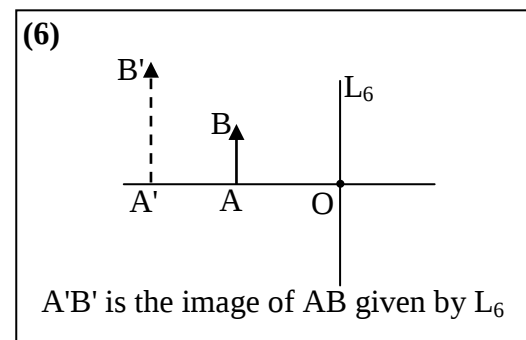
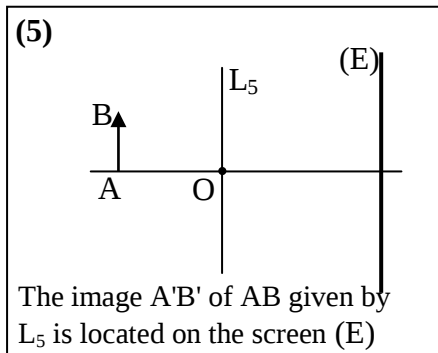
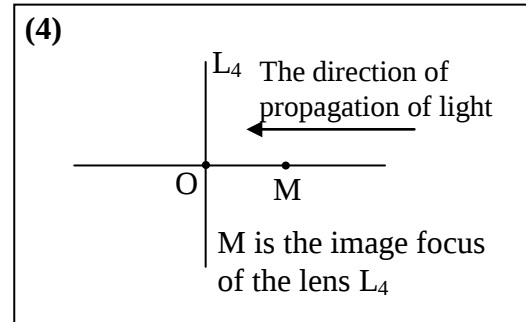
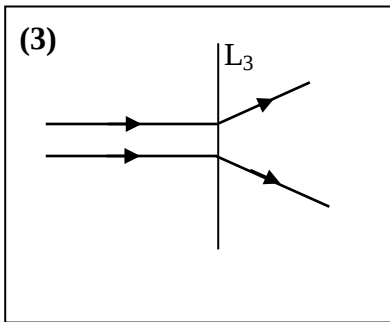
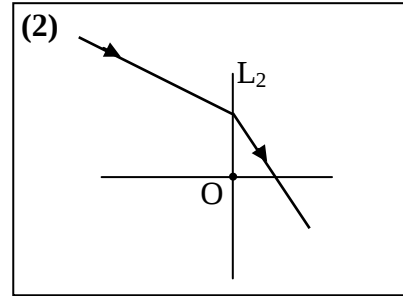
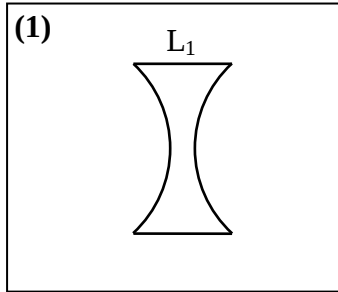


الاسم:
الرقم:مسابقة في مادة الفيزياء
المدة: ساعة واحدة

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

First exercise (6 pts)**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): $V_b = 5 \text{ ms/div}$;
vertical sensitivity: $S_v = 10 \text{ V/div}$.
 - 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.

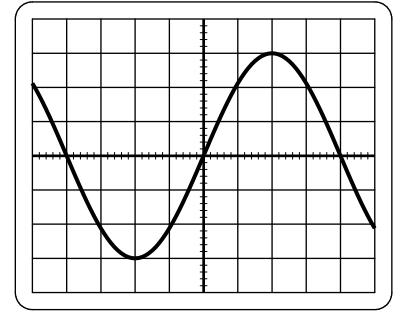


Figure (1)

- 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)?

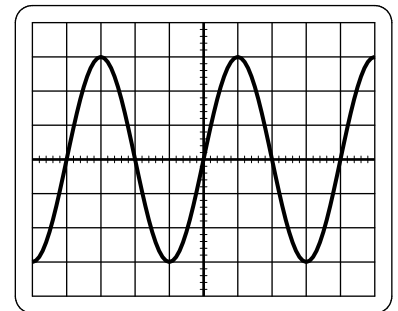


Figure (2)

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 $g = 10 \text{ N/kg}$.

- 1) **First experiment**
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) **Second experiment**
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) **Volume of the cavity**
 - a) By comparing V_1 and V_2 , verify that the sphere (S) is hollow.
 - b) Calculate the volume V of the cavity.

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)
 $\Rightarrow T = 5 \times 8 = 40 \text{ ms}$ ($\frac{1}{2}$ pt)
 $f = \frac{1}{T}$ ($\frac{1}{2}$ pt)
 $\Rightarrow f = \frac{1}{40 \times 10^{-3}} = 25 \text{ Hz}$ ($\frac{1}{2}$ pt)
 c) $U_m = S_v \times y$ ($\frac{1}{2}$ pt)
 $\Rightarrow U_m = 3 \times 10 = 30 \text{ V}$ ($\frac{1}{2}$ pt)
 $U_{\text{eff}} = \frac{U_m}{\sqrt{2}}$ ($\frac{1}{2}$ pt)
 $\Rightarrow U_{\text{eff}} = \frac{30}{1.4} = 21 \text{ V}$ ($\frac{1}{2}$ 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) $T = V'_b \times x'$
 $\Rightarrow V'_b = \frac{40}{4} = 10 \text{ ms/div}$ ($\frac{3}{4}$ 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 $P = 7.8 \text{ N}$ ($\frac{1}{2}$ pt)
 $W = M g$ ($\frac{1}{2}$ pt)
 $\Rightarrow M = \frac{7.8}{10} = 0.78 \text{ kg}$ ($\frac{1}{2}$ pt)
 c) $\rho = \frac{M}{V_1}$ ($\frac{1}{2}$ pt)
 $\Rightarrow V_1 = \frac{0.78}{7800} = 10^{-4} \text{ m}^3$ ($\frac{1}{2}$ pt)
 2) a) $P_a = 6.3 \text{ N}$ ($\frac{1}{2}$ pt)
 $F = P_r - P_a$ ($\frac{1}{2}$ pt)
 $F = 7.8 - 6.3 = 1.5 \text{ N}$ ($\frac{1}{2}$ pt)
 b) $F = \rho_L V_2 g$ ($\frac{1}{2}$ pt)
 $\Rightarrow V_2 = \frac{1.5}{1000 \times 10} = 1.5 \times 10^{-4} \text{ m}^3$ ($\frac{1}{2}$ pt)
 3) a) $V_1 < V_2$
 Therefore the sphere is hollow ($\frac{1}{2}$ pt)
 b) $V = V_2 - V_1 = 0.5 \times 10^{-4} \text{ m}^3$ ($\frac{1}{2}$ pt)

