وزارة التربية والتعليم العالي المديريّة العامة للتربية دائرة الامتحانـات الرسمية	امتحانات الشهادة المتوسطة	دورة العـام ٢٠١٨ الاستثنائية الاثنين ١٣ آب ٢٠١٨

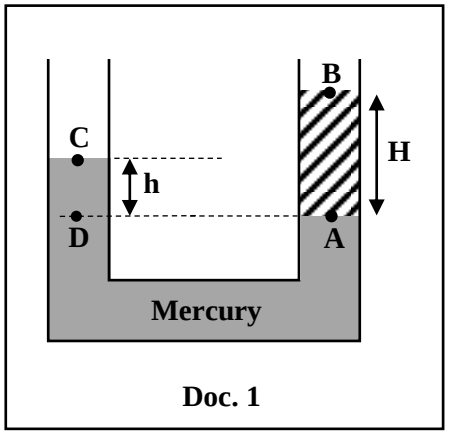
مسابقة في مادة الفيزياء	الاسم:
المدة: ساعة واحدة	الرقم:

This exam is formed of four obligatory exercises in two pages
Non programmable calculators are allowed

Exercise 1 (5 points) Pressure in liquids

Consider a U-tube, of uniform cross-section S, containing mercury. In one of the two branches we pour a quantity of water of volume V = 80 cm^3 (water and mercury are immiscible). At equilibrium, the height of water is H = 40 cm and that of mercury above the surface of separation of the two liquids is h (document 1). Given:

- g = 10 N/kg;
- atmospheric pressure P_0 = 102000 Pa at Beirut;
- density of water ρ_{water} = 1000 kg/m^3;
- density of mercury ρ_{Hg} = 13600 kg/m^3.



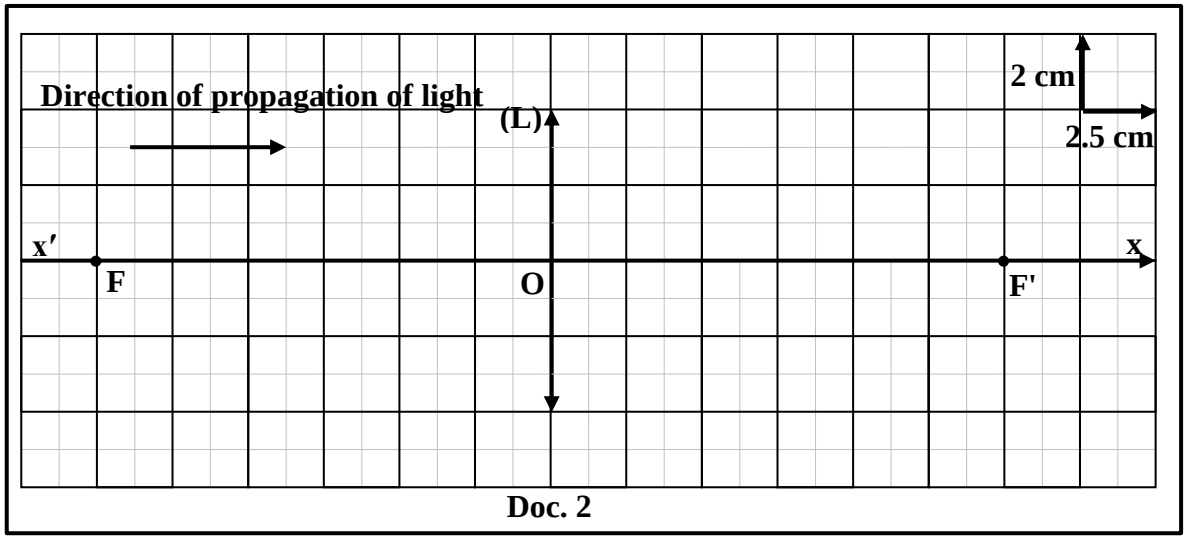
Doc. 1

Choose, with justification, the correct answer:

1. The pressure P_C at C is:
   a. greater than that at B. **b.** equal to that at B. **c.** smaller than that at B.
2. The value of S is:
   a. 3200 cm^2. **b.** 0.5 cm^2. **c.** 2 cm^2.
3. The total pressure P_A at A is:
   a. 502000 Pa. **b.** 4000 Pa. **c.** 106000 Pa.
4. The total pressure at D is equal to that at A, so the value of h is approximately equal to:
   a. 2.9 cm. **b.** 13.6 cm. **c.** 29 cm.
5. We repeat the same experiment at Al Barouk Mountain where the atmospheric pressure is less than P_0. The value of h:
   a. remains the same. **b.** increases. **c.** decreases.

Exercise 2 (6 points) Position of the virtual image given by a converging lens

Document 2 shows a converging lens (L), its optical center O, its optical axis x′x, its object focus F and its image focus F'.
A luminous object (AB) of size AB = 2 cm is placed at a distance d_1 from (L) perpendicularly to the optical axis at A. (A'B') is the image of (AB) given by (L). It is situated at a distance d_2 from (L).



Doc. 2

1. Show that the focal length of (L) is f = 15 cm.

2. The adjacent table gives, for different values of d_1, the corresponding values of d_2.

d_1 (cm)	2.5	5	7.5	10
d_2 (cm)	3	7.5	x	30

2.1. Referring to the table, how does d_2 vary when d_1 increases?

2.2. Out of the following values 5 cm, 15 cm and 40 cm, choose the value corresponds to x.

3. Reproduce, on your graph paper and using the same scale, the document 2.

4. The object (AB) is at 7.5 cm from (L).

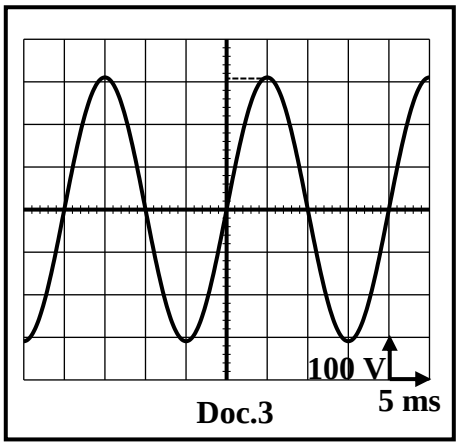
4.1. Place (AB) on the preceding reproduction respecting the chosen scale.

4.2. Construct, without explanation, the image (A'B').

4.3. Verify graphically the value of x.

Exercise 3 (4 points) Characteristics of the voltage of the mains (Electricity in the home)

The waveform of document 3 represents the variations of the voltage of the mains (u), delivered by EDL (Electricity of Lebanon), as a function of time



Doc.3

1. Referring to document 3:

1.1. indicate the type of the voltage (u).

1.2. show that the maximum voltage U_m of (u) is equal to 310 V.

1.3. calculate its period T.

2. Deduce:

2.1. the effective voltage U of (u). Take: $\sqrt{2} = 1.41$.

2.2. its frequency f.

3. On the rating plates of two electric devices, we read the following inscriptions:

Device A	Device B
110 V ; 60 Hz ; AC ~	220 V ; 50 Hz ; AC ~

Choose, with justification, the electric device that can function normally when it is fed by the voltage (u).

Exercise 4 (5 points) Normal functioning of the lamp

A lamp (L), carrying the inscriptions (6 W; 12 V), is assumed as a resistor (ohmic conductor) of resistance r.

1. Show that the current carried by the lamp (L) while functioning normally is $I_o = 0.5$ A.

2. Calculate r.

3. The lamp (L) is placed in an electric circuit as shown in document 4.

The resistors (R_1) and (R_2) have resistances $R_1 = 10\ \Omega$ and $R_2 = 20\ \Omega$ respectively.

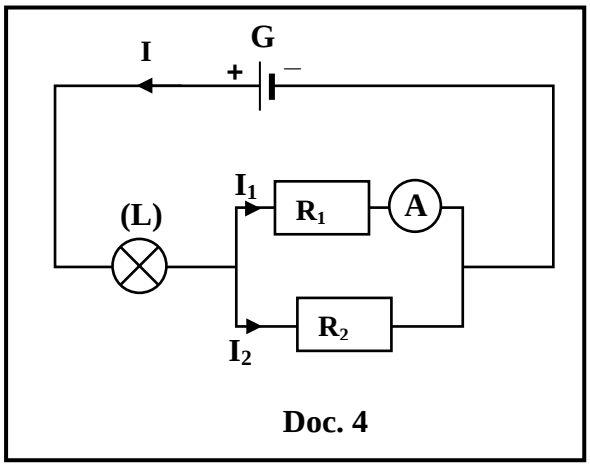
The ammeter (A), of negligible resistance, displays 0.1A.

3.1. Calculate the value of the voltage U_1 across (R_1).

3.2. Show that the current I_2 carried by (R_2) is 0.05 A.

3.3. Deduce the current I through the lamp (L).

3.4. Does (L) function normally in this circuit? Why?

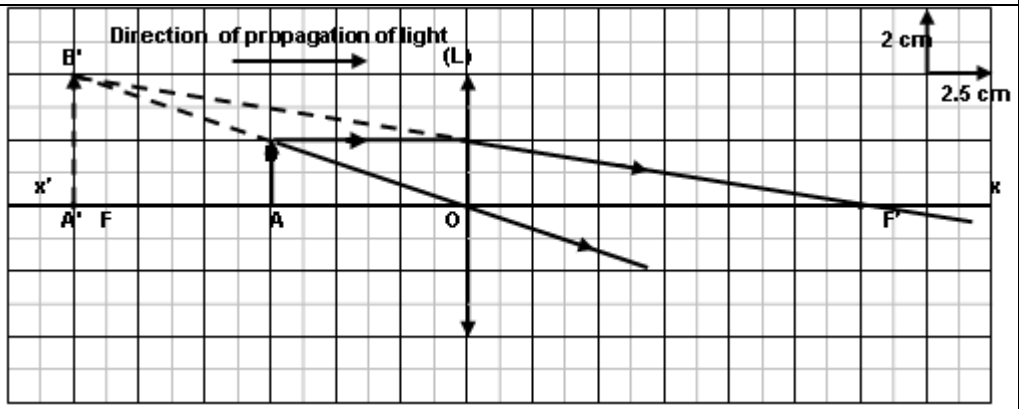


Doc. 4

Exercise 1 (5 points) **Pressure in liquids**

Part	Answer	Mark
1	b. (equal to that at B) since $P_C = P_B = P_{atm}$	**1**
2	c. ($S = 2\ cm^2$) $S = \frac{V}{H} = \frac{80\ cm^3}{40\ cm} = 2\ cm^2$	**1**
3	c. ($P_A = 106000Pa$) $P_A = P_{atm} + P_{water}$ $= 102000 + \rho_w \times g \times H$ $= 102000 + 1000 \times 10 \times 0.4$ $= 106000\ Pa$	**1**
4	a. (h = 2.9 cm) $P_A = P_B$ $106000 = \rho_{Hg} \times g \times h + 102000$ $h = \frac{4000}{136000} = 0.029\ m = 2.9\ cm$	**1**
5	a. (remains the same) since $P_c = P_B = P_{atm}$ (atmospheric pressure is the same on the surfaces of liquids of the two branches)	**1**

Exercise 2 (6 points) **Position of the virtual image given by a converging lens**

Part	Answer	Mark
1	$f = \overline{OF'} = 6 \times 2.5 = 15\ cm$	**0.75**
2.1	When d_1 increases, d_2 increases	**0.5**
2.2	x =15 cm	**0.5**
3		**0.75** **Redrawing**
4.1	See graph	**0.75**
4.2	See graph	**2**
4.3	$x = d_2 = 6 \times 2.5 = 15\ cm$	**0.75**

Exercise 3 (4 points) **Characteristics of the voltage of the mains (Electricity in the home)**

Part	Answer	Mark
1.1	The type of the voltage (u) is alternating sinusoidal.	**0.25**
1.2	$U_m = y \times S_v = 3.1 \times 100 = 310$ V	**0.75**
1.3	$T = x \times S_h = 5 \times 4 = 20$ ms $= 0.02$ s	**0.75**
2.1	$U = \frac{U_m}{\sqrt{2}} = \frac{310}{1.41} = 219.85$ V ≈ 220 V	**0.75**
2.2	$f = \frac{1}{T} = \frac{1}{0.02} = 50$ Hz	**0.75**
3	Device B functions normally, since its characteristics are the same of (u). $U = U_{rated(B)} = 220$ v $f = 50$ Hz the mode of the voltage is AC.	**0.75**

Exercise 4 (5 points) **Normal functioning of the lamp**

Part	Answer	Mark
1	$P = U \times I_0$ $I_0 = \frac{P}{U} = \frac{6}{12} = 0.5$ A	**1**
2	$P = rI^2$ $r = \frac{P}{I^2} = \frac{6}{0.5^2} = 24\ \Omega$	**1**
3.1	Apply ohm's law across the terminals of (R_1): $U_1 = R_1 \times I_1 = 1$ V	**1**
3.2	$I_2 = \frac{U_2}{R_2} = \frac{1}{20} = 0.05$ A ($U_1 = U_2 = 1$ V since R_1 and R_2 are connected in parallel)	**0.5**
3.3	(apply the law of addition of current) $I = I_1 + I_2$ $I = 0.1+0.05 = 0.15$A	**1**
3.4	No, since $I \neq I$	**0.5**