

الاسم:

مسابقة في مادة الفيزياء

الرقم:

المدة: ساعة واحدة

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 $k = 20 \text{ N/m}$, is attached at the upper end to a fixed support. A solid (S) of mass m is suspended to the lower end of the spring (Doc.1).

(S) is at equilibrium under the action of two forces: its weight \vec{W} of magnitude

$W = 1.5 \text{ N}$ and the tension \vec{T} of the spring of magnitude $T = 1.5 \text{ N}$.

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

The following statements are false. Rewrite them correctly.

1. The elongation of the spring at equilibrium is $x = 6 \text{ cm}$.
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 $m = 2 \text{ kg}$.

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 solid (S), of volume $V = 5 \times 10^{-5} \text{ m}^3$, suspended to the free end of a spring balance and a container that contains a certain quantity of (L).

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

1. The solid (S) is at equilibrium in air (Doc. 2).
The spring balance indicates 3.9 N .
What does this indication represent?
2. The solid (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)**Electric circuit**

A series circuit includes the following elements:

- A generator (G) maintaining across its terminals a constant voltage : $U_G = 12V$;
 - A motor (M);
 - A lamp (L) carrying the inscription 10 W;
 - A closed switch (K);
1. What is the voltage across the closed switch (K)?
 2. The voltage across the lamp is $U_L = 4V$.
 - 2.1. State the law of addition of voltages
 - 2.2. Calculate the voltage U_M across (M).
 3. The current flowing through (L) is $I = 1A$.
Does the lamp function normally? why?
 4. The switch (K) is now open. What is the voltage across it? Justify your answer.
 5. Give the value of the voltage across the terminals of the generator in this case.
 6. Give the value of the main electric current in the circuit.

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 $R = 880 \Omega$ each.
1. Show that the electric power consumed by each lamp is 55 W.
 2. Determine, in kWh, the 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.