الدورة الإستثنائية للعام 2011	الشهادة المتوسطة	وزارة التربية والتعليم العالي المديرية العامة للتربية دائرة الامتحانات
الاسم: الرقم:	مسابقة في مادة الفيزياء المدة ساعة	

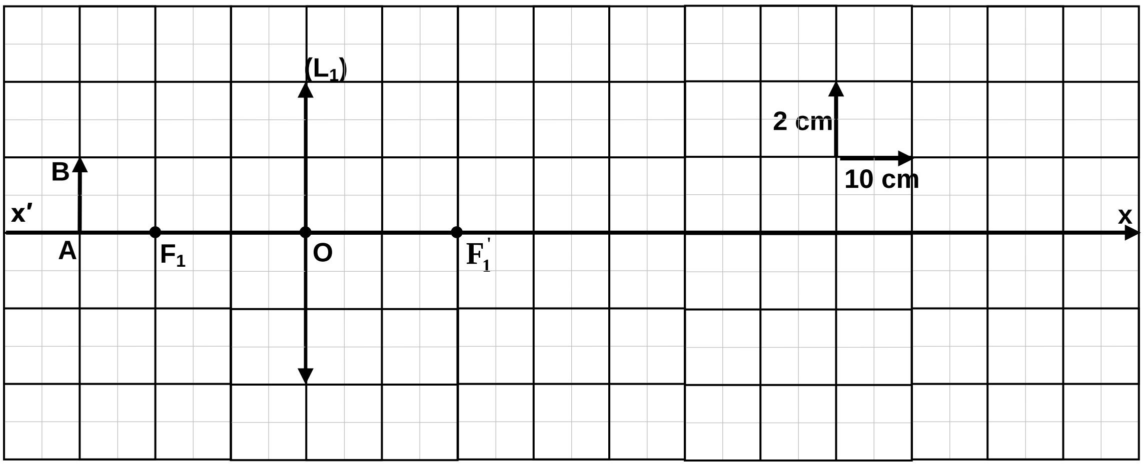
<u>This exam is formed of three obligatory exercises in two pages.</u>
<u>The use of non- programmable calculator is allowed.</u>

<u>First exercise</u> (7 points) Converging lens

The aim of this exercise is to show evidence of the variation of the size and the position of a real image given by a converging lens with the focal length of this lens.

I – First experiment

We consider the set up of the figure below. (L_1) is a converging lens of focal length $f_1 = 20$ cm, whose optical axis is $x'x$ and whose foci are F_1 and F_1' . AB is a luminous object placed at 30 cm from (L_1).



1. Redraw, on the graph paper using the same scale, the above diagram.
2. **a)** Trace the image A_1B_1 of AB. Justify.
   b) Deduce the size of A_1B_1 as well as its distance d_1 from (L_1).

II – Second experiment

We replace (L_1) by another converging lens (L_2) of focal length $f_2 = 25$ cm.
The object AB is kept at the same distance of 30 cm from the lens.

1. Draw, on the graph paper, the new diagram showing on it (L_2), $x'x$, AB and the two foci F_2 and F_2' of (L_2) .
2. **a)** Trace the new image A_2B_2 of AB.
   b) Deduce the size of A_2B_2 and its distance d_2 from (L_2).

III – Conclusion

1. Compare:
   a) A_1B_1 and A_2B_2.
   b) d_1 and d_2.
2. In order to examine the small details of the object AB we use the lens (L_2). Why?

Second exercise (7 points) Study of an electric circuit

Consider:

- Two lamps (L_1) and (L_2) considered as resistors of resistances $R_1 = 60\ \Omega$ and $R_2 = 20\ \Omega$ respectively carrying the same inscription: 6 V.
- A generator (G) delivering across its terminals, P and N, a constant voltage $U_{PN} = 12$ V.

We intend to use (G) so as to make the two lamps function normally at the same time.

1. Assume that (L_1) and (L_2) are connected in series across the terminals of (G) as shown in figure 1.
   a) By applying the law of addition of voltages, show that the current through the circuit must be $I = 0.15$ A.
   b) Determine, in this case, the voltage across the terminals of each lamp.
   c) One of the two lamps has the risk to burn out while the other one gives faint light. Why?
2. For the lamps to function normally, we connect across (L_1) a resistor (D) of resistance R as shown in figure 2.
   a) Determine the value I_1 of the current through (L_1) and the value I_2 of the current through (L_2).
   b) Find, by applying the law of addition of currents, the value I_3 of the current through the resistor (D).
   c) Deduce the value of R.

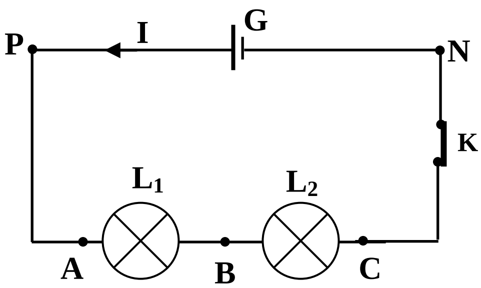


Fig. 1

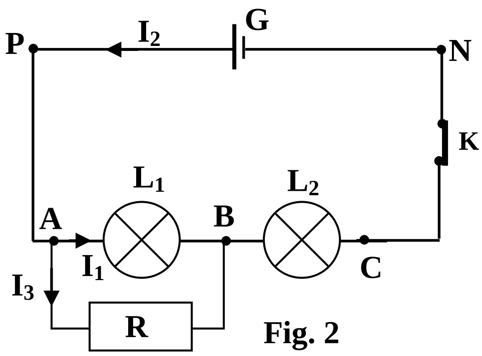


Fig. 2

Third exercise (6 points)

Determination of the density of a liquid

Given:

- Atmospheric pressure $P_{atm} = 76$ cm of mercury;
- Density of mercury $\rho_{Hg} = 13.6$ g/cm^3;
- Density of water $\rho_{water} = 1$ g/cm^3;
- $g = 10$ N/kg.

I – Atmospheric pressure

We consider a U tube containing water at equilibrium (figure 1).

1. The two points A and B are submitted to the same pressure which is the atmospheric pressure. Calculate, in Pascal, the value of this pressure.
2. The two points A and B are in the same horizontal plane. Justify.

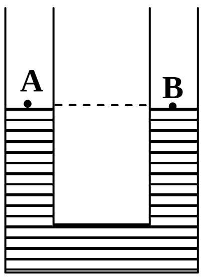


Figure (1)

II – Density of a liquid

In one of the two branches of the same U tube, we pour a quantity of a liquid immiscible with water of density ρ.
At equilibrium, the height of the liquid is $h = 20$ cm and that of water above the surface of separation of the two liquids is $h_1 = 16$ cm (figure 2).

1. Determine, in terms of ρ, the pressure at point C.
2. Calculate the pressure at point D.
3. The pressure at C and the pressure at D are equal. Why?
4. Deduce the value of ρ.

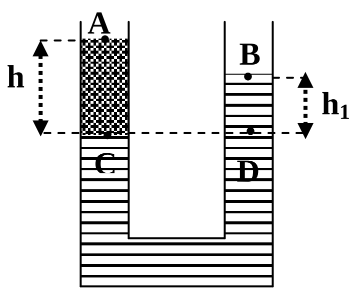


Figure (2)

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First exercise (7 points)

Part of the Q	Answer	Mark
I. 1)	Redrawing with the same scale.	½
I. 2)-a)	- Tracing the 1st particular ray **(½)** - justification **(¼)** - Tracing the 2nd particular ray. **(½)** - justification **(¼)** - Construction of the image. **(½)** - justification **(¼)**	**2¼**
I. 2)-b)	$A_1B_1 = 2\times2 = 4$ cm **(¼)** ; $d_1 = 6\times10 = 60$ cm **(¼)**	½
II.1)	figure	¾
II.2)-a)	- Tracing the 1st particular ray. **(½)** - Tracing the 2nd particular ray. **(½)** - Construction of the image A_2B_2. **(½)**	**1½**
II.2)-b)	$A_2B_2 = 5\times2 = 10$ cm **(¼)** ; $d_2 = 15\times10 = 150$ cm **(¼)**	½
III. 1) a)	$A_1B_1 = 4$ cm and $A_2B_2 = 10$ cm. thus : $A_2B_2 > A_1B_1$	¼
III. 1) b)	$d_1 = 60$ cm and $d_2 = 150$ cm. thus: $d_2 > d_1$	¼
III. 2)	We use (L_2) since $A_2B_2 > A_1B_1$	½

Second exercise (7 points)

Part of the Q	Answer	Mark
1)-a)	$U_{PN} = U_{PA} + U_{AB} + U_{BC} + U_{CN}$ **(½)** ; ($U_{PA} = U_{CN} = 0$) **(½)** $U_{AB} = R_1 \times I$ and $U_{BC} = R_2 \times I$ **(½)** $12 = R_1I + R_2I \Rightarrow I = \frac{\mathbf{12}}{\mathbf{R_1}+\mathbf{R_2}} = \frac{\mathbf{12}}{80} = 0.15A$ **(½)**	**2**
1)-b)	Across the terminals of L_1 : $U_1 = R_1I = 60\times0.15 = 9V$ **(½)** Across the terminals of L_2 : $U_2 = R_2I = 20\times0.15 = 3V$ **(½)**	**1**
1)c)	For $U_1 = 9V > 6V = U_{rated}$. The lamp may burn out **(½)** For $U_2 = 3V < 6V = U_{rated}$. The lamp shines weakly **(½)**	**1**
2)-a)	L_1 and L_2 function normally , thus $U_1 = U_2 = 6$ V **(½)** $U_1 = R_1I_1 \Rightarrow I_1 = \frac{6}{60} = 0.1A$ **(½)** ; $I_2 = \frac{6}{20} = 0.3A$ **(½)**	**1½**
2)-b)	$I_1 + I_3 = I_2$ **(½)** $I_3 = 0.3 - 0.1 = 0.2A$ **(½)**	**1**
II.2)c)	$U_{AB} = R.I_3 \Rightarrow R = \frac{\mathbf{U_{AB}}}{\mathbf{I_3}} = \frac{\mathbf{U_{L_1}}}{\mathbf{I_3}} = \frac{6}{0.2} = 30\Omega$	½

Third exercise (6 points)

Part of the Q	Answer	Mark
I.1)	$P_{atm} = \rho \times g \times H$ **(½)** $= 13600 \times 10 \times 0.76 = 103360$ Pa **(½)**	**1**
I.2)	Since A and B are submitted to the same pressure and are in the same liquid at equilibrium, then they are in the same horizontal plane.	**1**
II. 1)	$P_C = \rho\ g\ h + P_{atm}$ **(½)** $P_C = \rho \times 10 \times 0.2 + 103360$ $P_C = 2\rho + 103360$ **(½)**	**1**
II .2)	$P_D = \rho_1 \times g \times h_1 + P_{atm}$ $= 1000 \times 10 \times 0.16 + 103360$ $= 1600 + 103360$ $= 105260$ Pa	**1**
II .3)	Since C and D are in the same liquid at equilibrium and at the same horizontal plane.	**½**
II .4)	$P_C = P_D$ then $2\rho + 103360 = 1600 + 103360$ **(¾)** 2ρ (kg/ m^3) $= 1600 h_1$ (m) $\Rightarrow \rho = 800$ kg/m^3 **(¾)**	**1½**