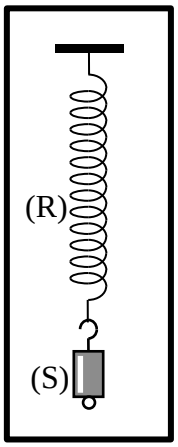
مسابقة في مادة الفيزياء
المدة: ساعة واحدة

الاسم:
الرقم:

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

Exercise 1 (4 points) Equilibrium of a solid

A spring (R), of stiffness k = 20 N/m, is attached to a fixed support. A solid (S) of mass m is suspended to the free end of the spring (Doc.1).
(S) is at equilibrium under the action of two forces: its weight $\vec{W}$ of magnitude W and the tension $\vec{T}$ of the spring of magnitude T = 1.5 N.
Take g = 10 N/kg.



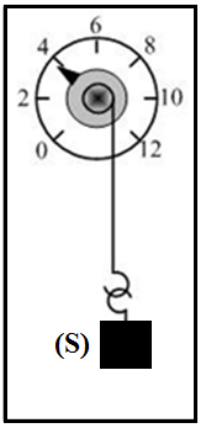
Doc.1

The following statements are false. Rewrite them correctly.

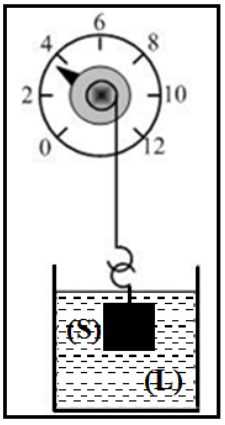
1. The elongation of the spring at equilibrium is x = 6 cm.
2. $\vec{W}$ is a contact force and $\vec{T}$ is a force acting from a distance.
3. Since (S) is at equilibrium, then the relation between $\vec{W}$ and $\vec{T}$ is: $\vec{W} = \vec{T}$.
4. The mass of (S) is m = 2 kg.

Exercise 2 (5 points) Nature of a liquid

The aim of this exercise is to identify the nature of a liquid (L). For this, we consider a container that contains a certain quantity of (L) and a solid (S), of volume $V = 5\times10^{-5}$ m^3, suspended to the free end of a spring balance.
Take g = 10 N/kg.



Doc.2



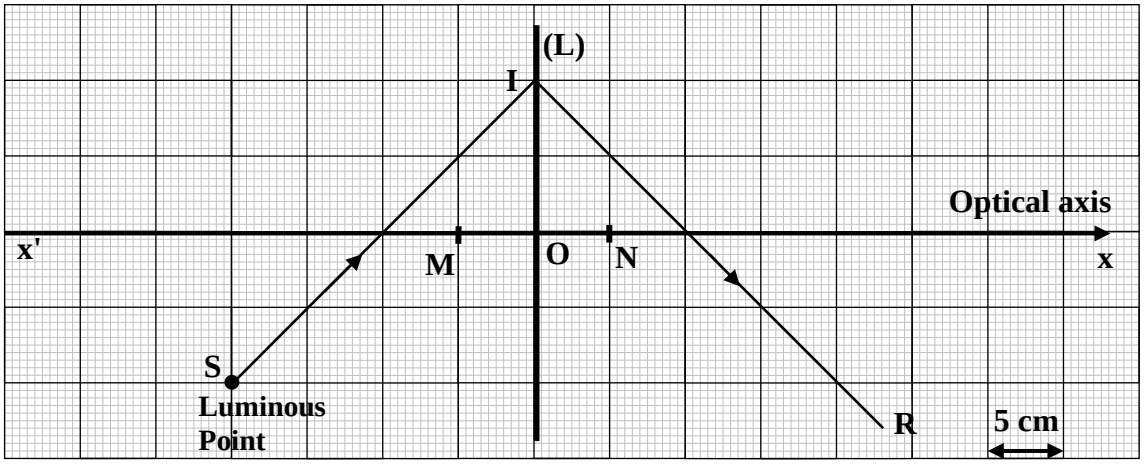
Doc.3

1. (S) is at equilibrium in air (Doc. 2).
   The spring balance indicates 3.9 N. What does this indication represent?
2. (S) is completely immersed in (L) of density ρ (Doc. 3).
   The spring balance then indicates 3.5 N.
   2.1. What does the indication of the spring balance represent in this case?
   2.2. Give the name of the force that led to a different indication on the spring balance.
   2.3. Calculate the magnitude of this force.
   2.4. Deduce the density ρ of (L).
   2.5. By referring to the table below, deduce the nature of (L).

Liquid	Alcohol	Vegetable oil	Olive oil	Acetone	Water
Density (kg/m^3)	800	910	918	792	1000

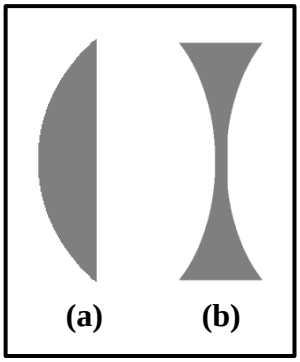
Exercise 3 (6 points) Nature of a lens

The document 4 shows a lens (L), its optical axis x'x, its optical center O, its two foci M and N, an incident luminous ray (SI) and its emergent ray (IR).



Doc. 4

1. (L) is a converging lens. Justify.
2. Let f be the focal length of (L).
   2.1. N is the image focus of (L). Justify.
   2.2. Deduce f.
3. Reproduce, on the graph paper, the figure of the document 4.
4. Trace, with justification, the path of a luminous ray issued from S and parallel to the optical axis of (L).
5. What does the point of intersection of the two emergent luminous rays represent?
6. Document 5 represents two different lenses. Specify which lens (a) or (b) corresponds to (L).



Doc.5

Exercise 4 (5 points) Domestic installation

A domestic electric installation is fed by an alternating sinusoidal voltage of effective value 220 V. This installation includes the following electrical appliances connected in parallel:

- an electric oven of 2000 W;
- an iron of 1000 W;
- a heater of 1070 W;
- two identical lamps, acting as ohmic conductors, of resistance R = 880 Ω each.

1. Show that the electric power consumed by each lamp is 55 W.
2. Determine, in kWh, the electric energy consumed by each lamp when it functions normally for 20 hours.
3. All the appliances function normally at the same time.
   3.1. Calculate the total electric power consumed by this installation.
   3.2. Deduce the main current I.
   3.3. Consider three circuit breakers carrying the inscriptions: 15 A, 20 A and 25 A. Which one is the most convenient for this installation? Justify your answer.

مسابقة في مادة الفيزياء
معيار التصحيح

Q	**Exercise 1:**	**4 pts**
1.	The elongation of the spring at equilibrium is x = 7.5 cm ($x = \frac{T}{K} = \frac{1.5}{20}$ = 0.075 m = 7.5cm)	**1**
2.	Weight $\overrightarrow{W}$ is force acting from a distance, Tension of the spring $\overrightarrow{T}$ is a contact force.	**1**
3.	1. Since (S) is at equilibrium, then the relation between $\overrightarrow{W}$ and $\overrightarrow{T}$ is: $\overrightarrow{W} = -\overrightarrow{T}$.	**1**
4.	the mass of (S) is m = 0.15 kg W = T = 1.5 N $m = \frac{W}{g} = \frac{1.5}{10}$ = 0.15 kg	**1**

Q	**Exercise 2:**	**5pts**
1.	The indication of the spring balance represents the real weight (W_R)	**0.75**
2.1.	The indication of the spring balance represents the apparent weight (W_{app})	**0.75**
2.2.	Archimedes up thrust (F)	**0.5**
2.3.	$F = W_R - W_{app}$ F = 3.9 – 3.5 = 0.4 N	**1**
2.4.	$\rho_L = \frac{F}{V_i \, x \, g}$ ($V_i = V_{cube} = 5x10^{-5}$ m^3completely immersed) $\rho_L = \frac{0.4}{5x10^{-5} \, x \, 10}$ = 800 kg/m^3	**1.5**
2.5	The nature of the liquid (L) is alcohol since $\rho_L = \rho_{alcohol}$ = 800 kg/m^3	**0.5**

Q	**Exercise 3:**	**6 pts**
1.	The lens (L) is converging lens since the emergent ray approaches towards the optical axis.	**0.5**
2.1.	N is the image focus since it is located at the same side of the emergent ray or N is the image focus since it is located at opposite side with the incident ray	**1**
2.2.	$f = \overline{ON}$ = 1 x5 = 5 cm	**1**
3.	See graph	**1**
4.	Draw from B incident ray parallel to the optical axis which emerges towards image focus N + figure	**1**
5.	Image S' of point object S.	**0.5**
6.	Lens (a) is converging lens since it has edges thinner than the centre, then lens (a) is similar to (L)	**1**

Q	**Exercise 4:**	**5pts**
1.	$p = \frac{U^2}{R} = \frac{220^2}{880}$ = 55 W	**1**
2.	$E = Pxt = 55x10^{-3}x20$ = 1.1 KW.h	**1**
3.1.	$P = P_1+P_2+P_3+2P_4 = 2000+1000+1070+55x2$ = 4180 W	**1**
3.2	$P_t = UI$ $I = \frac{P}{U} = \frac{4180}{220}$ = 19 A	**1**
3.3	The circuit breaker of 20 A is the most convenient since it is slightly more than the consumed current.	**1**