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| المادة: الفيزياء – لغة إنكليزية<br>الشهادة: المتوسطة<br>نموذج رقم 1 / 2019<br>المدة: ساعة واحدة | الهيئة الأكاديمية المشتركة<br>قسم: العلوم |  |
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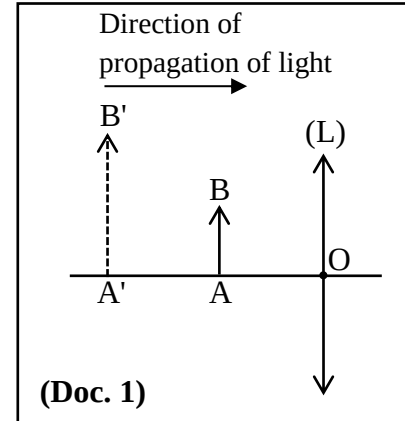
This test includes four mandatory exercises in two pages.  
The use of non-programmable calculators is allowed.

### Exercise 1 (5 points) Image given by a converging lens

The document (Doc. 1) represents an object AB and its image A'B' given by a converging lens (L).

Answer by true or false with justification.

- 1) The lens (L) has thin edges.
- 2) The image A'B', given by (L), is virtual.
- 3) The focal length of (L) is negative.
- 4) The points B', B and O are always collinear.
- 5) The lens (L) acts, in this case, as a magnifier.



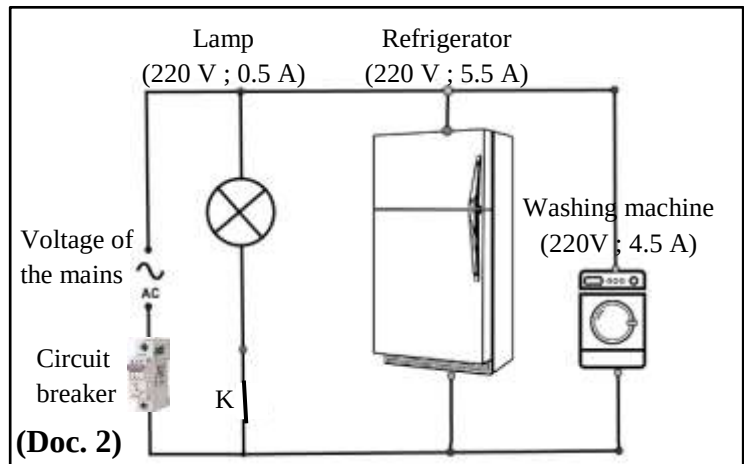
### Exercise 2 (5 points) Electric installation of a kitchen

The electric installation of a kitchen, represented in (Doc. 2), is fed by an alternating sinusoidal voltage, of effective value  $U = 220 \text{ V}$ .

This installation contains the following electric devices:

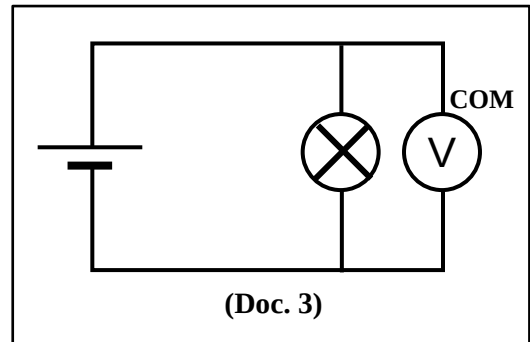
- A lamp;
- A refrigerator;
- A washing machine.

- 1) All the electric devices function normally. Justify.
- 2) All the devices are functioning normally at the same time. Specify, among the circuit breakers marked 10 A, 15 A and 30 A, the one that is the most convenient to protect this installation.
- 3) At the end of 24 hours, the refrigerator, of power 990 W, consumes an electric energy of 9.9 kWh. Specify whether the compressor of this refrigerator is working permanently.



**Exercise 3 (4 points)****Electric circuit**

In a lab session, a lamp, considered as a resistor of resistance  $R = 450 \, \Omega$ , is connected in parallel across the terminals of a generator as shown in (Doc. 3). A voltmeter, connected to the terminals of the lamp, reads  $U = -9 \, \text{V}$ .

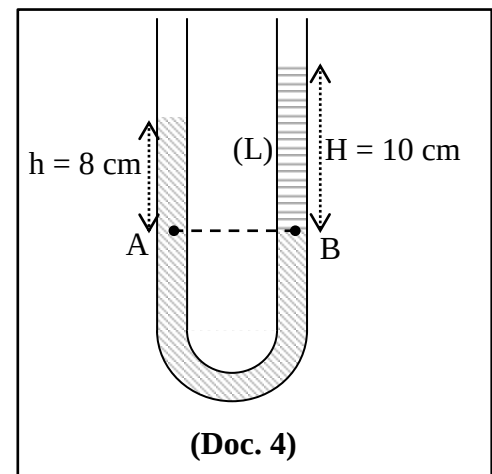


(Doc. 3)

- 1) Specify whether the voltmeter is used in DC mode or in AC mode.
- 2) How can one modify the voltmeter connections to obtain a positive reading?
- 3) Calculate the electric current carried by the lamp in normal functioning.
- 4) Redraw the diagram of the electric circuit represented in (Doc. 3), and insert an ammeter to measure the electric current carried by the lamp.

**Exercise 4 (6 points)****Determination of the density of a liquid**

To determine the density  $\rho$  of a liquid (L) immiscible with water, we pour a certain quantity of this liquid in one branch of a U shaped tube containing water as represented in (Doc. 4). The two sides of the tube are opened to the atmospheric pressure  $P_{\text{atm}}$ . At equilibrium, the height of the liquid is  $H = 10 \, \text{cm}$  and that of the water above the surface of separation of the two liquids is  $h = 8 \, \text{cm}$ .



(Doc. 4)

Given:

- Density of water:  $\rho_{\text{water}} = 1000 \, \text{kg/m}^3$ ;
  - $g = 10 \, \text{N/kg}$ .
- 1) Determine, in terms of  $\rho$ , the pressure due to the liquid (L) at point B.
  - 2) Calculate the pressure due to the water at point A.
  - 3) The pressures at A and B are equal. Justify.
  - 4) Deduce the value of  $\rho$ .

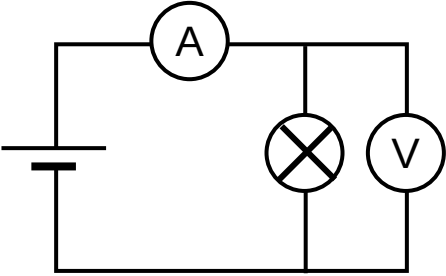
### Exercise 1 (5 points) Image given by a converging lens

| Question | Answer                                                                                                                                                       | Mark |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| 1        | True. The lens represented has thin edges because it is a converging lens.                                                                                   | 1    |
| 2        | True. The obtained image is virtual because it is on the same side as that of the object.                                                                    | 1    |
| 3        | False. The focal length of a converging lens is always positive. ( $f = \overline{OF'} > 0$ ).                                                               | 1    |
| 4        | True. The ray issued from the point object B and passing through the optical center O of (L) continues its path as if it was coming from the point image B'. | 1    |
| 5        | True. The lens acts as a magnifier since the obtained image is virtual, erect and of size larger than that of the object.                                    | 1    |

### Exercise 2 (5 points) Electric installation of a kitchen

| Question | Answer                                                                                                                                                                                                                                                                                                                                                      | Mark |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| 1        | All the electric devices function normally since they are connected in parallel across the mains and thus fed by an alternating sinusoidal voltage of effective value 220 V.                                                                                                                                                                                | 1    |
| 2        | The main current is written as: $I = I_1 + I_2 + I_3 = 0.5 + 5.5 + 4.5 = 10.5$ A.<br>The most convenient circuit breaker should be marked 15 A, because the current 15 A is larger than the maximum current carried by the circuit when all the devices function normally, and it's the nearest value to it.                                                | 1    |
| 3        | The power of the refrigerator is: $P = 990$ W = 0.99 kW.<br>If the compressor functions permanently for $\Delta t = 24$ hours, it consumes the energy:<br>$E = P \times \Delta t = 0.99 \times 24 = 23.76$ kWh<br>This value is larger than the consumed energy which is 9.9 kWh, then we conclude that the compressor didn't function during the 24 hours. | 1    |

**Exercise 3 (4 points)      Electric circuit**

| Question | Answer                                                                                         | Mark |
|----------|------------------------------------------------------------------------------------------------|------|
| 1        | The voltmeter is used in the DC mode since the symbol is that of a constant voltage generator. | 1    |
| 2        | To obtain a positive reading on the screen of the voltmeter, we reverse the connecting wires.  | 1    |
| 3        | Ohm's law, $U = RI$ , then $I = U/R = 9/450 = 0.02 \text{ A}$                                  | 1    |
| 4        |               | 1    |

**Exercise 4 (6 points)      Determination of the density of a liquid**

| Question | Answer                                                                                                                                                                   | Mark |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| 1        | The pressure due to the liquid of height $H$ at point B:<br>$P_{B(\text{liquid})} = \rho \times g \times H = \rho \times 10 \times 0.1 = \rho$                           | 1½   |
| 2        | The pressure due to the water of height $h$ at point A:<br>$P_{A(\text{water})} = \rho_{\text{water}} \times g \times h = 1000 \times 10 \times 0.08 = 800 \text{ Pa}$ . | 1½   |
| 3        | $P_A = P_B$ since A and B are at the same horizontal level and in the same liquid at rest.                                                                               | 1½   |
| 4        | The total pressure at A being equal to that at B, we may write: $P_A = P_B$<br>$P_{\text{atm}} + 800 = P_{\text{atm}} + \rho$ ; then $\rho = 800 \text{ kg/m}^3$ .       | 1½   |