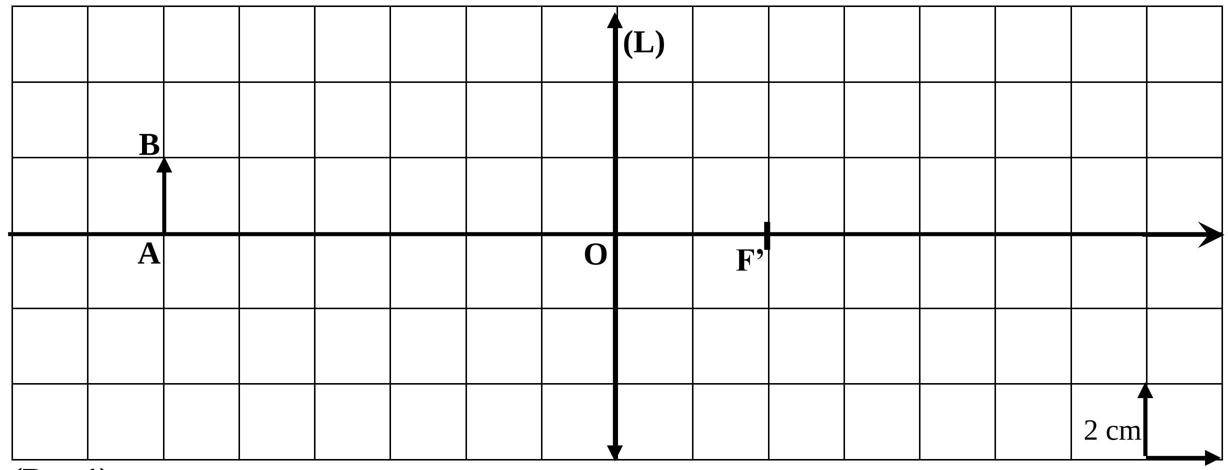
نموذج مسابقة (يراعي تعليق الدروس والتوصيف المعدّل للعام الدراسي 2016-2017 وحتى صدور المناهج المطوّرة)

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

Exercise 1 (6 points) Image given by a converging lens

The document (Doc 1) below represents a converging lens (L), its optical axis and optical center O, the image focus F’ and a luminous object (AB).



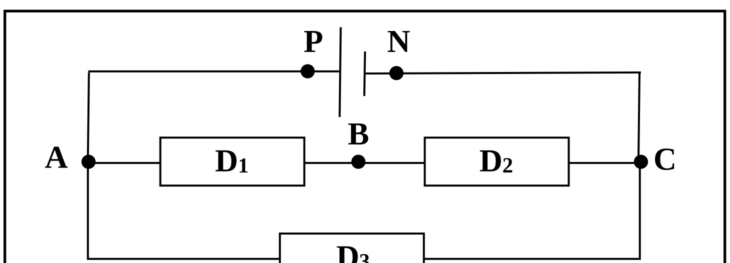
(Doc 1)

1) Reproduce the above document (Doc 1) on a graph paper.
2) Indicate the position of the object focus F of (L) and justify.
3) Find the focal length f of (L).
4) Let (A’B’) be the image of (AB) given by (L):
- **4-1)** Construct (A’B’) and provide the necessary explanations.
- **4-2)** Specify the nature of (A’B’).
- **4-3)** Find the distance d between (L) and (A’B’).

Exercise 2 (6 points) Laws of voltages and laws of currents

The circuit, shown in the document (Doc 2) below, consists of:

- A battery supplying across its terminals a constant voltage: $U_{PN} = 20$ V.
- Three electric components D_1, D_2 and D_3.



(Doc 2)

1) Calculation of voltages

1-1) Show that $U_{AC} = 20$ V.

1-2) Indicating the law used, Calculate the voltage U_{AB} knowing that $U_{BC} = 12$ V.

2) Calculation of currents

Given:

I_1 is the electric current carried by the electric component D_1;

I_3 is the electric current carried by the electric component D_3.

The electric current carried by the battery is $I = 10$ mA.

The electric current carried by the electric component D_2 is $I_2 = 3$ mA.

Indicating the laws used, calculate I_1 then I_3.

Exercise 3 (4 points) Equilibrium of a solid body

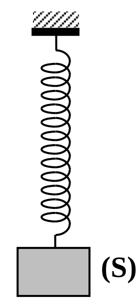
(S) is a solid body of mass m = 300 g.

Given:

Gravitational acceleration: g = 10 N/kg;

Stiffness constant of the spring: k = 2 N/cm.

The solid (S) is suspended from the free end of the spring as shown in the adjacent document (Doc 3). The solid (S) is in equilibrium under the action of its weight $\vec{W}$ of magnitude W and another force.



(Doc 3)

1) Give the name of the other force exerted on (S).

2) Specify the vector relation between the two forces exerted on (S).

3) Calculate the value of each of these two forces.

4) Calculate the elongation ΔL of the spring.

Exercise 4 (4 points) Archimedes upthrust

(S) is a solid body of weight W = 3 N and volume V = 100 cm^3.

Given:

Gravitational acceleration: g = 10 N/kg;

Density of water: $\rho = 1\,000$ kg/m^3;

The solid (S) is completely immersed in water.

1) Calculate the magnitude F of the Archimedes upthrust exerted by the water on (S).

2) The solid (S) is left to itself.

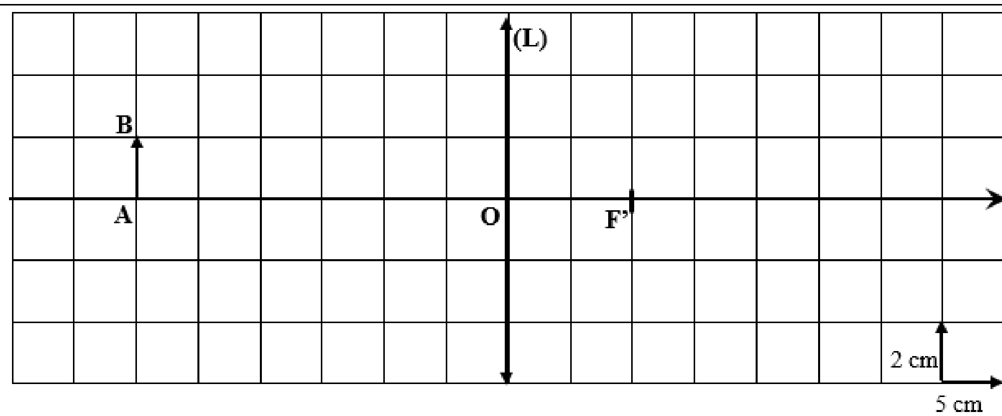
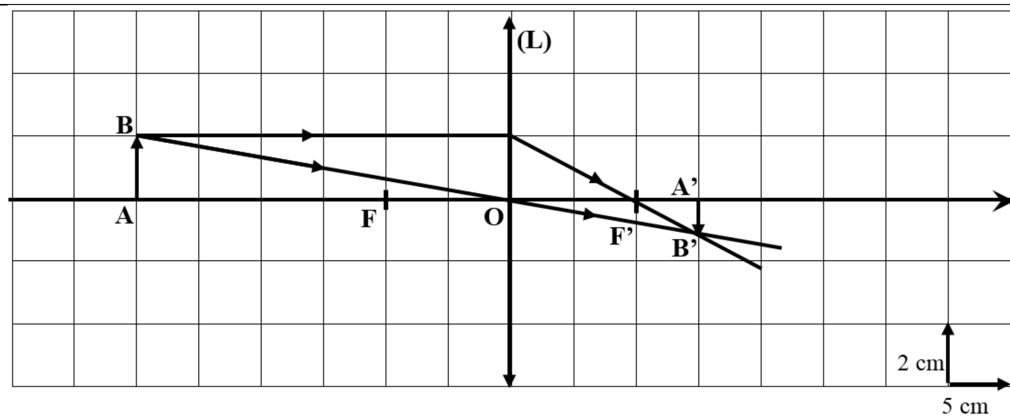
2-1) Compare W to F. Deduce if (S) sinks or floats at the surface of the water.

2-2) Calculate, in this case, the magnitude W_{app} of the apparent weight of (S).

المركز التربوي للبحوث والإنماء	الهيئة الأكاديميّة المشتركة قسم: العلوم	المادة: الفيزياء الشهادة: المتوسطة نموذج رقم 1 المدّة: ساعة واحدة

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

Exercise 1 (6 points) Image given by a converging lens

Question	Answer	Mark
1		½
2	F is the point symmetric to F' with respect to O. *«indicate the point F on the graph»*	½ ½
3	$f = \overline{OF'}$ $f = 2 \times 5 = 10\,\text{cm}$	½ ½
4-1	 From point B, we draw a ray that passes through point O. This ray emerges from point O of the lens without deviation. From point B, we draw an incident ray parallel to the optical axis. This ray emerges from the lens passing through point F'. Both emerging rays meet at point B'. From B', we construct a perpendicular line to the optical axis. This line intersects the optical axis at point A'.	½ ½ ½ ½
4-2	A'B' is a real image because it forms on the side of the emerging rays.	½ ½
4-3	$d = 3 \times 5 = 15\,\text{cm}$	½

Exercise 2 (6 points) Laws of voltages and laws of currents

Question	Answer	Mark
1-1	Law of uniqueness of the voltage: $U_{AC} = U_{PN} = 20$ V or Law of addition of voltages: $U_{AC} = U_{AP} + U_{PN} + U_{NC} = 0 + U_{PN} + 0 = U_{PN} = 20$ V	½ ¾ ½ ¾
1-2	Law of addition of voltages: $U_{AC} = U_{AB} + U_{BC}$ $U_{AB} = U_{AC} - U_{BC}$ therefore $U_{AB} = 20 - 12 = 8$ V	½ ½ ¾
2	Law of uniqueness of the current: $I_1 = I_2 = 3$ mA Law of addition of currents: $I = I_1 + I_3$ $I_3 = I - I_1$ therefore $I_3 = 10 - 3 = 7$ mA	½ ¾ ½ ½ ¾

Exercise 3 (4 points) Equilibrium of a solid body

Question	Answer	Mark
1	The tension $\vec{T}$ of the spring.	½
2	(S) is in equilibrium, $\vec{T} + \vec{W} = \vec{0}$.	½
3	$W = m \times g$ $W = 0.3 \times 10 = 3$ N $\vec{T} = -\vec{W}$ $T = W = 3$ N	½ ½ ½
4	Hooke's law : $T = k \times \Delta L$ $\Delta L = \frac{T}{k}$ $\Delta L = \frac{3}{2} = 1.5\,\text{cm}$	½ ½ ½

Exercise 4 (4 points) Archimedes upthrust

Question	Answer	Mark
1	$F = \rho \times V_{immersed} \times g$ but $V_{immersed} = V$ because (S) is completely immersed in water therefore $F = \rho \times V \times g$ $F = 1\,000 \times 100 \times 10^{-6} \times 10 = 1$ N	½ ½ ½ ½
2-1	$W > F$ therefore (S) sinks.	½ ½
2-2	$W_{app} = W - F$ $W_{app} = 3 - 1 = 2$ N	½ ½