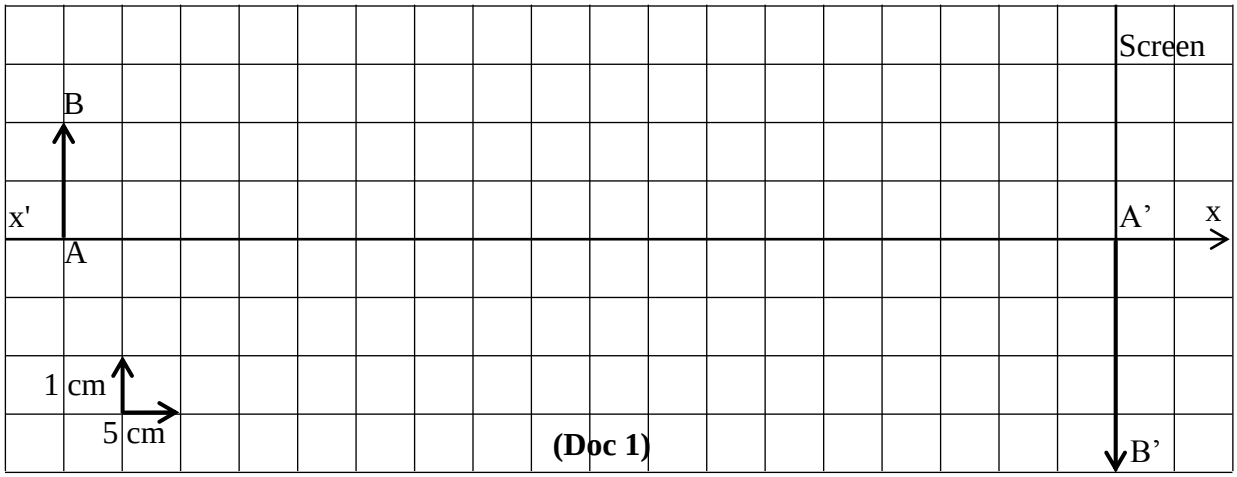
المادة: الفيزياء الشهادة: المتوسطة نموذج رقم 4 المدّة: ساعة واحدة	الهيئة الأكاديميّة المشتركة قسم: العلوم	المركز التربوي للبحوث والإنماء

نموذج مسابقة (يراعي تعليق الدروس والتوصيف المعدّل للعام الدراسي 2016-2017 وحتى صدور المناهج المطوّرة)

This test includes four mandatory exercises in two pages.
The use of non-programmable calculators is allowed.

Exercise 1 (5 points) Determination of the focal length of a converging lens

In a lab session, we have a converging lens (L), a luminous object AB of height 2 cm and a screen. The aim is to determine the focal length of (L).
We place the object at a distance d from the lens (L). We note that when the distance D between the object and the screen is 90 cm, we obtain on the screen a sharp image of height 4 cm.
The figure (Doc 1) below shows the object AB, its real image A'B' and the optical axis x'x of (L).

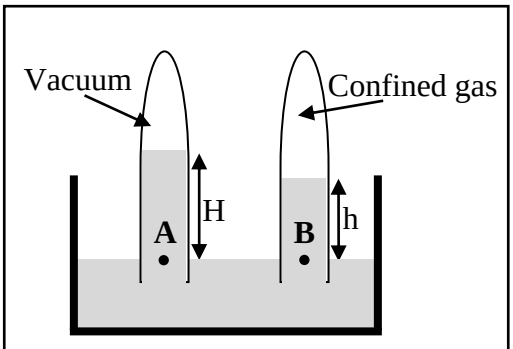


(Doc 1)

1) Redraw, on a graph paper, the above figure (Doc 1).
2) The straight line passing through B and B' meets the optical axis x'x at a point O.
2-1) Explain why the point O is the optical center of (L).
2-2) Represent the lens (L) on the figure.
3) To determine the focal length of the lens (L), we draw a luminous ray issued from B parallel to the optical axis.
3-1) Complete the path of this ray.
3-2) Indicate on the figure, with justification, the position of the image focus F' of (L).
3-3) Deduce the focal length of (L).

Exercise 2 (4 points) Pressure of a confined gas

The aim of this exercise is to determine the pressure of a confined gas. For this purpose, we performed the experiment represented by the adjacent document (Doc 2) and obtained:
H = 75 cm and h = 50 cm.
Both tubes and the tank contain mercury of density $\rho = 13600\ kg/m^3$. Take: g = 10 N/kg.

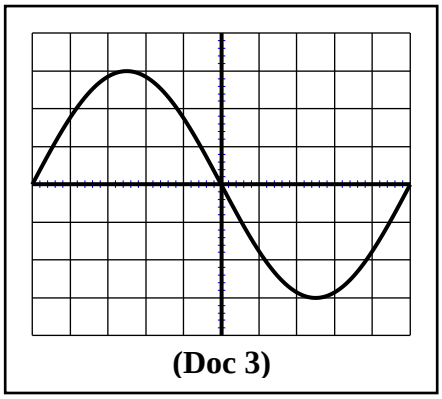


(Doc 2)

1) The pressures at points A and B are equal. Justify.
2) Calculate the pressure at A.
3) Deduce the pressure of the confined gas.

Exercise 3 (6½ points) Alternating voltage and the adjustment of an oscilloscope

The adjacent document (Doc 3) represents the waveform of an alternating voltage u delivered, across its terminals, by a low frequency generator (LFG).
The maximum value of the voltage u is U_m = 15 V and its period is T = 20 ms.



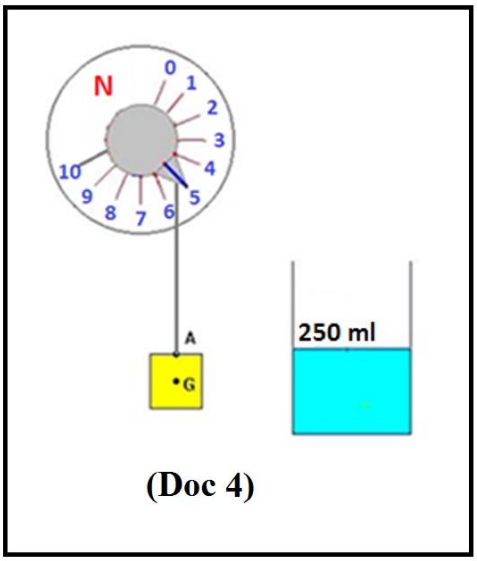
(Doc 3)

1) Adjustment of the oscilloscope.
- **1-1)** Determine the vertical sensitivity S_v of the oscilloscope.
- **1-2)** Determine the horizontal sensitivity S_h of the oscilloscope.

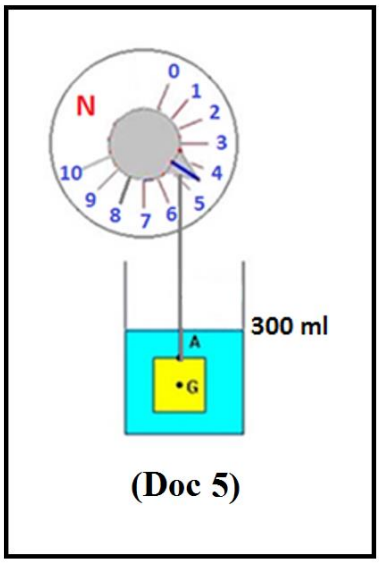
2) Voltage u.
- **2-1)** Indicate the type of the alternating voltage u.
- **2-2)** Calculate the frequency of u.
- **2-3)** Calculate the effective value of u.
- **2-4)** A lamp (L), of rated voltage 15 V, is directly connected across the terminals of the (LFG). Specify if the lamp (L) glows strongly, normally or dimly.

Exercise 4 (4½ points) Determination of the density of a liquid

The aim of this exercise is to measure the density ρ of a liquid (L). For this purpose, we have a solid (S) whose weight is of magnitude W = 5 N, a spring balance and a graduated cylinder containing liquid (L) of volume V_1 = 250 ml as shown in the adjacent document (Doc 4).
We suspend (S) from the spring balance and immerse it completely in liquid (L). At equilibrium, the level of the liquid corresponds to the graduation V_2 = 300 ml and the spring balance indicates 4.6 N as shown in the adjacent document (Doc 5).
Take: g = 10 N/kg.



(Doc 4)



(Doc 5)

The solid (S) is subjected to the Archimedes upthrust $\vec{F}$ of magnitude F.

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

2) Let $\vec{W}_{app}$ be the apparent weight of (S), of magnitude W_{app}.
Write the expression of F in terms of W and W_{app}.

3) Calculate F.

4) Calculate, in ml, then convert to m^3, the volume V of the displaced liquid.

5) Determine the density ρ of the liquid (L) in kg/m^3.

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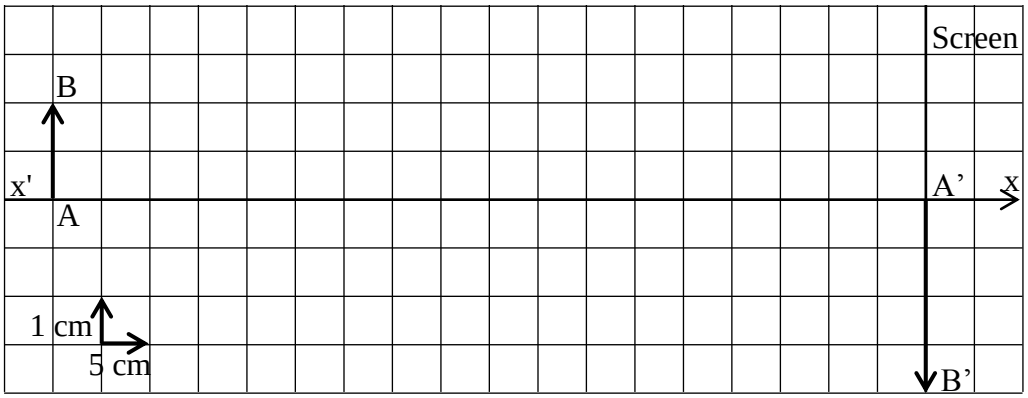
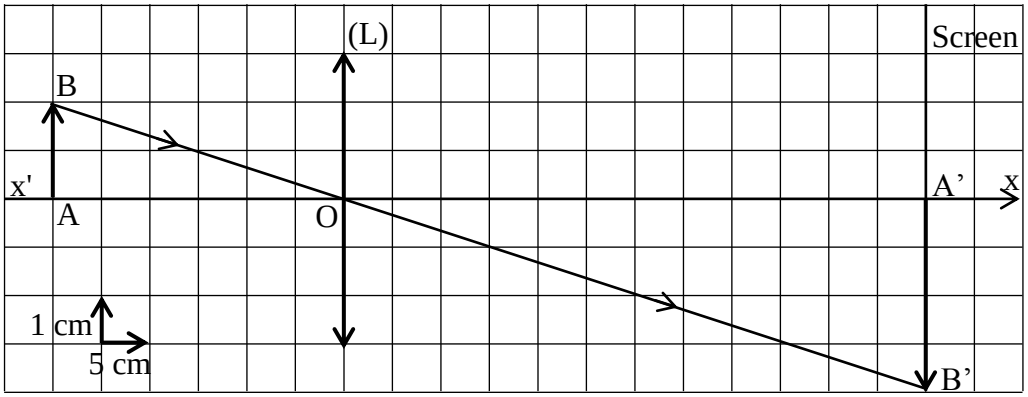
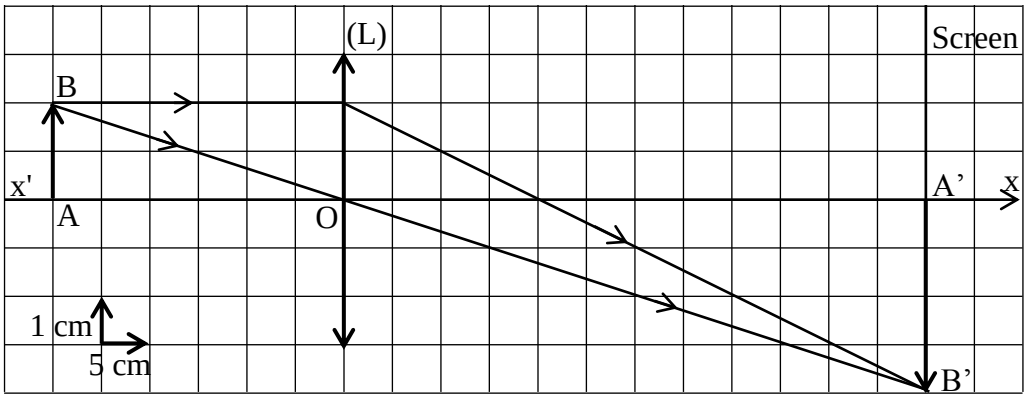
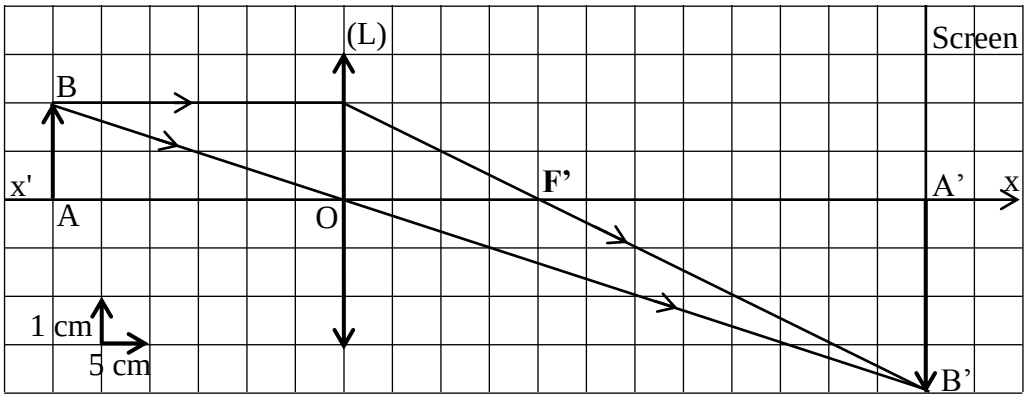
أسس التصحيح (تراعي تعليق الدروس والتوصيف المعدّل للعام الدراسي 2016-2017 وحتى صدور المناهج المطوّرة)

Exercise 1 (5 points) Determination of the focal length of a converging lens

Question	Answer	Mark
1		½
2-1	A luminous ray, issued from B and passing through the optical center of a converging lens, emerges without deviation and passes through the real image B' of B. The points B, B' and the optical center of the lens are thus aligned. In addition, the optical center belongs to the optical axis. Then the optical center is the intersection between the ray BB' and the optical axis. In our case, it is the point O.	1 ½
2-2		½

3-1		½
3-2	When a ray of light falls parallel to the optical axis of a converging lens, the emerging ray passes through the image focus F'. Hence, F' is the intersection between this emergent ray and the optical axis. 	½ ½
3-3	$f = \overline{OF'}$. $f = 4 \times 5 = 20$ cm.	½ ½

Exercise 2 (4 points) **Pressure of a confined gas**

Question	Answer	Mark
1	A and B are in the same liquid at equilibrium and in the same horizontal plane.	1
2	$P_A = \rho \times g \times H + P_{Vacuum}$ $P_A = 13600 \times 10 \times 0.75 + 0 = 102000$ Pa.	1 ½
3	$P_B = \rho \times g \times h + P_{Gas}$ $P_{Gas} = P_B - \rho \times g \times h = P_A - \rho \times g \times h$ $P_{Gas} = 102000 - 13600 \times 10 \times 0.5 = 34000$ Pa	½ 1

Exercise 3 (6½ points) **Alternating voltage and the adjustment of an oscilloscope**

Question	Answer	Mark
1-1	The voltage u has a maximum value U_m covering Y_m = 3 div. $U_m = S_v Y_m$ $S_v = \frac{U_m}{Y_m}$ $S_v = \frac{15}{3} = 5\,V/div$	½ 1
1-2	The voltage u has a period T covering X = 10 div. $T = S_h X$ $S_h = \frac{T}{X}$ $S_h = \frac{20}{10} = 2\,ms/div$	½ 1
2-1	Alternating sinusoidal voltage.	½
2-2	$f = \frac{1}{T}$ with T = 20 ms = 20×10^{-3} s $f = \frac{1}{20\times10^{-3}} = 50\,Hz$	½ 1
2-3	$U = \frac{U_m}{\sqrt{2}}$ $U = \frac{15}{\sqrt{2}} = 10.6\,V$	½ ½
2-4	The lamp glows dimly because it is connected across an alternating voltage of effective value that is less than its rated voltage (10.6 V < 15 V).	½

Exercise 4 (4½ points) **Determination of the density of a liquid**

Question	Answer	Mark
1	The line of action of $\vec{F}$ is vertical and its direction is upward.	½ ½
2	$F = W - W_{app}$	½
3	F = 5 – 4.6 = 0.4 N.	½
4	$V = V_2 - V_1 = 300 - 250 = 50$ ml $V = 50 \times 10^{-3}$ l = 50×10^{-6} m^3 or 5×10^{-5} m^3	½ ½
5	$F = \rho \times V_{immersed} \times g$ but $V_{immersed}$ = V because (S) is completely immersed in the liquid (L) therefore $F = \rho \times V \times g$ $\rho = \frac{F}{V \times g}$ $\rho = \frac{0.4}{50\times10^{-6}\times10} = 800\,kg/m^3$	½ 1