وزارة التربية والتعليم العالي
المديرية العامة للتربية
دائرة الامتحانات الرسمية

امتحانات الشهادة المتوسطة

دورة العام ٢٠١٦ العاديّة
الجمعة ٣ حزيران ٢٠١٦

مسابقة في مادة الفيزياء
المدة: ساعة

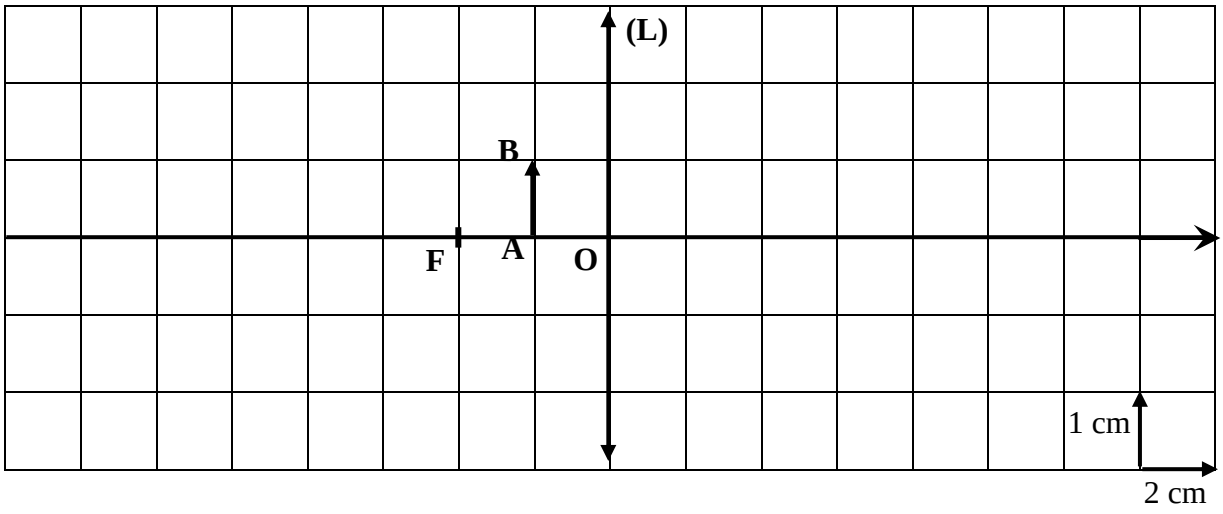
الاسم:
الرقم:

This exam is formed of three obligatory exercises in two pages
Non programmable calculators are allowed

First exercise (7 points) Image given by a converging lens

The aim of this exercise is to verify, by geometrical construction, that a converging lens can't act as a magnifier unless the object is placed between its optical center O and its object focus F.
For this, we consider a converging lens (L) and a luminous object (AB).

I- The object (AB) is at 2 cm from (L)



1) Reproduce, at the given scale, the above document on the graph paper.
2) Specify, on the reproduced figure, the position of the image focus F′ of (L).
3) Show that the focal length of (L) is f = 4 cm.
4) a) Construct the image (A_1B_1) of (AB) given by (L).
   b) Specify the nature of (A_1B_1).
   c) Determine the size A_1B_1 of the image (A_1B_1).

II- The object (AB) is at 6 cm from (L)

1) Trace, on a new diagram, the image (A_2B_2) of (AB) given by (L).
2) A_2B_2 is the size of (A_2B_2). Compare A_2B_2 with A_1B_1.
3) Indicate the nature of the image (A_2B_2).

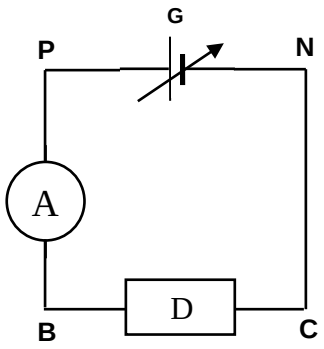
III- Conclusion

In both cases, the size of the obtained image is larger than that of the object, but (L) acts as a magnifier only when the object is between O and F. Justify.

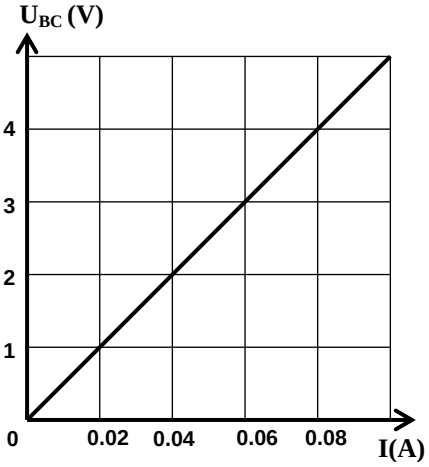
Second exercise (6.5 points) Nature of an electric component

In order to determine the nature of an electric component (D), we connect the electric circuit of the adjacent figure. This circuit includes in series:

- a generator (G) maintaining across its terminals a constant voltage of adjustable value;
- a digital ammeter (A) of negligible resistance;
- the electric component (D).

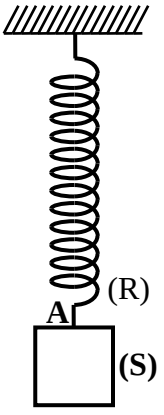


1) Redraw the diagram of the electric circuit and indicate on it the terminals ″**A**″ and ″**COM**″ of the ammeter in order to display a positive value.
2) In order to measure the voltage U_{BC} across (D), we use a digital voltmeter.
   a) Represent this voltmeter on the redrawn figure indicating its ″**V**″ and ″**COM**″ terminals.
   b) $U_{PB} = 0$ V. Justify.
   c) Show that $U_{PN} = U_{BC.}$
   d) The voltmeter displays a positive value. Justify.
3) We vary the value of the voltage U_{PN} across the terminals of the generator. The adjacent curve gives the variation of U_{BC} as a function of the current I in the circuit.
   a) (D) acts as a resistor. Justify.
   b) Determine, graphically, the value of the resistance R of (D).
   c) (D) is replaced by two resistors connected in series and of resistances $R_1 = 30\ \Omega$ and $R_2 = \mathbf{x}\ \Omega$. Calculate **x**.



Third exercise (6.5 points) Determination of the density of a liquid

Consider a solid cube (S) of side a = 3 cm. We suspend (S) at the lower extremity A of a spring (R). The other extremity of the spring is fixed to a support (adjacent figure).
The stiffness of the spring is k = 10 N/m. Take g =10 N/kg
At equilibrium, (R) is elongated by $\Delta L = 7.3$ cm.



1) Determine, using Hooke's law, the magnitude T of the tension $\vec{T}$ of the spring.
2) (S) is at equilibrium under the action of two forces: its weight $\vec{W}$ and the tension $\vec{T}$.
   a) Give the condition of equilibrium of (S).
   b) Deduce the magnitude W of the weight $\vec{W}$ of (S).
3) Show that the volume of (S) is $V = 2.7\times10^{-5}\ m^3$.
4) (S) is now totally immersed in a liquid (L) of density ρ_L. The magnitude of the tension of the spring becomes $T' = 0.41$ N. This variation of the magnitude is due to Archimedes' upthrust $\vec{F}$ exerted by the liquid on (S).
   a) Give the line of action and the direction of $\vec{F}$.
   b) Show that the magnitude of $\vec{F}$ is F = 0.32 N.
   c) Determine $\rho_{L.}$

مشروع معيار التصحيح

مسابقة في مادة الفيزياء
المدة:ساعة

Firstexercise (7 points)

Part of Q.	correction	Note
I-1	Reproduction	0.5
I-2	F' is symmetricof F with respect to O + figure.	0.75
I-3	f = OF'=2 × 2 cm = 4 cm.	0.75
I-4-a	Construction + figure	1.5
I-4-b	Nature : virtual because : object between O and F or Erect w.r.t. the object or in front of (L).	1
I-4-c	A_1B_1= 2 × 1= 2cm.	0.5
II-1	Figure.	0.5
II-2	A_1B_1= A_2B_2.	0.5
II-3	Nature:real.	0.5
III	Because when the object is between O and F, the image is erect and larger than the object.	0.5

Secondexercise (6.5 points)

Part of the Q.	correction	Note
1-	Figure : "A" is connected to P and "COM" to B.	0.5
2-a	Figure : V is connected to B and COM to C.	1
2-b	U_{PB}= 0 V because the ammeter has a negligible resistance.	0.5
2-c	According to the law of addition of voltage: $U_{PN} = U_{PB} + U_{BC} + U_{CN} = 0 + U_{BC} + 0$ Thus $U_{PN} = U_{BC}$	1.5
2-d	The voltmeter measures$U_{BC} = U_{PN} > 0$. Thus the displayed value is positive.	0.5
3-a	(D) acts as a resistor since its characteristics is a straight line passing through the origin.	0.5
3-b	$R=\frac{4-0}{0.08-0}$= 50 Ω.	1
3-c	R= R_1 + x thus x= 50 – 30= 20 Ω.	1

Third exercise (6.5 points)

Part of the Q.	correction	Note
1	T = K×Δl = 10× 0.073 = 0.73N	1.25
2-a	$\vec{w} + \vec{T} = \vec{0}$ or $\vec{w} = -\vec{T}$	0.75
2-b	w = T = 0.73 N.	0.5
3	$V = a^3 = (3\times 10^{-2})^3 = 2.7\times 10^{-5}\ m^3$	1
4-a	$\vec{F}$ {line of action : vertical direction : upward	1
4-b	F = w – w_{app} and w_{app} = T' = 0.41 N. Thus F =0.73 – 0.41 = 0.32 N.	1
4-c	F = $\rho_L \times V_i \times g$ thus $\rho_L=\frac{F}{Vi\times g}$=1185.18kg/$m^3$.	1