وزارة التربية والتعليم العالي
المديرية العامة للتربية
دائرة الامتحانات

الشهادة المتوسطة

دورة العام 2013 الاستثنائية
الأربعاء 28 آب 2013

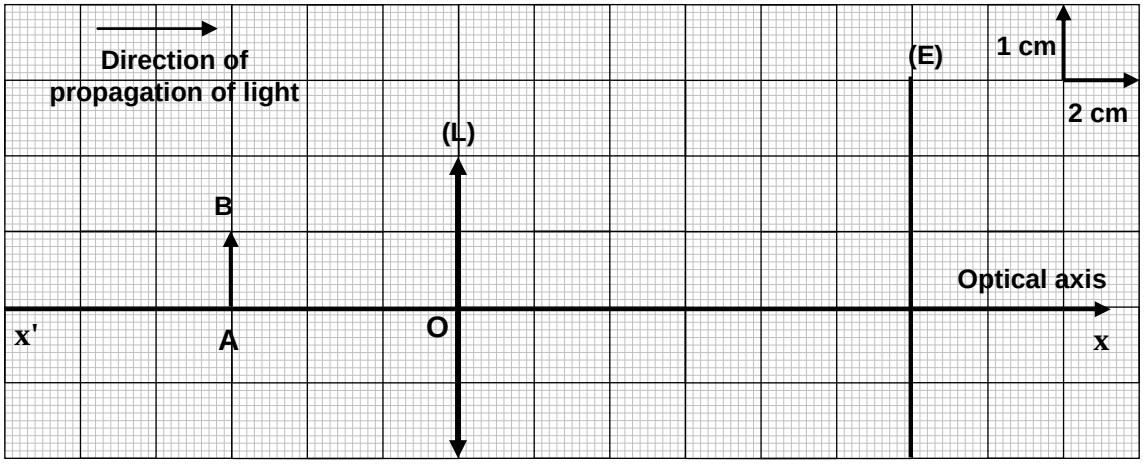
مسابقة في مادة الفيزياء
المدة ساعة

الاسم:
الرقم:

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

First exercise (7 points) **Focal length of a converging lens**

The aim of this exercise is to determine the focal length of a converging lens.
On the diagram below, AB represents a luminous object, (L) a converging lens and (E) a screen on which the image A'B' of AB is given by (L).



I) Showing evidence of the nature of (L)

1) Is the image A'B' of AB real or virtual? Justify.
2) Deduce that (L) is a converging lens.

II) Determination of the focal length of (L)

1) Redraw, on the graph paper and by same scale, the above diagram.
2) Place on the drawn diagram the point image A□ of A given by (L). Justify.
3)a) By tracing one particular ray issued from B, construct the image B□ of B given by (L).
b) Trace the image A□B□ of AB Deduce its size.
4) Trace the path of a luminous ray issued from B and parallel to the optical axis.
5) a) Indicate the position of the image focus F□ of (L). Explain.
b) Deduce the focal length f of (L).

Second exercise (7 points) **Normal functioning of a lamp**

The circuit of figure 1 consists of:
- a generator (G) delivering across its terminals a constant voltage U_{AC} = 12V;
- a resistor (D) of resistance R;
- a lamp (L) carries the inscriptions (9V;30mA);
- a closed switch (K);
- an oscilloscope connected across the terminals of (D).

The aim of this exercise is to determine the value of R of (D) in order to let the lamp function normally.

I. Role of (D)

1) What do the inscriptions 9V and 30mA of (L) represent?
2) If (L) is connected directly across the terminals of (G), it burns out. Justify.
3) Deduce the role of (D) in this circuit.

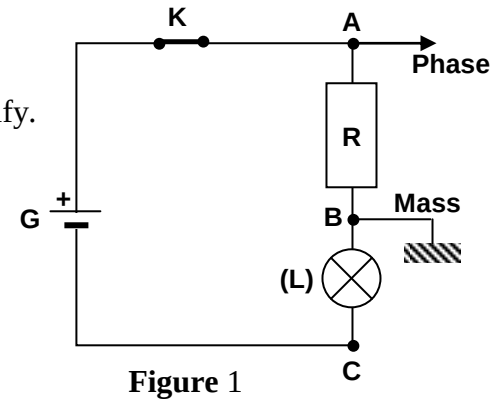


Figure 1

II. Exploitation of the waveform

Figure 2 shows the waveform displayed by the oscilloscope.
Given: vertical sensitivity: S_v = 1 V/div.

1) a) Does the oscilloscope measure U_{AB} or U_{BA}? Justify.
b) Calculate the value of U_{AB}.
c) Deduce the value of the voltage U_{BC} and name the used law.
2) (L) functions normally. Justify.

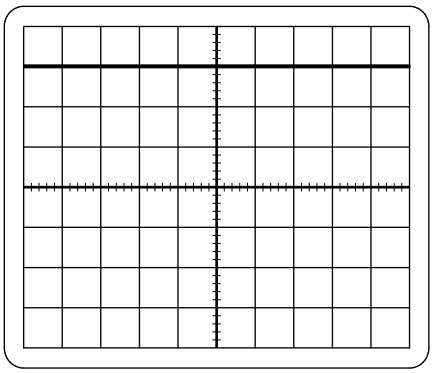


Figure 2

III. Determination of the value of R

1) Specify the value of the intensity I of the current traversing the circuit.
2) Deduce the value of R.

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

Consider a U tube containing a certain amount of water (figure 1).
Given: atmospheric pressure: P_{at} = 76 cm of mercury;
Density of mercury: ρ_{Hg} = 13600 kg/m^3 and g = 10 N/kg.

1) a) The two free surfaces of water are at the same horizontal plane. Justify.
b) Calculate, in Pa, the value of the pressure at A and that at B in figure 1.

2) We want to determine the density ρ□ of a certain liquid (L) that does not mix with water. For this reason, we pour in branch (1) of the tube an amount of oil to a height h = 20 cm and of density ρ = 900 kg/m^3 and in branch (2) a certain amount of (L) to a height h' = 16 cm. The surfaces of separation (water-oil) and (water-liquid) are at the same horizontal plane (figure 2).

a) Determine, in Pa, the value of the total pressure at A.
b) Deduce, in Pa, the value of the total pressure at B.
c) Give the expression of the total pressure at B as a function of ρ□.
d) Deduce the value of ρ□.

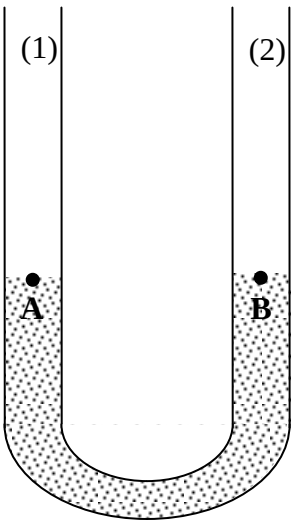


Figure 1

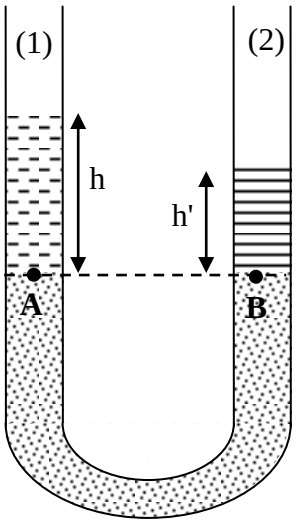


Figure 2

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مشروع معيار التصحيح | مسابقة في مادة الفيزياء | الاسم:
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First exercise (7 points)

Part of the Q	Answer	Mark
I. 1)	A'B' is a real image…… **(0.5)** Since it is received on the screen (E) ……**(0.5)**	**1**
I. 2)	L is converging since it gives a real image.	**0.5**
II. 1)	Redrawing	**0.5**
II. 2)	Position of A□ on the diagram……**(0.5)** A□ is found on (E) and on the other hand it is on the optical axis thus A□ is the intersection of (E) with optical axis……**(0.5)**	**1**
II. 3) a)	Trace of ray BO……**(0.5)** Image B□ on the screen. The incident ray BO passes through optical center continues its path undeviated passes through B□, B□ is the intersection of ray BO with (E) ……**(0.5)**	**1**
II. 3) b)	See diagram (For image) ……**(0.5)** size A□ B□ = 2x1 =2cm……**(0.5)**	**1**
II. 4)	Trace……**(0.5)**	**0.5**
II. 5) a)	See diagram……**(0.5)** F□ is the point of intersection between the emergent ray corresponding to the parallel incident ray then it is the image focus…… **(0.5)**	**1**
II. 5) b)	f = OF' = 2x2 = 4cm	**0.5**

Second exercise (7 points)

Part of the Q	Answer	Mark
I.1)	9V is the rated voltage of the lamp…… **(0.5)** 30mA is the current carried by the lamp while functioning normally……**(0.5)**	**1**
I.2)	Since the voltage of the generator is greater than the rated voltage of (L)	**0.5**
I.3)	(D) plays a role of protecting lamp from burning	**0.5**
II.1)a)	It measures the voltage U_{AB} (0.25) Oscilloscope measures voltage between phase(E) and mass (M) Since the terminal A is connected to the phase of the oscilloscope…… (0.5)	**0.75**
II.1)b)	$U_{AB} = S_v xy = 1\times3 = 3V$	**0.5**
II.1)c)	$U_{AC} = U_{AB} + U_{BC}$ **(0.5)** $U_{BC} = 12 - 3 = 9v$……**(0.5)** law of addition of voltage……**(0.5)**	**1.5**
II.2)	U_{BC} = 9V is equal to the rated voltage of the lamp	**0.5**
III.1)	Since the lamp functions normally …… **(0.5)** Then I = 0.03A = 30mA …… **(0. 5)**	**1**
III.2)	R = $\frac{U_{AB}}{I}$ ……(0.25) R = 100Ω……(0.5)	**0.75**

Third exercise (6 points)

Part of the Q	Answer	Mark
1.a	Since they are under same atmospheric pressure in the same liquid at equilibrium	**0.75**
1.b	$P_A = P_B = P_{at}$ …… **(0.25)** $P_{atm} = \rho_{Hg}.g.H$ …… **(0.5)** P = 103360 Pa. ……**(0.25)**	**1**
2.a	$P_A = P_{oil} + P_{at}$ …… **(0.5)** $P_A = \rho_{oil}.g.h + 103360$ Pa = 105160 ……**(1)**	**1.5**
2.b	$P_B = P_A$ = 105160 Pa ……**(0.25)** Since B and A are at the same horizontal level in the same liquid at equilibrium …… **(0.5)**	**0.75**
2.c	$P_B = P_L + P_{at}$ $P_B = \rho' g h' + P_{at}$……**(0.5)** $P_B = 1.6\rho' + 103360$……**(0.5)**	**1**
2.d	$\rho' = \frac{105160 - 103360}{1.6} = 1125\ kg/m^3$.	**1**