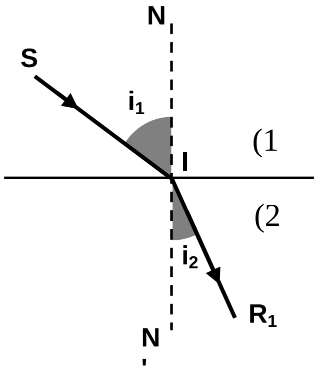
2011 الدورة العادية للعام	الشهادة المتوسطة	وزارة التربية والتعليم العالي المديرية العامة للتربية دائرة الامتحانات
الاسم: الرقم:	مسابقة في مادة الفيزياء المدة ساعة	

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

First exercise (7 points) Refraction and total reflection of light

The aim of this exercise is to study the path of a luminous ray from a transparent medium (1) into a transparent medium (2), One of them is glass and the other is air.
The limiting angle of refraction of the system (glass- air) is $i_L = 42^{o}$.

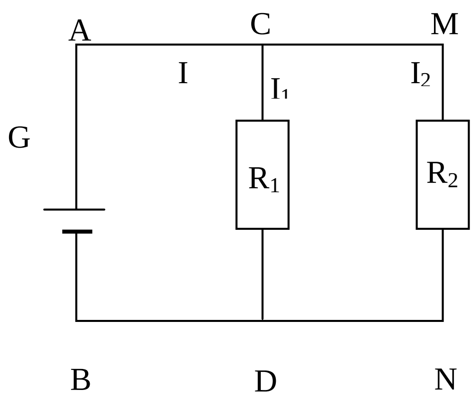


1) We send a luminous ray S_1I in medium (1) at an angle of incidence i_1. It emerges into medium (2) along the ray IR_1 that forms an angle i_2 with the normal NN' (adjacent figure).
a) Give the name of the physical phenomenon that the ray S_1I undergoes at I.
b) S_1I represents the incident ray. What does IR_1 represent?
c) Compare i_1 and i_2.
d) i)The medium (2) is more refractive than medium (1). Justify.
ii) The medium (2) is then glass. Why?

2) We send now, in the medium (2), a light ray S_2I that forms with the normal an angle of incidence $i_3 = 42^{o}$.
a) The ray emerges grazing the surface of separation. Why?
b) Give the value of the angle of refraction i_4 corresponding to i_3.
c) Draw the corresponding sketch.

3) We send now, in the medium (2), another ray S_3I that forms with the normal an angle of incidence $i' = 50^{o}$.
a) The ray S_3I undergoes total reflection. Why?
b) Determine the value of the angle of reflection r' corresponding to i'.

Second exercise (7 points) Electric power



The circuit of the adjacent figure is formed of:
- a generator G delivering across its terminals a constant voltage $U_{AB} = 12$ V ;
- two resistors of resistances $R_1 = 30\ \Omega$ and $R_2 = 60\ \Omega$.

We designate by I the current in the main branch, by I_1 the current traversing (R_1) and by I_2 the current traversing (R_2).

1- **a)** Reproduce the adjacent figure and indicate on it the direction of the currents in all branches.
b) $U_{AB} = U_{CD} = U_{MN} = 12$ V. Why?
c) Determine the value of I_1 and that of I_2. Deduce that I = 0.6 A.

2- a) Knowing that $U_{AB} = RI$, calculate the value of $\frac{1}{R}$.

b) Find the value of the expression : $\frac{1}{R_1} + \frac{1}{R_2}$.

c) Deduce the relation among R_1, R_2 and R.

3- a) Calculate the value of the electric power P_1 consumed by (R_1) and P_2 consumed by (R_2).

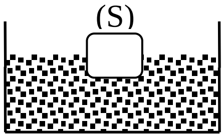
b) The electric power P_e delivered by G is given by: $P_e = U_{AB}I$.

i) Calculate the value of P_e.

ii) Find the relation among P_e, P_1 and P_2 .

Third exercise (6 points) Determination of the volume of a solid

Consider a solid (S) of density $\rho_S = 1$ g/cm^3. (S) is immersed in a liquid of density ρ. (S) is in equilibrium and the volume of the immersed part is V_i (adjacent figure).



1-(S) floats on the surface of a liquid.

a) Name the two forces acting on (S).

b) Tell, for each of the two forces, whether it is a contact force or an action from a distance force.

c) Give the line of action and the direction of each of these two forces.

d) Write down the vector relation between these two forces.

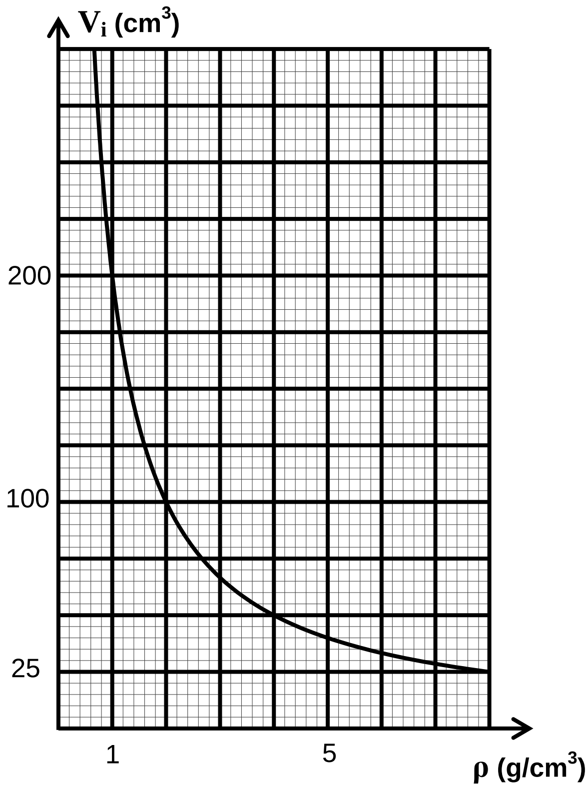
e) Reproduce the figure and represent, without a scale, these two forces.

2- We repeat the experiment by putting (S) successively in different liquids. The adjacent graph represents the variation of V_i as a function of ρ.

a) According to the graph, does the volume of the immersed part increase or decrease when the density of the liquid increases?

b) For ρ = 1 g/cm^3, (S) is totally immersed in the liquid. Why?

c) Deduce graphically the volume of (S).



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

Answer the three following exercises:

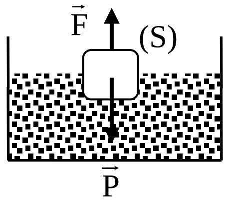
First exercise (7 points)

Part of the Q	Answer	Mark
1.a	The refraction of light.	**1**
1.b	IR_1 is the refracted ray.	**0.5**
1.c	According to the figure, we find $i_2 < i_1$.	**0.5**
1.d.i	The refracted ray is closer to the normal than the incident ray ($i_2<i_1$). The medium (2) is then more refractive than the medium (1).	**1**
1.d.ii	The glass is more refractive than the air, therefore medium (2) is glass.	**0.5**
2.a	Since $i_3 = 42^o = i_L$, the refracted ray grazes the surface of separation.	**1**
2.b	$i_4 = 90^o$	**0.5**
2.c	Sketch	**1**
3.a	Because the angle of incidence is greater than the limiting ($i=50^o > 42^o$)	**0.5**
3.b	The angle of incidence is equal to the angle of reflection : $r' = i' = 50^o$	**0.5**

Second exercise (7 points)

Part of the Q	Answer	Mark
1.a	Reproduction + directions	**0.5**
1.b	$U_{AB} = U_{CD} = U_{MN} = 12$ V according to the law of uniqueness of voltage in a parallel circuit.	**0.5**
1.c	$U_{CD} = R_1I_1$ thus $I_1 = 0.4$ A. (0.75) $U_{MN} = R_2I_2$ thus $I_2 = 0,2$ A. (0.5) $I = I_1 + I_2 = 0.6$ A. (0.75)	**2**
2.a	$\frac{1}{R} = \frac{0.6}{12} = 0.05$	**0.5**
2.b	$\frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{30} + \frac{1}{60} = \frac{1}{20} = 0.05$	**0.5**
2.c	$\frac{1}{R} = 0.05$ and $\frac{1}{R_1} + \frac{1}{R_2} = 0.05$, therefore $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$	**0.5**
3.a	$P_1 = U_{CD}.I_1 = 12\times0.4 = 4.8$ W (0.75) $P_2 = U_{MN}.I_2 = 12\times0.2 = 2.4$ W (0.5)	**1.25**
3.b.i	$P_e = U_{AB}.I = 12\times0.6 = 7.2$ W	**0.5**
3.b.ii	$P_1 + P_2 = 4.8 + 2.4 = 7.2$ W Thus $P_e = P_1 + P_2$	**0.75**

Third exercise (6 points)

Part of the Q	Answer	Mark
N^o Q	**Answer**	**Marking Scheme**
1.a	Weight of the solid. (0.5) Archimedes up thrust force.(0.5)	**1**
1.b	Weight of the solid: action from a distance. (0.5) Archimedes up thrust force: contact force.(0.5)	**1**
1.c	Weight : vertical line of action and downward direction;(0.25,0.25) Up thrust: vertical line of action and upward direction;(0.25,0.25)	**1**
1.d	(S) in equilibrium, then : $\overrightarrow{W} + \overrightarrow{F} = \vec{0}$	**0.5**
1.e	(0.5 for each for force) 	**1**
2.a	According to the graph, we notice that the immersed volume decreases when the density of the liquid increases	**0.5**
2.b	Because $\rho = \rho_s$	**0.5**
2.c	For $\rho = 1$ g/cm^3, we find $V_i = V_s = 200$ cm^3.	**0.5**