وزارة التربية والتعليم العالي المديرية العامة للتربية دائرة الامتحانات	الشهادة المتوسطة	دورة 2013 العادية
	مسابقة في مادة الفيزياء المدة ساعة	الاسم: الرقم:

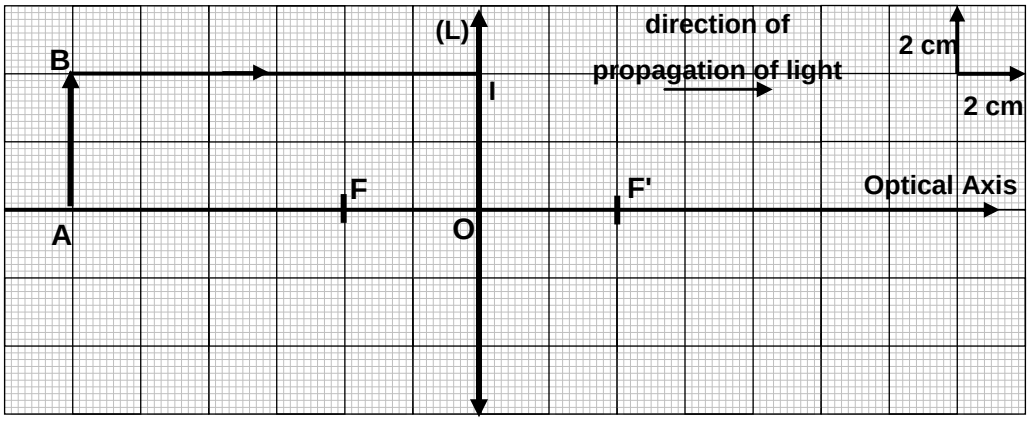
This exam is formed of three obligatory exercises in two pages.
Non- programmable calculators are allowed.

First exercise (7 points) **Converging lens**

Consider a converging lens (L) of focal length f = 4cm and an object (AB) placed perpendicular to the optical axis of (L) as shown in the figure below. F represents the object focus of (L) and F′is its image focus.

1) O is the optical center of (L). Justify.
2) Determine the size of object (AB) and its distance d from (L).
3) Redraw the figure below on the graph paper using the same scale.
4)
- **a)** Complete, on the figure, the path of the particular ray (BI). Justify.
- **b)** Trace the path of another particular ray issued from B and incident on (L).
- **c)** Construct, using the above two rays, the image (A'B') of (AB).
- **d)** Specify the nature of the image (A'B').
- **e)** Determine the size of the image A'B'.

5) (A'B') is obtained clearly on a screen (E). Determine the distance d' between (L) and (E).



Second exercise (7 points) **Water heater**

A water heater is formed of a water reservoir equipped with a resistor (D) of resistance R.

I) Determination of R

1) The resistor (D) transforms the electric energy received into another form of energy. Give the name of this form of energy.

2) The characteristic current-voltage of the resistor (D) is one of the two adjacent graphs (figures a and b).
- **a)** The graph of figure (a) does not correspond to the characteristic of (D). Justify.
- **b)** Show, using the graph (b), that R= 50 Ω.

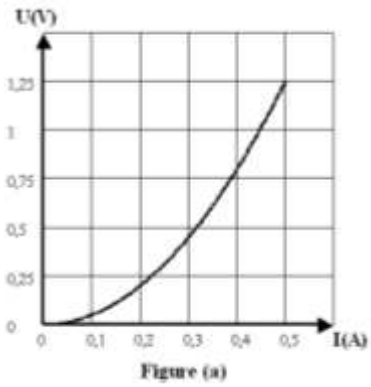


Figure (a)

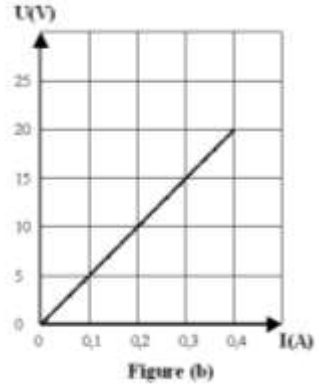


Figure (b)

II) Consumption of the water heater

The water heater functions normally under an alternating sinusoidal voltage of effective value U= 220 V.

1) Show that the expression of the electrical power consumed by the water heater is given by: $P = \frac{U^2}{R}$.

Deduce the value of P = 968 W.

2) Calculate, in kWh, the electrical energy consumed by the water heater during 5 hours of functioning.

3) The water heater functions for 15 days in a month at an average rate of 5 hours daily.

a) Calculate the electrical energy consumed by the water heater during one month.

b) Deduce the monthly amount to be paid by the consumer knowing that the average cost of each kWh is 100 L.L

Third exercise (6 points) **Determination of the density of a liquid**

The aim of this exercise is to determine the density ρ_L of a liquid (L). For this purpose, we consider a solid (S) of mass m and several liquids of different densities.

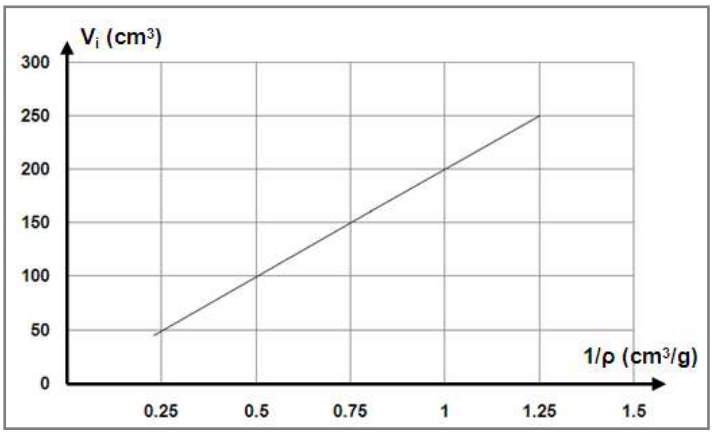
1) **(**S) floats on the surface of one of these liquids of density ρ.

a) Give the name of each of the two forces acting on (S). Indicate, for each of these two forces, whether it is a contact force or a force acting from a distance.

b) Write the condition of equilibrium of (S).

c) Deduce the expression of m in terms of ρ and the immersed volume V_i of (S).

2) As the liquid is changed, the density ρ varies and the immersed volume V_i of (S) varies too. We draw the graph of V_i as a function of $\frac{1}{\rho}$ (curve below).



a) Show that the slope of the obtained curve represents the mass m of (S).

b) In the case of the liquid (L), $V_i = 100\ cm^3$. Determine then the density ρ_L of (L).

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First exercise (7 points)

Parts of Q.	Answer key	Note
1	O is the optical center since it is the point of intersection between the optical axis and the lens.	**0.5**
2	AB = 2×2 = 4 cm. (0.5) d = 6×2 = 12 cm. (0.5)	**1**
3	Reproduction.	**0.5**
4.a	Trace of the 1st ray. (0.5) Since the incident ray is parallel to the optical axis of the converging lens, then it emerges passing through the image focus F' (0.5)	**1**
4.b	Trace of the 2nd ray (passing through O or through F).	**1**
4.c	Construction of the image. (trace 0.5) + (Explanation 0.5)	**1**
4.d	Nature: (A'B') is a real image (0.5) Since it is formed after the lens. (0.5)	**1**
4. e	A'B' = 1×2 = 2 cm.	**0.5**
5	d' = 3×2 = 6 cm.	**0.5**

Second exercise (7 points)

Parts of Q.	Answer key	Note
I.1)	Thermal energy (or heat)	**0.5**
I.2.a)	Since the obtained curve is not a straight line passing through the origin.	**1**
I.2.b)	Using Ohm's law : U = R×I (0.5) $\Rightarrow$ R = U / I = 5 / 0,1 = 50 Ω (0.5)	**1**
II.1)	P = U× I (0.25) and U = R×I (0.25) then I = U/ R therefore P = U^2/ R. (0.5) P = (220×220) / 50 = 968 W. (0.5)	**1.5**
II.2)	E = P×t (0.5) E = 0,968 kW × 5 h = 4,84 kWh (1)	**1.5**
II.3.a)	Monthly consumed energy: E_1=15 ×E =15 × 4, 84 = 72,6 kWh.	**1**
II.3.b)	Monthly cost: 72,6 ×100 = 7260 LL (0.5)	**0.5**

Third exercise (6 points)

Parts of Q. N°	Answer key	Notes
1.a)	$\vec{W}$: weight of the body (0.5) force acting from a distance (0.5) $\vec{F}$: Archimedes up-thrust (0.5) contact force (0.5)	**2**
1.b)	At the equilibrium : $\vec{W} + \vec{F} = \vec{0}$ or $\vec{W}$ and $\vec{F}$ have same line of action - opposite direction and same magnitude.	**0.75**
1.c)	W = m×g (0.5) et F = $\rho \times V_i \times g$ (0.5) then m×g = $\rho \times V_i \times g$ Thus : m= $\rho \times V_i$ (0.5)	**1.5**
2.a)	Slope = $\frac{V_i}{\frac{1}{\rho}} = V_i \times \rho$ = m	**0.75**
2.b)	For V_i = 100 cm^3 we find graphically $\frac{1}{\rho}$ = 0,5 cm^3/g (0.5) then ρ = 2 g/cm^3. (0.5)	**1**