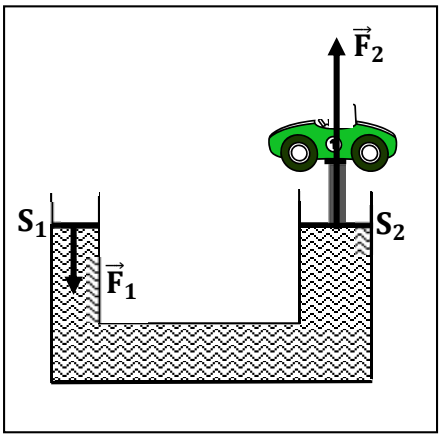
وزارة التربية والتعليم العالي المديرية العامة للتربية دائرة الامتحانات الرسميّة	امتحانات الشهادة المتوسطة	دورة العام 2017 الاستثنائيّة السبت في 29 تموز 2017

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

This exam is formed of four obligatory exercises in two pages
Non programmable calculators are allowed

Exercise 1 (3 points) Hydraulic jack

A hydraulic jack is an application on the hydraulic press. It is used to lift loads as cars.
Document 1 shows a hydraulic press containing oil.
Both branches are closed with two pistons of negligible mass and of respective cross-sectional areas S_1 and S_2.



Doc. 1

Choose the correct answer.

1. The functioning of the hydraulic press is based on:
- **a.** Archimedes principle
- **b.** Pascal's theorem
- **c.** Hooke's law.

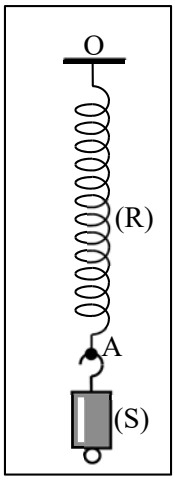
2. The unit of pressure in SI is:
- **a.** N/m^2
- **b.** N/cm^2
- **c.** N/m.

3. A force $\vec{F}_1$ of magnitude $F_1 = 100$ N is applied normally on the first piston which has cross-sectional area $S_1 = 5\times10^{-4}\ m^2$. The pressure exerted on the small piston is:
- **a.** 5×10^{-2} Pa
- **b.** 5×10^{-6} Pa
- **c.** 2×10^{5} Pa.

4. The force $\vec{F}_1$ allows to maintain a car at equilibrium as shown in document 1. The force $\vec{F}_2$ exerted on the large piston must have a magnitude:
- **a.** $F_2 = \frac{F_1\times S_2}{S_1}$
- **b.** $F_2 = \frac{F_1\times S_1}{S_2}$
- **c.** $F_2 = F_1\times S_1\times S_2$.

Exercise 2 (6 points) Equilibrium of a solid

A spring (R), perfectly elastic, has a stiffness k = 10 N/m. This spring is fixed, at its upper end O, to a support. A solid (S) of mass m = 100 g is suspended to the lower end A of (R), as shown in document 2. (S) is at equilibrium.
Take g = 10 N/kg.



Doc. 2

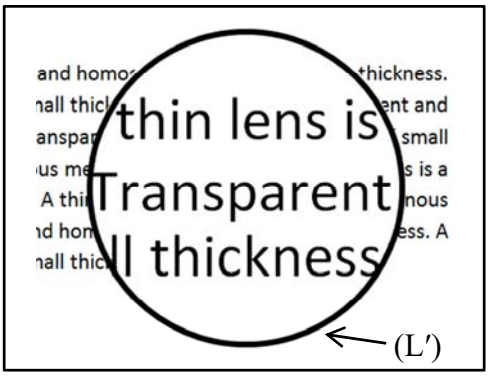
1. (S) is submitted to two forces: its weight $\vec{W}$ and the tension of the spring $\vec{T}$.
   1.1. Reproduce the figure of document 2 and represent these forces without a scale.
   1.2. Tell, for each of the two forces, whether it is a contact force or a force acting at a distance.
   1.3. Calculate the magnitude W of $\vec{W}$.
   1.4. Show that the magnitude T of $\vec{T}$ is 1 N in this case.
2. The initial length of (R) is $L_0 = 20$ cm.
   2.1. Determine, in cm, the elongation ΔL of (R).
   2.2. Deduce the final length L of (R).
3. (R) can be elongated to a maximum value $\Delta L_{max} = 15$ cm without losing its elasticity.
   Determine then the maximum mass m_{max} that could be hung at A.

Exercise 3 (6 points) Converging lens

Consider a converging lens (L) of focal length f = 4 cm and object (AB) of size AB = 1 cm.

1. (AB) is placed 2 cm in front of (L) perpendicularly at A to the optical axis of (L).
   1.1. Construct, with real scale, the image (A′B′) of (AB) given by (L).
   1.2. Is the image (A′B′) erect or inverted with respect to (AB)?
   1.3. (A′B′) is virtual. Justify.
   1.4. Give the size A′B′ of the image (A′B′).

2. During a laboratory session, a teacher gives a student a converging lens (L′) to examine a text as shown in document 3.
   By referring to this document, give two characteristics of the obtained image allowing to confirm that (L′) is used in the same conditions of (L).



Doc.3

Exercise 4 (5 points) Protection of a lamp

Consider the following electric devices:

- a lamp (L) acting as a resistor (ohmic conductor) and bearing the inscriptions (6 V; 9 W);
- a generator (G) maintaining across its terminals a DC voltage of constant value U_G.

Take $U_G = 21$ V in all the exercise.

1. If (L) is connected directly to the terminals of (G), it may burn out. Justify.
2. In order to let (L) functions normally, it is connected with an ohmic conductor (R) of resistance R in series with (G).
   2.1. Draw the diagram of the circuit.
   2.2. Show that the voltage across the terminals of (R) is $U_R = 15$ V.
   2.3. Calculate the electric current I in the circuit.
   2.4. Deduce R.

Exercise 1 (3points) Hydraulic jack

Question	Answer	Mark
1.	b. Pascal's theorem	0.75
2.	a. N/m^2	0.75
3.	c. $2x10^5Pa$	0.75
4.	a. $F_2 = \frac{F_1 x S_2}{S_1}$	0.75

Exercise 2 (6points) Equilibrium of a solid

Question	Answer	Mark
1.1	Figure	1
1.2	$\vec{W}$: force acting at a distance ; $\vec{T}$: contact force.	0.5
1.3	W = mxg W= 0.1×10 = 1 N.	1
1.4	At equilibrium : $\vec{W} + \vec{T} = \vec{0}$ Then $\vec{T} = -\vec{W}$ T = W = 1 N.	1
2.1	According to Hooke's law : T = K×ΔL $\Delta L = \frac{T}{k}$ = 0.1 m = 10 cm.	1
2.2	$L = L_o + \Delta L$ = 30 cm.	0.5
3	At equilibrium : T = W then mg = KΔL Therefore: $m_{max} = \frac{\Delta L_{max} x k}{g} = \frac{0.15 \times 10}{10} = 0.15$ kg = 150 g.	1

Exercise 3 (6 points) converging lens

Question	Answer	Mark
1.1.	Figure(lens optical axis + object + F+F′+O) - (Traces of two rays + image + Explanation) – (image explanation)	2.5
1.2	The image (A′B′) is erect w.r.t. the object.	0.75
1.3.	Since the image is erect **or** it is formed before lens **or** since the OA < f	0.75
1.4.	A′B′ = 2cm	0.5
2.	Direction: erect w.r.t. the object (AB) – size of the obtained image given by (L′) > size of the object **or** size of the obtained image given by (L′) > size of the object – Nature of the image : Virtual.	1.5

Exercice 4 (5 points) Protection of a lamp

Question	Answer	Mark
1	Since $U_G > U_{rated} = 6$ V	1
2.1	See figure	0.5
2.2	$U_G = U_R + U_L$ $U_R = U_G - U_L = 21 - 6 = 15$ V.	1.25
2.3	At normal functioning: $I = I_{rated} = \frac{P_r}{U_r} = \frac{9}{6} = 1.5A$.	1.25
2.4	$U_R = RI$ then $R = \frac{U_R}{I} = \frac{15}{1.5} = 10\Omega$.	1