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

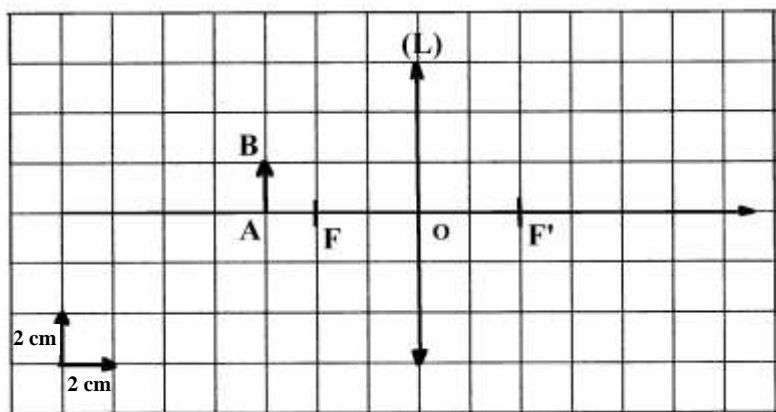
**This exam consists of three obligatory exercises in two pages.
Non- programmable calculators are allowed.**

First exercise Roles of a converging lens (7 points)

The aim of this exercise is to show that a converging lens may have different roles. For this we consider a converging lens (L) of focal length $f = 4$ cm and an object AB of height $AB = 2$ cm, perpendicular at A to the optical axis of the lens.

I- First experiment

The object AB is placed at a distance $OA = 6$ cm from the optical center O of (L).
The diagram below shows (L), its optical axis, its two foci F and F' and the object AB.



- 1) Reproduce, on the graph paper and with the same scale, the above figure.
- 2) Draw, on the reproduced figure, the image A_1B_1 of AB given by (L).
- 3) Give the nature and the direction of A_1B_1 .
- 4) Determine graphically the height and the position of the image A_1B_1 .

II- Second experiment

The object AB is now placed at a distance $OA = 2$ cm from the optical center of the lens.

- 1) Construct, on a new diagram and with the same previous scale, the image A_2B_2 of AB given by (L).
- 2) Give the nature and the direction of A_2B_2 .
- 3) Determine graphically the height and the position of the image A_2B_2 .

III- Conclusion

In the first experiment, the lens may be used as the objective of a slide projector allowing us to obtain a magnified image on a screen. What is the role of the lens in the second experiment? Justify.

Second exercise Study of an electric circuit (7 points)

The electric circuit of figure 1 is formed of:

- a generator (G) that maintains across its terminals a constant voltage $U_G = 9 \text{ V}$;
- a resistor (D_1) of resistance $R_1 = 4 \Omega$;
- a lamp (L) carrying the indications (6 V; 3 W);
- a resistor (D).

- 1) What does each of the indications carried by (L) represent?
- 2) (L) functions normally.
 - a) Calculate the value of the current I_2 carried by (L).
 - b) What is the value of the voltage U_{D_1} across (D_1)?
 - c) Deduce the value of the current I_1 carried by (D_1).
- 3) a) By applying the law of addition of voltages, calculate the value of the voltage U_D across (D).
 - b) The characteristic current-voltage of (D) is that of figure 2. Determine, graphically, the value of the current I through (D).
- 4) By comparing I and the sum ($I_1 + I_2$) tell what law of electricity is thus verified.

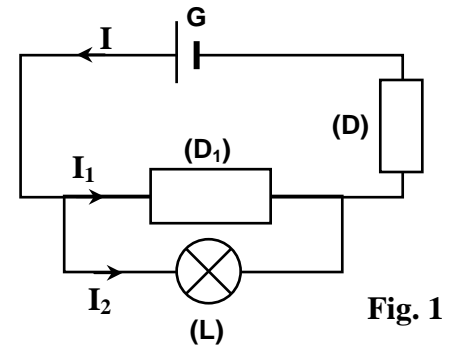


Fig. 1

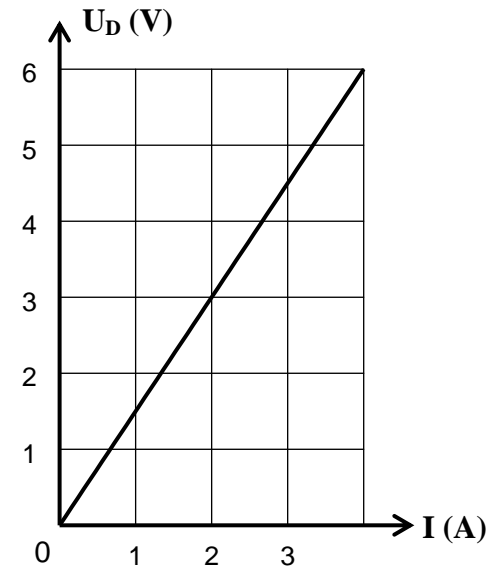


Fig. 2

Third exercise Determination of the density of an alcohol (6 points)

In order to determine the density of an alcohol, we take a solid (S) suspended from the free end of a spring balance, and two containers: one containing water and the other alcohol. Take $g = 10 \text{ N/kg}$.

I- Real weight of (S)

(S) is in equilibrium in air. The spring balance indicates 8 N. This indication represents the value P of the real weight of (S). Why?

II- Volume of (S)

We immerse (S) completely in water of density $\rho = 1000 \text{ kg/m}^3$ (fig. 1). The spring balance then indicates 7 N.

- 1) What does the indication of the spring balance represent?
- 2) Calculate the value F of the Archimedes up thrust exerted by water on (S).
- 3) Deduce the volume V of (S).

III- Density of the alcohol

Now, (S) is completely immersed in alcohol (fig. 2). The spring balance indicates in this case 7.2 N.

- 1) Calculate the value F' of Archimedes up thrust exerted by the alcohol on (S).
- 2) Deduce the value ρ' of the density of this alcohol.

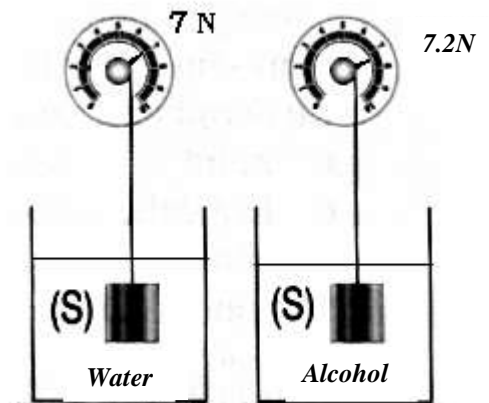


Figure 1

Figure 2

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| Part of the Q | Answer | Mark |
|-----------------------------------|--|------|
| First question (7 points) | | |
| I. 1) | Reproduction | 0.5 |
| I. 2) | - Trace of the 1 st ray. (0.5) - Trace of the 2 nd ray. (0.5) - Construction of A ₁ B ₁ (0.5) | 1.5 |
| I. 3) | Nature : A ₁ B ₁ is a real image (0.5) direction : A ₁ B ₁ is inverted with respect to AB (0.5) | 1 |
| I. 4) | A ₁ B ₁ = 4 cm (0.25) Position : at 12 cm from L (0.25) | 0.50 |
| II. 1) | - Trace of the 1 st particular ray. (0.5) - Trace of the 2 nd particular ray (0.5). - Construction of A ₂ B ₂ (0.5) | 1.5 |
| II. 2) | Nature : A ₂ B ₂ is a virtual image (0.25) Direction : A ₂ B ₂ is erect with respect to AB (0.25) | 0.50 |
| II. 3) | A ₂ B ₂ = 4 cm (0.25) Position : at 4 cm from L (0.25) | 0.50 |
| III. | Role of a magnifier (0.5) Since A ₂ B ₂ is a virtual image, erect with respect to the object and larger than the object (0.5) | 1 |
| Second exercise (7 points) | | |
| 1.a | 6 V: rated voltage (0.5) 3 W: rated power (0.5) | 1 |
| 2.a | P = U _L × I ₂ (0.5) I ₂ = 0.5 A (0.5) | 1 |
| 2.b | U _{D1} = U _L = 6 V. | 0.50 |
| 2.c | U _{D1} = R ₁ × I ₁ (0.5) I ₁ = 1.5 A (0.5) | 1 |
| 3.a | U _G = U _{D1} + U _D (0.5) U _D = 9 - 6 = 3 V (0.5) | 1 |
| 3.b | Reading the graph gives I = 2 A for U _D = 3 V. | 0.50 |
| 4 | I ₁ + I ₂ = 0.5 + 1.5 = 2 A and I = 2 A then I = I _S = I ₁ + I ₂ (1) The verified law is the law of addition of currents (1) | 2.0 |
| Third exercise (6 points) | | |
| I. | Since a spring balance indicates, at equilibrium and in air, the real weight of the suspended body. | 1 |
| II. 1) | The indication of the spring balance represents the apparent weight of the solid (S) in water. | 1 |
| II. 2) | The Archimedes up thrust is given by : F = W _r - W _a (0.5) F = 8 - 7 = 1N (0.5) | 1 |
| II. 3) | The Archimedes up thrust is also given by : F = ρ.v.g (0.5) $V = \frac{F_{water}}{\rho_{water} \times g} = \frac{1}{1000 \times 10} \quad \text{thus } V = 10^{-4} \text{ m}^3 (0.5)$ | 1 |
| III. 1) | The Archimedes up thrust exerted by alcohol : F' = W _r - W'a F' = 8 - 7,2 = 0.8 N. | 1 |
| III. 2) | F' = ρ'.g.v → ρ' = 0.8 / 10 ⁻⁴ × 10 = 800 kg / m ³ | 1 |