Grade: 9
physics

FIRST EXERCISE (8.5 pts)

Mechanics

A) A spring of 14cm length and of spring constant K= 100 N/m, is fixed on a support and placed on an inclined plane (figure a). We put at extremity A of the spring a ball S of mass m= 0.8 kg. This ball compresses the spring to decrease its length to 10 cm (figure b).

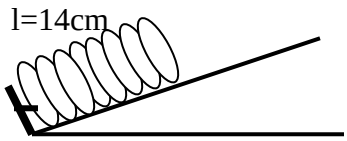


Figure (a)

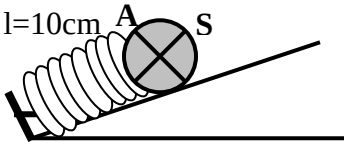


Figure (b)

Neglect the friction forces and given that g =10N/kg.

1. List the group of forces acting on S and classify them into contact forces and forces acting from a distance.
2. Reproduce figure (b) then represent on it the above forces (without a scale).
3. Determine the intensity of the force exerted by the Earth on S.
4. Calculate the intensity of the force exerted by the spring on S.

B) We hang the ball S to the extremity of a dynamometer (figure c) then we immerse it into water (figure d).

Given the density of water ρ= 1000kg/m^3.

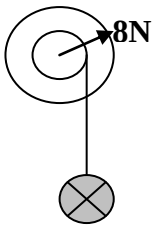


Figure (c)

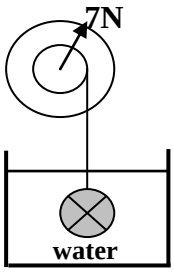


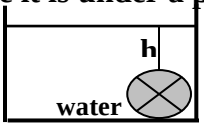
Figure (d)

1. What does the value given by the dynamometer in figure (d) represent?
2. The ball S is in equilibrium in figure (d). Give the condition of equilibrium.
3. Name the force which is responsible for the variation of the value given by the dynamometer between figure (c) and (d). Calculate its value.
4. Calculate the volume of ball S.

C) We remove the ball from the dynamometer and we place it in water where it is under a pressure of P= 106360 Pa.

Given the atmospheric pressure P_0= 103360 Pa.

1. Calculate the height (h) of water above the ball S.



(5.5 pts)

SECOND EXERCISE

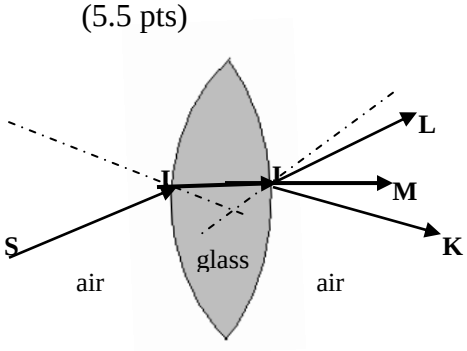
Optics

We aim to study the propagation of light through a convergent lens.

A) Send a luminous ray SI through a lens made of glass as shown by the adjacent figure.

Note : the doted lines represent the normal at points I and J.

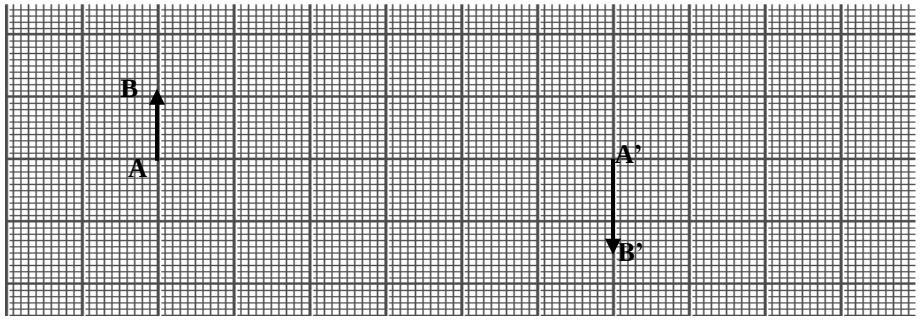
Given $n_{air}=1$; $n_{glass}=1.44$



1. This lens is convergent. Justify
2. Explain the passage of ray SI from air to glass.
3. Choose from the following the refracted ray which is correspondent to the incident ray IJ.

   i- JK ii- JL iii- JM.

B) We place the convergent lens on the optical axis to obtain for an object AB= 1cm, an image A'B'=1.5cm as shown by the figure.



1. Reproduce the figure in real dimensions
2. Place the lens on the optical axis. Justify your answer.
3. Determine, by construction, the position of the image focus F'. Deduce the focal length of the lens

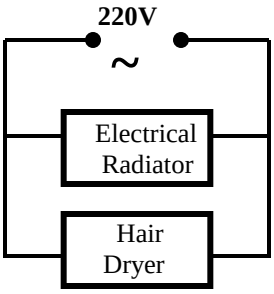
THIRD EXERCISE (6 pts)

Electricity

An outlet of an installation (of voltage =220 V) is supported by a wire of intensity 15A.

We connect to this outlet an electrical radiator and a hair dryer of inscriptions (220V; 1500 W). Observe the figure.

A circuit breaker of 25A is used to protect this installation.



1. Indicate on which line (live or neutral) we should connect the circuit breaker.
2. The hair dryer consumes 2000J in one second.
   a. Calculate the electrical power of this apparatus.
   b. Deduce if the hair dryer functions normally. Justify your answer.
   c. Calculate the intensity of the current passing through the hair dryer.
3. The radiator is formed of two resistors: $R_1=30\ \Omega$ and $R_2=60\ \Omega$ and supplied by a current of 11 A.
   a. Calculate the resistance of the radiator by using ohm's law.
   b. Deduce how are the two resistors grouped? Justify your answer without calculation.
   c. Name the apparatus which is used to measure directly the resistance of a resistor. How is it connected?
4. The hair dryer and the radiator function at the same time.
   a. Calculate the intensity of current crossing the live line.
   b. Will the circuit breaker be released? Justify your answer.
   c. Is there a risk of fire? Justify your answer.

Good Work