الدورة الإستثنائية للعام 2012	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 exercises in two pages.
The use of a non-programmable calculator is allowed.

First exercise (7 points)

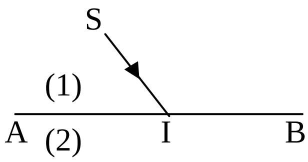
Refraction of light

A luminous beam, propagating in a medium (1), falls on the surface separating this medium from another medium (2). We notice that all the incident rays admit refracted rays.

1) Medium (2) is more refractive than medium (1). Why?

2) During the passage from medium (1) to medium (2), is the refracted ray nearer or farther from the normal than the incident ray? Why?

3) The adjacent diagram represents the surface of separation (AB) between the two mediums (1) and (2), the incident ray (SI) and the point of incidence I.



a) Redraw the diagram.

b) Trace, on your diagram, the path of the refracted ray (IR) corresponding to the incident ray (SI).

c) Indicate, on this diagram, the angle of incidence i, the angle of refraction r and the angle of deviation d.

4) Another luminous beam passes now from medium (2) into medium (1). We notice that an incident ray undergoes refraction only if the angle of incidence is $i \leq 49^0$.

a) What does the angle 49^0 represent to the system of the two mediums (1) and (2)?

b) Consider an incident ray (S_1I_1) with an angle of incidence $i_1 = 60^0$.

i) The incident ray (S_1I_1) undergoes total internal reflection. Justify.

ii) After meeting the surface of separation, the considered ray undergoes a deviation by an angle d', [d' is the angle between the prolongation of the incident ray (S_1I_1) and the reflected ray (I_1R_1)].

Draw a diagram showing the incident ray (S_1I_1), the surface of separation (AB), the normal (NN') at the point of incidence I_1, the reflected ray (I_1R_1), and the angle d'.

iii) Deduce the value of d'.

Second exercise (7 points)

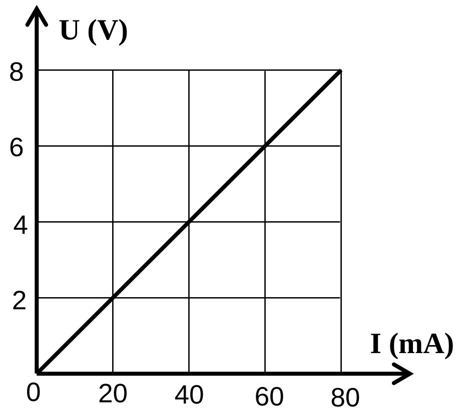
Maximum voltage of a resistor

The aim of this exercise is to determine the maximum voltage U_{max} that a resistor (D) of resistance R can withstand. For this we set-up an electric circuit formed of:

- a DC generator (G) of adjustable voltage;
- the resistor (D);
- a voltmeter (V) to measure the voltage U across (D);
- an ammeter (A), of negligible resistance, to measure the current I that traverses (D).

A – Determination of R

1) Draw a diagram of the corresponding circuit.
2) Knowing U and I, give the name of the law that must be applied to deduce R.
3) Write the relation that expresses this law.
4) The characteristic curve current-voltage of (D) is given by the graph of the adjacent figure.
   a) Give the value of the voltage U across (D) when it carries a current I = 50 mA.
   b) Deduce the value of R.



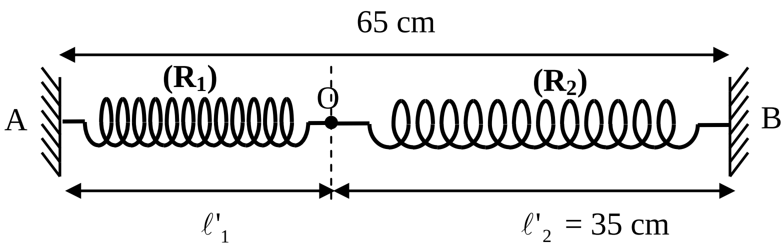
B – Determination of U_{max}

1) Give the expression of the power P dissipated in (D) in terms of U and I.
2) Show that P can be written in two forms: $P = \frac{U^2}{R}$ and $P = R.I^2$.
3) Knowing that the maximum power withstand by (D) is P_{max} = 1W, calculate U_{max}.

Third exercise (6 points)

Mechanical interactions

In order to determine the force constant (stiffness) K_1 of an elastic spring (R_1), of free length ℓ_1 = 20 cm, we consider the system of the adjacent figure.
In this system, the extremity A of (R_1) is connected to a fixed support. The other extremity is connected at O to another spring (R_2), of stiffness K_2 = 100 N/m and of free length ℓ_2 = 30 cm. The other extremity B of (R_2) is connected to another fixed support.
The system formed of (R_1) and (R_2) is at rest.



1) Referring to the figure, calculate the length ℓ'_1 of (R_1).
2) a) Show that the two springs are elongated.
   b) Calculate the elongations ΔL_1 of (R_1) and ΔL_2 of (R_2).
   c) (R_1) and (R_2) are in interaction. Why?
3) Write down the vector relation between the two forces $\vec{T}_1$, exerted by (R_1) on (R_2), and $\vec{T}_2$, exerted by (R_2) on (R_1), at point O.
4) Calculate the magnitude T_2 of the force $\vec{T}_2$ and deduce the magnitude T_1 of $\vec{T}_1$.
5) Find the value of K_1.

الدورة الإستثنائية للعام 2012	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	The medium (2) is more refractive ………………………………………….. (0.5) Because when the refracted ray exists always for any incidence, light is passing from less refractive medium to a more refractive one ……………………………….. (0.5).	**1**
2	The refracted ray deviates towards the normal………………………………….. (0.5) Since this is the case of passage from one medium into a more refractive one….(0.5)	**1**
3	Diagram.	**1.5**
4.a	49^0 represents the limiting angle.	**0.5**
4.b.i	Total reflection.	**0.5**
4.b.ii	Diagram……………………………………………………………………. (1.5) Deviation: D' = 60^0. ………………………………………………………..(1)	**2.5**

Second exercise (7 points)

Part of the Q	Answer	Mark
1)	Diagram	**1.50**
2.a)	Ohm's law.	**0.50**
2.b)	U = R.I	**0.50**
3.a)	I = 50 mA ; thus graphically U = 5 V.	**0.50**
3.b)	R = U/I = 5/0.05 = 100 Ω	**1**
4.a)	P = U.I	**0.50**
4.b)	P = U.I and U = RI thus P = RI^2. (0.75) P = U.I and I = U/R thus P = U^2/R. (0.75)	**1.50**
4.c)	$U_{max} = \sqrt{R \times P_{max}}$ = 10 V.	**1**

Third exercise (6 points)

Part of the Q	Answer	Mark
1	$\ell'_1 = 65 - \ell'_2 = 30$ cm	**0.50**
2.a	$\ell'_1 > \ell_1$ and $\ell'_2 > \ell_2$. The two springs are elongated.	**1**
2.b	The elongated (R_1), exerts a force on (R_2).The elongated (R_2), exerts a force on (R_1). The two springs are in interaction.	**1**

3	$\Delta \ell_2 = \ell'_2 - \ell_2 = 5$ cm. (0.5) $T = K.\Delta \ell$ (0.5) thus $T_2 = K_2.\Delta \ell_2 = 5$ N (0.5)	**1.5**
4	According to the principle of interaction: $\vec{T}_1 = -\vec{T}_2$.	**0.50**
5	$T_1 = T_2 = 5$ N.	**0.50**
6	$\Delta \ell_1 = \ell'_1 - \ell_1 = 10$ cm. (0.5) Hooke's law: $K_1 = \frac{T_1}{\Delta \ell_1} = 50$ N/m. (0.5)	**1**