وزارة التربية والتعليم العالي المديرية العامة للتربية دائرة الامتحانات	امتحاناتللشّهادة المتوسطة	دورة العام 2015 العادية الإثنين 8 حزيران 2015

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: focal length of a converging lens (7 points)

The aim of this exercise is to determine the focal length $f_1$of a converging lens (L_1). For this, we consider an object (AB) of size AB = 4 cm,a screen (E),the lens (L_1) anda set of converging lenses of known focal lengths.

I- We place (AB) perpendicularly to the optical axis of (L_1), A being on the optical axis at 60 cm from (L_1). The image (A_1B_1) of (AB) is obtained on the screen (E) as shown in figure 1.

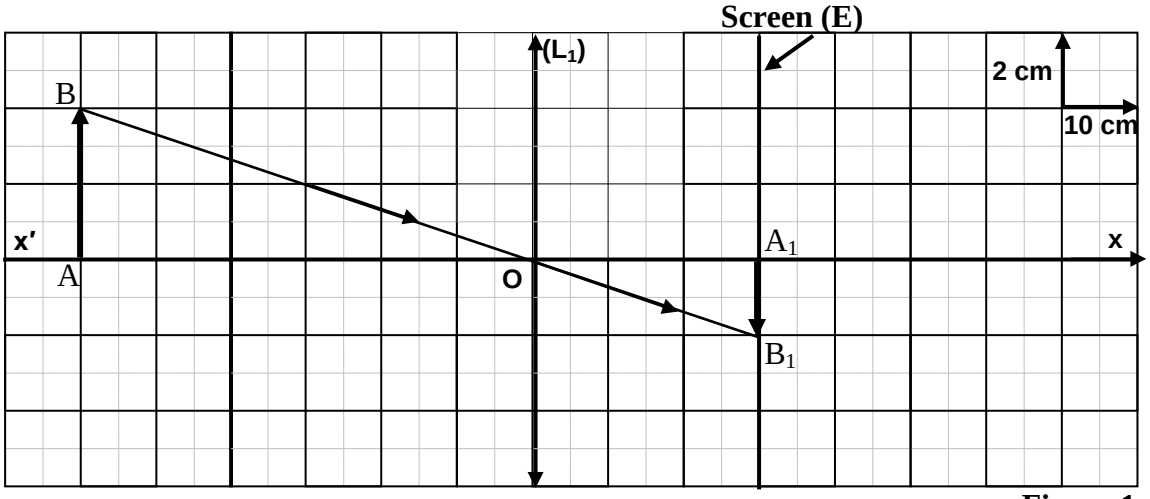


Figure 1

1) Redraw, with the same scale,the above figure.
2) The ray (BO) emerges from (L_1) without deviation. Justify.
3) a) Specify the nature of the image (A_1B_1).
b)Give the size of (A_1B_1).
c) Determine the distance d_1 between (L_1) and (A_1B_1).
4)a) Using a particular ray, determine the position of theimage focus F_1' of (L_1).
b)Deduce that f_1 = 20 cm.

II- We perform the preceding experiment again by replacing (L_1) successively by each of the converging lenses of the given set. For each lens we determine the distance d between the lens and the image of (AB). The curve of figure 2 represents the variation of d as a function of the focal length f knowing that the object (AB) being always in the preceding position.

Usingthe graph of figure 2:
1) Indicate whether d increases or decreases when f increases from10 cmto 40 cm. Justify your answer by choosing two points from the curve.
2) Determine again the focal length f_1 of (L_1).

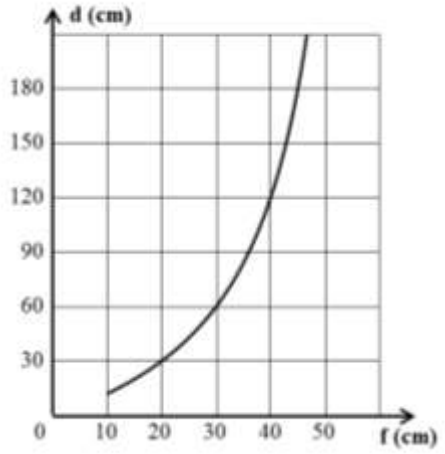


Figure 2

Second exercise: resistance of a voltmeter (7 points)

The aim of this exercise is to show that the resistance of a voltmeter is very large. For this we consider the series circuit that is represented in figure 1 which is formed of:

- a generator (G) maintaining across its terminals a constant voltage U_{PN} = 12 V;
- an ammeter (A) of negligible resistance;
- two resistors (R_1) and (R_2) of resistances R_1 = 10 Ω and R_2 = 20Ω respectively;
- A switch (k).

The switch k is closed.

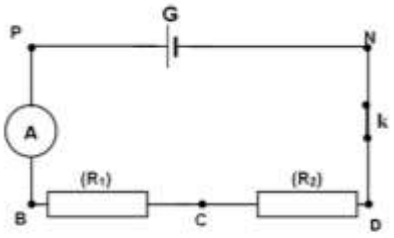


Figure1

1) The voltageU_{PB} across (A) iszero. Justify.
2) The voltageU_{DN} across (K) iszero. Justify.
3) Deduce that the voltage $U_{PN} = U_{BD}$.
4) Calculate the equivalent resistance R_{eq} of (R_1) and (R_2).
5) Calculate the current flowing in the circuit.
6) Show that the voltage U_{CD} = 8 V.
7) We connect, between C and D, a voltmeter (V) that can be considered as a resistor of resistance R as shown in figure 2. The current flowing in the voltmeter is I' = 0.01 mA.

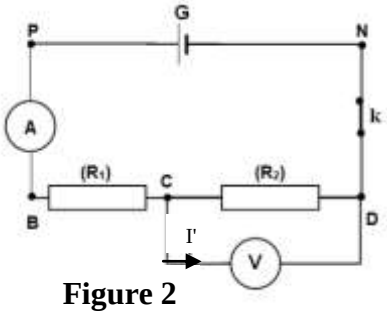


Figure 2

a) Knowing that the voltage U_{CD}remains 8 V.Calculate the resistance R of the voltmeter.
b) Deduce that the calculated value of R satisfies the aim ofthis exercise.

Third exercise: reaction of the bottom of a container (6 points)

The aim of this exercise is to determine the magnitude of the force exerted by the bottom of acontainercontaining water on a sphere (S) totally immersed in water. The massof (S) is M = 0.5 kg and its volume is
$V = 2 \times 10^{-4} m^3$.
Given: density of water $\rho = 1000\ kg/m^3$;
gravitational field strength is g = 10 N/kg.

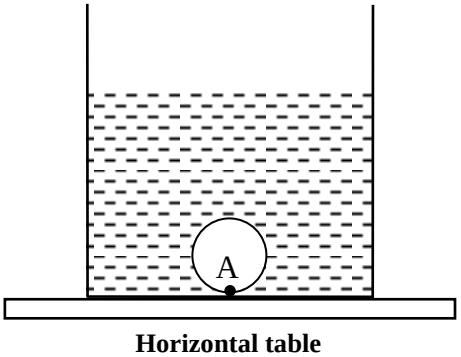
I- Real weight of (S)

1) Calculate the magnitude of the weight $\vec{W}$ of (S).

2) Indicate the direction and the line of action of $\vec{W}$.

II- Apparent weight of (S)

The sphere (S) is totally immersed in wateras shown in the adjacent figure.



Horizontal table

1) a) Calculate the magnitude F of Archimedes up-thrust $\vec{F}$ exerted by water on (S).

b) Indicate the line of action and the direction of $\vec{F}$.

2) Deduce the magnitude $W_{app}$of the apparent weight of (S).

III- Force exerted by the bottom on (S)

The sphere exerts on the bottom of the container a force $\vec{R}_1$ of magnitude R_1 = 3 N.

Determine, using the principle of interaction, the magnitude of the force $\vec{R}_2$ exerted by the bottom of the container on (S).

مشروع معيار التصحيح

مسابقة في مادة الفيزياء
المدة ساعة

First exercise (7 points)

Part of the Q.	Answer	Mark
I.1	Drawing	0.5
I.2	Any ray passing through the optical center of the lens emerges without deviation.	0.5
I.3.a.	Real image. It is formed on the screen	1
I.3.b.	A_1B_1= 2x1 =2cm	0.5
I.3.c.	d_1= 3×10 = 30cm	0.5
I.4.a.	Tracingof the ray We draw a ray issued from B parallel to the optical axis of (L_1). It emerges the lens through B_1. The point of intersection of the emergent ray and the optical axis of (L_1) is the image focus F_1'.	0.5 0.5 0.5
I.4.b.	f_1= OF_1'= 2×10= 20 cm.	0.5
II.1	As f increases the distance d increases For f = 20 cm, d= 30 cm , For f = 40 cm d = 120 cm	1
II.2	For lens (L_1), when OA = 60 cm, d_1= 30 cm and graphically f_1 = 20 cm.	1

Second exercise (7 points)

Part of the Q	Answer	Mark
1)	Because the ammeter has negligible resistance	0.5
2)	Because the switch is closed. (or it is acting as a connecting wire)	0.5
3)	$U_{PN} = U_{PB} + U_{BD} + U_{DN}$ (law of addition of voltages) $U_{PN} = 0 + U_{BD} + 0$ $U_{PN} = U_{BD}$	0.5 0.5
4)	R_1 and R_2 are connected in series: $R_{eq} = R_1 + R_2 = 10 + 20 = 30\ \Omega$.	1
5)	Ohm's law : $U_{PN} = RI$, $I = \frac{U_{PN}}{R} = 0.4$ A	1
6)	$U_{CD} = R_2.I = 20 \times 0.4 = 8$ V	1
7.a)	$U_{CD} = RI$, $R = \frac{U_{CD}}{I} = 8\times10^5\Omega$ ($0.01mA = 10^{-5}A$).	1.5
7.b)	$R = 8\times10^5\ \Omega$ which is very large.	0.5

Third exercise (6 points)

Part of the Q	Answer	Mark
I.1	W= Mg W= 0.5x10 = 5 N	1
I.2	Line of action : vertical Direction : downward	1
II. 1.a	$F = \rho_L.V_s.g$ F = 2 N.	1
II.1.b	Line of action : vertical Direction : up ward	1
II.2	$W_a = W - F$ W_a = 3 N	1
III.	Principle of interaction $\vec{R}_1 = -\vec{R}_2$ so $R_2 = R_1$= 3 N	1