $\vec{B}$ is removed, and an electric field $\vec{E}$ is applied so that the beam crosses the opening N after describing a parabolic trajectory in the reference mark (O, x, y).

a) Give the expression of the force F' which is exerted on a proton in the uniform electric field E. (0.5 marks)

b) Specify on a diagram the direction and the sense of $\vec{E}$ (0.25 marks)

c) Give the expression of the value of the electric field E according to m_p, V_0, q and r. Calculate numerically E. (1 marks)

4) The fields $\vec{E}$ and $\vec{B}$ preserving the previous directions and sense are applied simultaneously. Which relation should be checked by their values so that the protons leave the device by the opening P without being deviated. (0.5 marks)

Exercise N°4 (5 marks)

A dipole RLC connected in series, consists of a coil and a condenser of capacity C = 0.5 μF, is supplied by a generator delivering a sinusoidal voltage of variable frequency N; the effective voltage U at the boundaries of the generator is 0.9V

N(Hz)	2000	2100	2150	2200	2250	2275	2300	2325	2350	2375	2400	2450	2500	2600	2700	2800
I(mA)	22	32	42	57	84	102	120	130	118	100	85	60	43	30	22	16

1) Plot the curve I = f(N) (1 marks)

2) Determine using the plotted curve:

a) The frequency of resonance N_0 (0.5 marks)

b) The corresponding effective Intensity I_0. (0.5 marks)

3) Calculate the inductance L of the coil. (1 marks)

4) Evaluate using the chart:

a) The bandwidth, (0.5 marks)

b) The factor of quality Q of the circuit. (0.5 marks)

5) Calculate the resistance R of the circuit. (1 marks)