مسابقة في مادة الفيزياء
المدة: ساعة واحدة

الاسم:
الرقم:

This exam is formed of three exercises in two pages
<u>The use of non programmable calculators is recommended</u>

<u>First exercise</u> **(7 pts)** **Magnifying an object using a converging lens**

Two students of ***Grade 9*** wish to show their classmates the details of a small object AB.
They use a converging lens (L) and a screen (E).

I – One of these two students places the object AB in front of (L) as in figure (1).

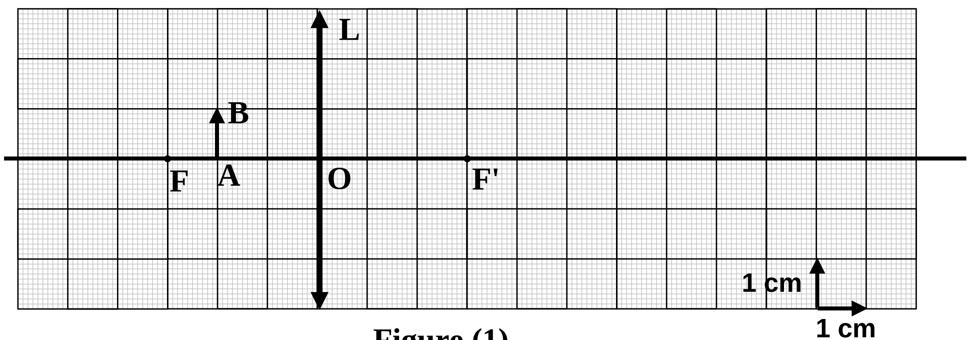


Figure (1)

1) Redraw, in a real scale, the figure (1) on the graph paper.
2) ***a)*** Trace the path of a luminous ray issued from B and parallel to the optical axis of (L).
b) Trace the path of another luminous ray issued from B passing through the optical center O.
c) Draw then the image A'B' of AB.
d) Give the nature and the size of A'B'.

II – The other student places AB as in figure (2). Its image A''B'' is thus formed on the screen (E).

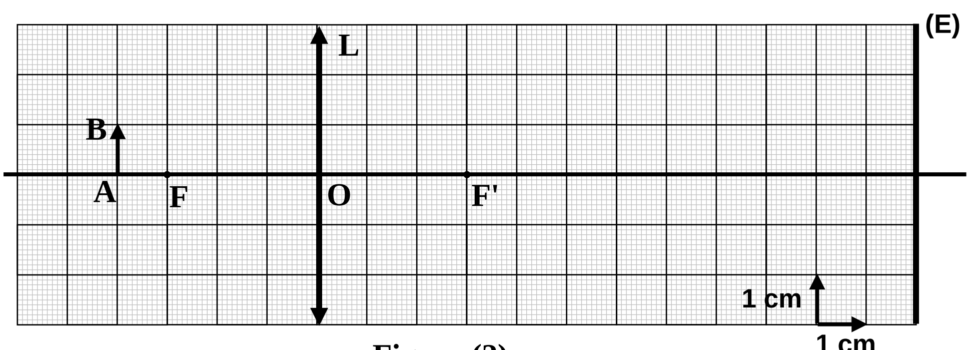


Figure (2)

1) Redraw, in a real scale, figure (2) on the graph paper.
2) Trace the path of a luminous ray issued from B passing through the object focus F.
3) Specify on the redrawn figure, with justification, the position of the image B''.
4) Draw the image A''B''.
5) Give the nature and the size of A''B''.

III – Which of the two students was able to show the details of AB to all his classmates at the same time? Why?

<u>Second exercise</u> (6 pts) Normal functioning of a lamp

The object of this exercise is to study the functioning of a lamp (L) that carries the inscriptions (3V; 3W).

I- Resistance of the lamp (L)

The lamp (L) is connected in a convenient circuit so as to function normally.

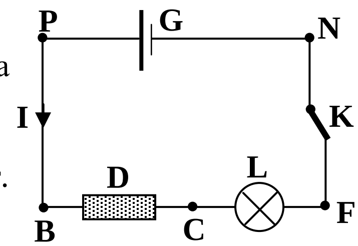
1) ***a)*** What is the voltage across (L)?

b) What is the power consumed by (L)?

c) Deduce the value of the current I_0 carried by (L).

2) (L) may be considered as a resistor of resistance r. Show that r = 3 Ω.

II- Functioning of the lamp (L)



We connect (L) in series with a resistor (D) of resistance R = 17 Ω across the poles of a generator delivering a constant voltage U_{PN} = 12V.

A current I passes then in the circuit.

1) ***a)*** Determine the value of the resistance equivalent to the combination of R and r.

b) Determine the value of I.

c) (L) does not function normally. Why?

2) To make (L) function normally, we replace (D) by another resistor (D′) of resistance R′.

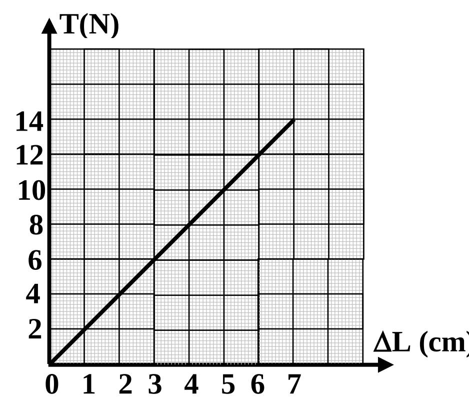
R′ must be smaller than R. Why?

<u>Third exercise</u> (7pts) Tension and elongation of a spring

Consider an elastic spring and a solid (S) of mass M.

Given: g = 10 N/kg.

I – Characteristic of the spring



The adjacent figure shows, within the elastic limit of the spring, the variations of the tension T as a function of the elongation ΔL of the spring.

1) Referring to the graph, complete the table below.

T (N)	2		6
ΔL (cm)		2	
$K = \dfrac{T}{\Delta L}$ (N/cm)			

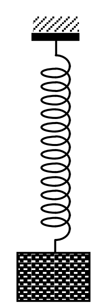
2) K represents a characteristic physical quantity of the spring.

a) Give the name of this characteristic.

b) Give its value in SI.

c) Give the name of the law that gives the relation between T, K and ΔL

II – Equilibrium of solid (S)


(S)

We suspend the solid (S) from the free end of the spring. (S) is at rest.

1) Give the names of the two forces acting on (S).

2) Write down the vector relation between these two forces.

3) Deduce the relation between T and M.

III – Elastic limit of the spring.

The maximum elongation of the spring within its elastic limit is 7cm. If we suspend a mass of 1.7kg, the spring loses its elasticity. Justify referring to the graph.

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فيزياء
دورة سنة ٢٠٠٧ الإستثنائية

First exercise : (7 pts)

I –

1) Redraw **(½ pt)**

2) **a)** Trace **(½ pt)**
b) Trace **(½ pt)**
c) Drawing of A′B′ **(½ pt)**
d) Nature : I V **(½ pt)**
Size: A′B′ = 3 cm **(½ pt)**

II –

1) Redraw **(½ pt)**

2) Trace **(½ pt)**

3) B″ is the intersection of the refracted ray with the screen **(½ pt)**

4) Drawing of A″B″ **(½ pt)**

5) Nature: I R **(½ pt)**
Size: A″B″ = 3 cm **(½ pt)**

III – The 2nd student **(½ pt)**
Because the image is on the screen then it is visible by all the students **(½ pt)**

Second exercise : (6 pts)

I –

1) a) $U_L = 3$ V **(½ pt)**
b) P = 3 W **(½ pt)**
c) $P = U I_0$ **(½ pt)**

$\Rightarrow I_0 = \dfrac{P}{U} = \dfrac{3}{3} = 1$ A **(½ pt)**

2) $U = rI_0$ **(½ pt)**
$\Rightarrow r = \dfrac{U}{I_0} = \dfrac{3}{1} = 3\ \Omega$ **(½ pt)**
or $P = r I_0^2 \Rightarrow r = 3\ \Omega$

II –

1) a) $R_e = R + r$
(because R and r in series) **(½ pt)**
$\Rightarrow R_e = 17 + 3 = 20\ \Omega$ **(½ pt)**
b) $U_{PN} = R_e I$ **(½ pt)**
$\Rightarrow I = \dfrac{U_{PN}}{R_e} = \dfrac{12}{20} = 0.6$ A **(½ pt)**
c) (L) will not function normally because $I = 0.6\text{ A} < I_0 = 1$ A **(½ pt)**
2) $U_{PN} = R_e I$ = constant
For (L) to function normally I should increase $\Rightarrow R_e$ should decrease $\Rightarrow$ R should decrease $\Rightarrow R' < R$ **(½ pt)**

Third exercise : (7 pts)

I –

1) T = 4 N **(1/4 pt)**
$\Delta L_1 = 1$ cm **(1/4 pt)**
$\Delta L_2 = 3$ cm **(1/4 pt)**
K = 2 N/cm ; 2 N/cm ; 2 N/cm **(3/4 pt)**

2) a) Stiffness of the spring **(½ pt)**

b) K = 200 N/m **(½ pt)**

c) Hooke's Law **(½ pt)**

II –

1) $\vec{W}$: Weight of (S) **(½ pt)**
$\vec{T}$: Tension of spring **(½ pt)**
2) $\vec{W} + \vec{T} = \vec{0}$ **(½ pt)**
3) T = Mg **(½ pt)**

III - $\Delta L_{max} \rightarrow T_{max}$ **(½ pt)** = 14 N **(½ pt)**
$T_{max} \rightarrow M_{max} = \dfrac{T_{max}}{g} = \dfrac{14}{10} = 1.4$ kg **(½ pt)**
$M = 1.7\text{ kg} > M_{max} = 1.4$ kg **(½ pt)**

or $P = Mg = 1.7 \times 10 = 17\text{ N} > 14$ N