مسابقة في مادة الفيزياء
المدة: ساعة واحدة

الاسم:
الرقم:

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

<u>First exercise</u> (6 ½ pts) Refraction of light

The aim of this exercise is to study the behavior of light when striking the surface of separation of two mediums, air and water. For this purpose we use a luminous source (S) and a vessel containing water.

Given:

The limiting angle of refraction water-air: $i_\ell = 49^0$.

A. <u>(S) is placed in air</u>

Consider the luminous incident ray SI_1 and its corresponding refracted ray I_1R. NN' represents the normal to the surface of separation (AB) at the point of incidence I_1 (figure 1).

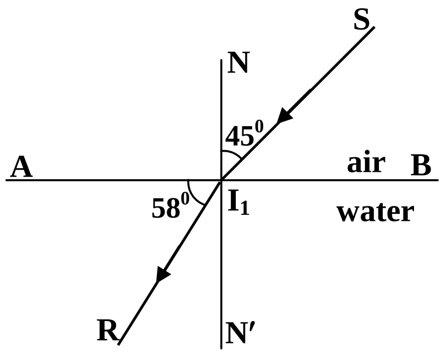

Figure 1

1. Give the value of the angle of refraction of the ray I_1R.

2. Deduce the corresponding angle of deviation.

3. By referring to figure 1, justify which one of the two mediums, water or air, is more refractive?

B. <u>(S) is placed in water</u>

Consider the three luminous incident rays SI_2 , SI_3 and SI_4 (figure 2).

1. SI_2 traverses the surface of separation (AB) and crosses into air. Why?

2. SI_3 undergoes total internal reflection. Why?

3. SI_4 emerges grazing the surface of separation (AB). Why?

4. Reproduce figure 2 and complete the path followed by each of the three rays SI_2 ,SI_3 and SI_4 .

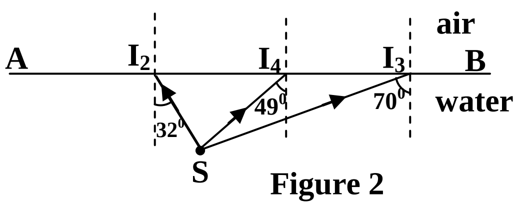

Figure 2

Second exercise : (6 ½ pts)

Characteristic intensity-voltage curve of a resistor

During a lab activity, a group of grade nine students have a regulated d.c generator (G), a resistor (D) of resistance R, an ammeter (A), a voltmeter (V), a switch (K) and connecting wires.
For the purpose of tracing and exploiting the characteristic intensity-voltage curve of a resistor (D), these students, after constructing the appropriate electric circuit, performed measurements by using the voltmeter (V) and the ammeter (A).
The results are shown in the table below:

U_V	0	2	4	
I_{mA}		10		50

1. Draw a schematic diagram of the electric circuit.
2. Calculate, by applying Ohm's law, the value of R.
3. Copy and complete the above table.
4. Trace the characteristic intensity-voltage curve of the resistor (D).

   Scale : for the axis of abscissa : 1 cm ↔ 5 mA

   for the axis of ordinate : 1 cm ↔ 1 V
5. The voltmeter (V) is damaged. Determine graphically the value of the voltage across the terminals of (D) when the ammeter (A) indicates 40 mA.

Third exercise (7 pts)

Floating objects

Is it easier to swim in the fresh water of a lake or in sea water?
To answer this question, we perform the two following experiments with a solid (S) of mass m = 2 kg.
Given: g =10 N/kg .

A. First experiment

(S) floats at the surface of the water of the lake of density 1000 kg/m^3.

1. What condition must the two forces acting on (S) satisfy so that it floats at the surface of water?
2. Calculate the value of the weight of (S). Deduce the value of Archimedes up thrust.
3. Calculate the volume V_1 of the immersed part of (S).

B. Second experiment

(S) floats at the surface of sea water of density 1040 kg/m^3

1. Archimedes up thrust remains the same. Why?
2. Calculate the volume V_2 of the immersed part of (S).

C. Answer for the question

Knowing that swimming is easier when the immersed volume of the floating object decreases, is it easier to swim in the fresh water of a lake or in the sea water? Why?

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First Exercise : (6 ½ pts)

A. 1. $r = 90^0 - 58^0 = 32^0$ (0.5)

2. $\delta = i - r$ (0.5)

$\Rightarrow \delta = 45^0 - 32^0 = 13^0$ (0.5)

3. Water is the more refractive medium because the refracted ray approach the normal (1)

B. 1. Because $i = 32^0 < i_\ell = 49^0$ (0.5)

2. Because $i = 70^0 > i_\ell = 49^0$ (0.5)

3. Because $i = i_\ell$ (0.5)

4. figure : Trace of SI_2 (1)

Trace of SI_3 (1)

Trace of SI_4 (0.5)

Second Execrcise: (6 ½ pts)

1. Circuit (1)

2. $U = RI$ (0.5)

$\Rightarrow R = \frac{U}{I} = \frac{2}{10 \times 10^{-3}} = 200\Omega$ (1)

3. (1.5)

U_V	0	2	4	10
I_{mA}	0	10	20	50

4. graph (1.5)

5. Explanation and value U = 8 V (1)

Third exercise: (7 pts)

A. 1. The two forces are opposite or same direction , opposite sense and same magnitude (1)

or the sum $= \vec{0}$

2. $W = mg$ (0.5)

$\Rightarrow W = 20$ N (0.5)

$F = W = 20$ N (0.5)

3. $F = \rho_L V_1 g$ (0.5)

$\Rightarrow V_1 = 2 \times 10^{-3}$ m^3 (1)

B. 1. Same body $\Rightarrow$ same force (1)

or same weight $\Rightarrow$ same force

2. $V_2 = \frac{20}{1040 \times 10} = 1.92 \times 10^{-3}$ m^3 (1)

C. In sea water (0.5)

Because $V_2 < V_1$ (0.5)