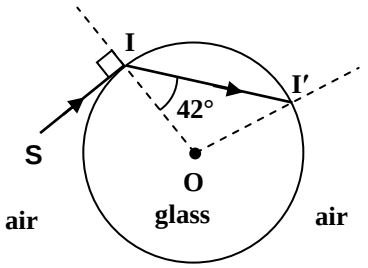
وزارة التربية والتعليم العالي المديرية العامة للتربية دائرة الامتحانات	الشهادة المتوسطة	دورة سنة 2009 العادية
	مسابقة في مادة الفيزياء المدة: ساعة واحدة	الاسم: الرقم:

This exam is formed of three obligatory exercises in two pages.
The use of non programmable calculators is allowed.

First exercise (7 points)

The path of a luminous ray through a sphere of glass

In the adjacent figure, a luminous ray SI passes from air into a sphere of glass of center O.
OI and OI' represent respectively the normal at I and the normal at I′ to the surface of separation of the system (air-glass).
The object of this exercise is to study the behavior of SI after crossing into the sphere.



1) a) What is the value of the angle of incidence of SI at I ?
b) What is the value of the corresponding angle of refraction ?

2) Give, with justification, the value of the limiting (critical) angle of refraction i_ℓ of the system (air – glass).

3) Show that the value of the angle of incidence of the ray II' at I' is 42^o.

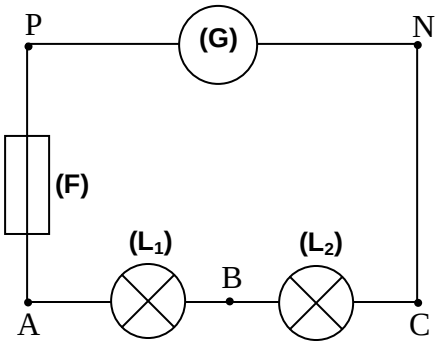
4) a) The ray II′ emerges into air. Why ?
b) Determine the value of the angle of refraction at I′.

5) Redraw the adjacent figure and complete the path of the ray II′.
6) a) Calculate the angle of deviation D_1 that the ray SI undergoes at I.
b) Calculate the angle of deviation D_2 that the ray II′ undergoes at I′.
c) Deduce the angle of total deviation D that the ray SI undergoes.

Second exercise (7 points)

Role of a fuse

In order to show evidence of the role of a fuse, we construct the circuit of the adjacent figure. This circuit includes in series :
- a generator (G) delivering across its terminals a constant voltage $U_{PN} = U = 24$ V.
- two identical lamps (L_1) and (L_2) considered as resistors, carrying the indications (12 V; 0.6 A).
- a fuse (F) of negligible resistance carrying the indication 0.65 A.



1) a) Give the significance of each of the indications carried by the lamps.
b) Determine the resistance of each of the two lamps
2) a) The voltage across (F) is zero. Why ?
b) Determine the values of the voltages $U_1$and U_2 across the terminals of (L_1) and (L_2) respectively.
c) deduce that the lamps function normally.
d) What is then the value of the current I through the circuit?

3) The lamp (L_2) is short circuited

a) Give the value of the voltage U_2' across the terminals of (L_2). Justify.

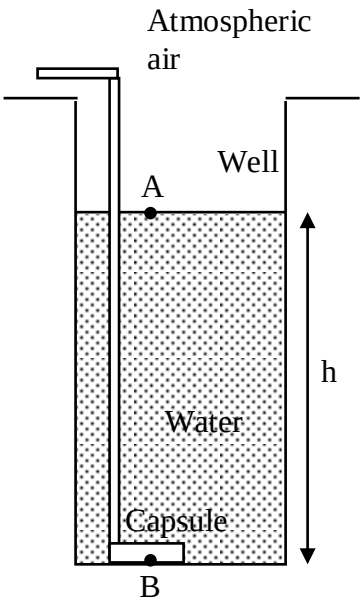
b) Deduce the value of the voltage U_1' across the terminals of (L_1) and the value of the current I′ through the circuit.

c) (L_1) may burn out. Why ?

d) In fact (L_1) does not burn out but it will be off. Explain.

Third exercise (6 points)

Depth of a well



We would like to determine graphically the depth h (in m) of water in a well. For this purpose, we place, at the bottom of the well, a manometric gauge that gives the total pressure at a point B of the bottom.

Given:

- Density of water: 1000 kg/m^3;
- Atmospheric pressure: 103360 Pa;
- g = 10 N/kg.

1) Give the value of the pressure P_o at A.

2) Express, as a function of h, the pressure P_1 (in Pa) exerted by water on the point B.

3) Show that the total pressure P at B, expressed in Pa, is written in the form $P = 10000h + P_o$.

4) Trace, on the graph paper, the graph of the variation of $\Delta P = (P - P_o)$ as a function of h.
Scale: on the abscissa: 1 cm for 0.1 m;
on the ordinate: 1 cm for 1000 Pa.

5) On a certain summer day, the pressure given by the gauge has the value P = 105360 Pa.

a) Calculate then the value of ΔP.

b) Deduce graphically the depth h of water in the well on that day.

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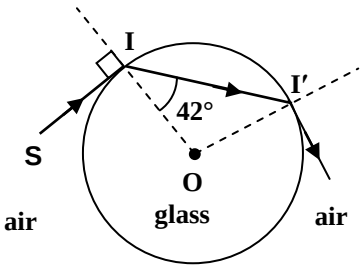
First exercise (7 points)

Part of the Q	Answer	Mark
1.a	$i = 90^o$.	0.50
1.b	$r = 42^o$.	0.50
2	For $i = 90^o$ we get $r = i_\ell$ thus $i_\ell = 42^o$.	1
3	The triangle IOI' is isosceles thus $i' = 42^o$.	0.50
4.a	Since $i' = 42^o = i_\ell$.	0.50
4.b	$r' = 90^o$ since $i' = 42^o = i_\ell$. (or the principle of reversibility of light).	1
5	Redrawing (0.5) Ray grazing (0.5) 	1
6.a	$D_1 = i - r = 48^o$.	0.50
6.b	$D_2 = r' - i' = 48^o$.	0.50
6.c	$D = D_1 + D_2$ since the two deviations are of the same direction (0.5) thus $D = 96^o$. (0.5)	1

Second exercise (7 points)

Part of the Q	Answer	Mark
1.a	12 V : rated voltage of each lamp (0.50) ; 0.6 A: rated current of each lamp. (0.50).	1
1.b	$U = R.I$ (0,50) $R = 12/0.6 = 20\ \Omega$. (0.50)	1
2.a	$U_{(F)} = 0$ because (F) is of negligible resistance.	0.50
2.b	Law of addition of voltages : $U_G = U_F + U_1 + U_2$ (0.50) but $U_F = 0$ and $U_1 = U_2$ thus $U_G = 2U_1$ hence $U_2 = U_1 = 12$ V. (0.50)	1
2.c	$U_1 = U_2 = U_{rated} = 12$ V. Thus the two lamps function normally.	0.50
2.d	$I = 0.6$ A since the lamps function normally.	0.50
3.a	$U'_2 = 0$ because the voltage across a connecting wire is zero.	0.50
3.b	$U'_1 = U_G = 24$ V. (0.50) ; $U_G = RI'$ thus $I' = 24/20 = 1.2$ A. (0.50)	1
3.c	$I' = 1.2\ A > I_{rated} = 0.6$ A. there is risk that (L_1) may burn out. Or $U' = 24\ V > U_{rated}$	0.5
3.d	$I' = 1.2\ A > 0.65$ A. The fuse will melt, cut the circuit and then protects (L_1).	0.5

Third exercise (6 points)

Part of the Q	Answer	Mark
1	$P_o = P_{atm} = 103360$ Pa.	**0.50**
2	$P_1 = \rho_{water}.g.h$ (0.50) $P_1 = 10000h$ (1)	**1.50**
3	$P = P_1 + P_o$ (0.5) $P = 10000h + P_o$ (0.5)	**1**
4	Graph (straight line passing through the origin)	**1**
5.a	$\Delta P = P - P_o = 2000$ Pa.	**1**
5.b	Using the graph (0.5) h = 0.2 m (0.5)	**1**