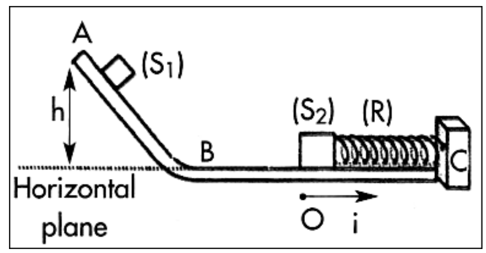
دورة سنة 2003 العادية	امتحانات شهادة الثانوية العامة فرع علوم الحياة	وزارة التربية والتعليم العالي المديرية العامة للتربية دائرة الامتحانات
الاسم : الرقم :	مسابقة في الفيزياء المدة : ساعتان	

This exam is formed of three obligatory exercises in three pages numbered from 1 to 3. The use of non-programmable calculators is allowed.

<u>First Exercise</u> (6 ½ points) Determination of the force constant of a spring



In order to determine the force constant k of a spring (R) of un-jointed turns, we consider:
- a frictionless track ABC found in a vertical plane,
- a spring (R) having one end fixed to a support C and its other end connected to a solid (S_2) of mass m_2 of negligible dimensions.
- a solid (S_1) of mass $m_1 = 0.1$ kg and of negligible dimensions held at A at height h = 0.8 m above the horizontal plane containing BC.

The horizontal plane containing BC is taken as the gravitational potential energy reference. Take g = 10 m/s^2.

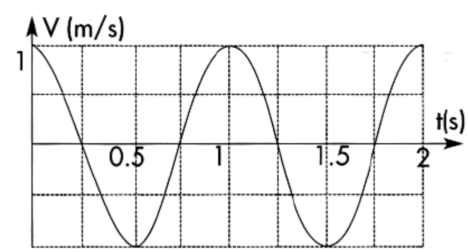
1- (S_1), released from rest at A, reaches (S_2) with a velocity $\vec{V_1}$. Show that the magnitude of $\vec{V_1}$ is $V_1 = 4$ m/s.

2- (S_1), collides with (S_2) and sticks to it, thus forming a particle (S). Determine, in terms of m_2, the expression of V_o the magnitude of the velocity $\vec{V_o}$ of (S) just after the impact.

3- The system [(S), (R)] forms a horizontal elastic pendulum, (S) oscillating around its equilibrium position at O.

a- Determine the differential equation that describes the motion of the oscillator. Deduce the expression of its proper period T_o.

b- Figure (2) represents the variation of the algebraic value of the velocity of (S) as a function of time.
The origin of time corresponds to the instant when the velocity of (S) is $\vec{V_o}$.



i- Give the value V_o of $\vec{V_o}$.
ii- Deduce the value of m_2.
iii- Give the value of T_o.
iv- Calculate k.

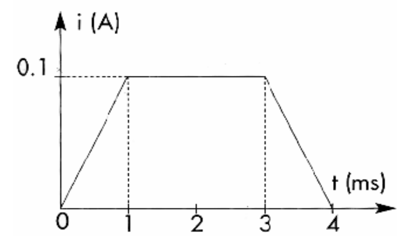
<u>Second Exercise</u> **(7 points)** **Role and characteristics of a coil**

Consider a coil (B) that bears the following indications: L = 65 mH and r = 20 Ω.

A- Role of a coil

In order to show the role of a coil, we connect the coil across a generator G_1 .

The variation of the current i carried by the coil as a function of time is represented in figure (1).



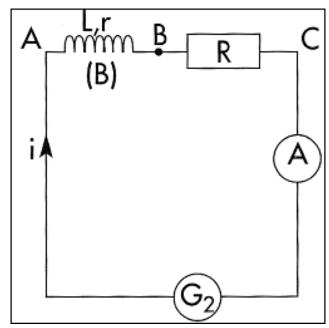
1- a- Give, in terms of L and i, the literal expression of the induced electromotive force e produced across the coil.

b- Determine the value of e in each of the following time intervals: [0; 1ms], [1 ms; 3 ms], [3 ms; 4 ms].

2- In what time interval would the coil act as a generator? Justify your answer.

B- Characteristics of the coil

In order to verify the values of L and r, we perform the two following experiments:

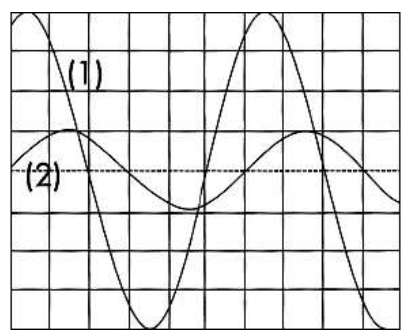


I- **First experiment:** The coil (B), a resistor of resistance R = 20 Ω and an ammeter of negligible resistance are connected in series across a generator (G_2) of electromotive force E = 4 V and of negligible internal resistance (figure 2). After a certain time, the ammeter reads I = 0.1 A. Deduce the value of r.

II- **Second experiment:** The ammeter is removed and G_2 is replaced by a generator G_3 delivering an alternating sinusoidal voltage.

1- Redraw figure (2) and show on it the connections of an oscilloscope that allows to display, on the channel (1), the voltage v_g across the generator and, on channel (2), the voltage v_R across the resistor.

2- The voltages displayed on the oscilloscope are represented on figure (3).



Given: vertical sensitivity on both channels: 2 V/division.

horizontal sensitivity: 1 ms/division.

a- The waveform (1) represents v_g. Why?

b- The voltage across the generator has the form: $v_g = V_m \cos\omega t$. Determine U_m and ω.

c- Determine the phase difference φ between v_g and v_R.

d- Determine the expression of the instantaneous current i carried by the circuit.

e- Using the law of addition of voltages at an instant t, and using a particular value of t, deduce the value of the inductance L.

III- Compare the values found for r and L, with those indicated on the coil.

<u>Third exercise</u> (6 ½ points) The two aspects of light

To show evidence of the two aspects of light, we perform the two following experiments:

A- First experiment

We cover a metallic plate by a thin layer of cesium whose threshold wavelength is λ_o = 670 nm. Then we illuminate it with a monochromatic radiation of wavelength in vacuum λ = 480 nm. A convenient apparatus is placed near the plate in order to detect the electrons emitted by the illuminated plate.

1- This emission of electrons by the plate shows evidence of an effect. What is that effect?

2- What does the term "threshold wavelength" represent?

3- Calculate, in J and eV, the extraction energy (work function) of the cesium layer.

4- What is the form of energy carried by an electron emitted by the plate? Give the maximum value of this energy.

Given: Planck's constant: h = 6.6 x 10^{-34} J.s;
speed of light in vacuum: c = 3 x 10^{8} m/s;
1 eV= 1.6 x 10^{-19} J.

B- Second experiment

The two thin slits of Young's apparatus, separated by a distance a, are illuminated with a laser light whose wavelength in vacuum is λ = 480 nm. The distance between the screen of observation and the plane of the slits is D=2m.

1- Draw a diagram of the apparatus and show on it the region of the interference.

2- The conditions to obtain the phenomenon of interference on the screen are satisfied. Why?

3- Due to what is the phenomenon of interference?

4- **a-** Describe the aspect of the region of interference observed on the screen.

b- We count 11 bright fringes. The distance between the centers of the farthest fringes is l = 9.5 mm. What do we call the distance between the centers of two consecutive bright fringes? Calculate its value and deduce the value of a.

C- The two experiments show evidence of two aspects of light. Specify the aspect shown by each experiment.