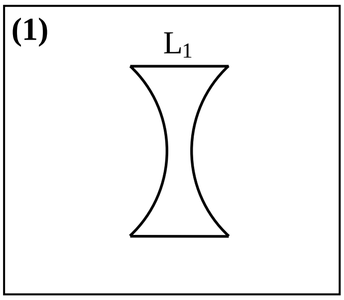
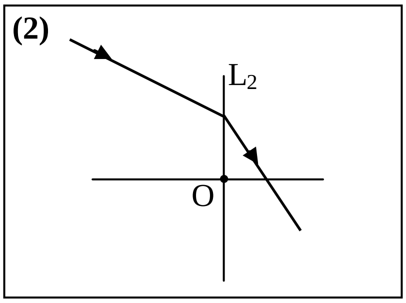
الاسم: الرقم:	مسابقة في مادة الفيزياء المدة: ساعة واحدة

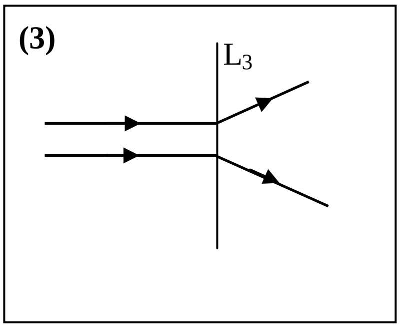
This exam is formed of three exercises in two pages.
<u>The use of a non-programmable calculator is recommended</u>.

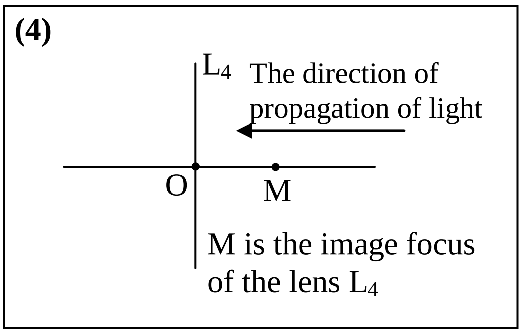
<u>First exercise (6 pts)</u> **Converging or Diverging lens?**

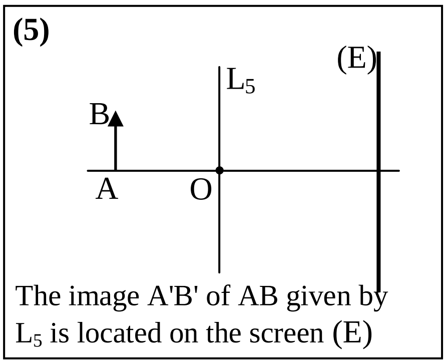
In the figures shown below, L_1, L_2, L_3, L_4, L_5, and L_6 represent lenses.
Specify, ***with justification***, in each case, whether the lens is converging or diverging.

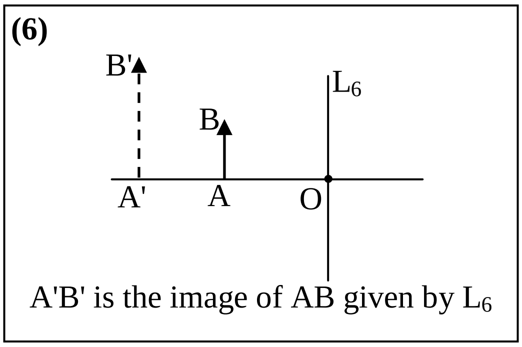












Second Exercise: (6 ½ pts) Studying a voltage using an oscilloscope

Our purpose is to study, using an oscilloscope, some characteristics of a voltage (u) delivered by a low frequency generator G.

1) Figure (1) represents the wave form of the voltage (u).
The oscilloscope is adjusted as follows:
horizontal sensitivity (time base): V_b = 5 ms/div ;
vertical sensitivity: S_V = 10 V/div .

a) Indicate the type of the voltage (u).
b) Calculate the period and the frequency of (u).
c) Calculate the maximum value of (u). Deduce its effective value.

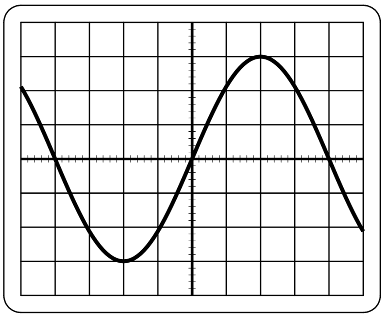


Figure (1)

2) The generator G still delivers the same voltage (u). We modify one of the two sensitivities of the oscilloscope. The wave form of figure (2) is then obtained.

a) Indicate, with justification, which of the two sensitivities V_b or S_V has been modified.
b) Calculate the new value of this sensitivity.

3) We turn off the sweeping. What will be the shape of the displayed voltage (u)?

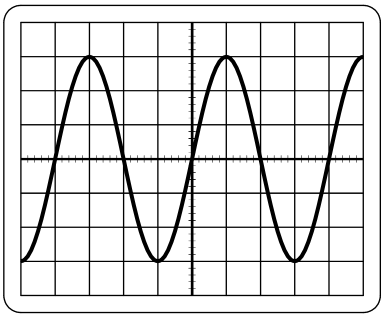


Figure (2)

Third exercise: (7 ½ pts) Hollow sphere

The aim of this exercise is to determine experimentally the volume of the cavity of an iron sphere (S).
Given g = 10 N/kg.

1) **<u>First experiment</u>**
We attach (S) to a dynamometer (spring balance). The dynamometer indicates 7.8 N at equilibrium.

a) Name the two forces acting on (S).
b) Give the relation between the values of these forces. Deduce the mass of (S).
c) Calculate the volume V_1 of iron. Given: The density of iron = 7800 kg/m^3.

2) **<u>Second experiment</u>**
The sphere (S), still attached to the same dynamometer, is completely immersed in water.
The dynamometer indicates 6.3 N.

a) What is the value of the apparent weight of (S)? Deduce the value F of Archimedes up-thrust exerted by water on (S).
b) Determine the volume V_2 of the sphere (S). Given: The density of water =1000 kg/m^3.

3) **<u>Volume of the cavity</u>**

a) By comparing V_1 and V_2 , verify that the sphere (S) is hollow.
b) Calculate the volume V of the cavity.

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First exercise : (6 pts)

1) L_1 is a diverging lens because it has thick edges or because it is biconcave. **(1 pt)**

2) L_2 is a converging lens because the emergent ray approaches the optical axis or the emergent ray converges towards the optical axis. **(1 pt)**

3) L_3 is a diverging lens because the incident **cylindrical** beam emerges from the lens as a diverging beam. **(1 pt)**

4) L_4 is a diverging lens because the image focus is before L_4 or because it is on the side of the incident light. **(1 pt)**

5) L_5 is a converging lens because the image is real being located on the screen. **(1 pt)**

6) L_6 is a converging lens because the image is bigger than the object or because it is farther from the lens than the object. **(1 pt)**

Second exercise : (6 ½ pt)

1) a) Sinusoïdal **($\frac{1}{2}$ pt)**

b) $T = V_b \times x$ **($\frac{1}{2}$ pt)**

$\Rightarrow T = 5 \times 8 = 40$ ms **($\frac{1}{2}$ pt)**

$f = \frac{1}{T}$ **($\frac{1}{2}$ pt)**

$\Rightarrow f = \frac{1}{40 \times 10^{-3}} = 25$ Hz **($\frac{1}{2}$ pt)**

c) $U_m = S_V \times y$ **($\frac{1}{2}$ pt)**

$\Rightarrow U_m = 3 \times 10 = 30$ V **($\frac{1}{2}$ pt)**

$U_{eff} = \frac{U_m}{\sqrt{2}}$ **($\frac{1}{2}$ pt)**

$\Rightarrow U_{eff} = \frac{30}{1.4} = 21$ V **($\frac{1}{2}$ pt)**

2) a) V_b has been modified because the number of divisions corresponding to the period has changed. Or because the number of divisions corresponding to U_m remained the same. **($\frac{3}{4}$ pt)**

b) $T = V'_b \times x'$

$\Rightarrow V'_b = \frac{40}{4} = 10$ ms/div **($\frac{3}{4}$ pt)**

3) Vertical line **($\frac{1}{2}$ pt)**

Third exercise : (7 ½ pts)

1) a) $\vec{W}$: Weight of (S) **($\frac{1}{2}$ pt)**

$\vec{T}$: Tension of the spring **($\frac{1}{2}$ pt)**

b) $W = T$ **($\frac{1}{2}$ pt)**

Thus P = 7.8 N **($\frac{1}{2}$ pt)**

$W = M g$ **($\frac{1}{2}$ pt)**

$\Rightarrow M = \frac{7.8}{10} = 0.78$ kg **($\frac{1}{2}$ pt)**

c) $\rho = \frac{M}{V_1}$ **($\frac{1}{2}$ pt)**

$\Rightarrow V_1 = \frac{0.78}{7800} = 10^{-4}$ m^3 **($\frac{1}{2}$ pt)**

2) a) $P_a = 6.3$ N **($\frac{1}{2}$ pt)**

$F = P_r - P_a$ **($\frac{1}{2}$ pt)**

$F = 7.8 - 6.3 = 1.5$ N **($\frac{1}{2}$ pt)**

b) $F = \rho_L V_2 g$ **($\frac{1}{2}$ pt)**

$\Rightarrow V_2 = \frac{1.5}{1000 \times 10} = 1.5 \times 10^{-4}$ m^3 **($\frac{1}{2}$ pt)**

3) a) $V_1 < V_2$

Therefore the sphere is hollow **($\frac{1}{2}$ pt)**

b) $V = V_2 - V_1 = 0.5 \times 10^{-4}$ m^3 **($\frac{1}{2}$ pt)**