INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES LYON

Scan First
Year 2020-2021

Physics - S1 – Exam #1

October 16, 2020 **Duration: 1 h**

No document allowed. No mobile phone. ***Any type of calculator allowed****. The proposed grading scale is only indicative.*

The marks will account not only for the results, but also for the justifications, and the way you analyze the results. Moreover, any result must be given ***in its literal form involving only the data given in the text****. It is also reminded that the general clarity and cleanness of your paper may also be taken into account.*

I – Snell's window – open exercise (7 points)

Snell's window (also called Snell's circle or optical man-hole) is an optical phenomenon due to the properties of the water/air diopter. An underwater viewer, located several meters under the water surface, and looking up at the water surface from underneath, sees everything above the surface through a cone of light of width of about 97 degrees. The area outside this Snell's window appears either completely dark, or shows a reflection of underwater objects. An example is given in figure 1.

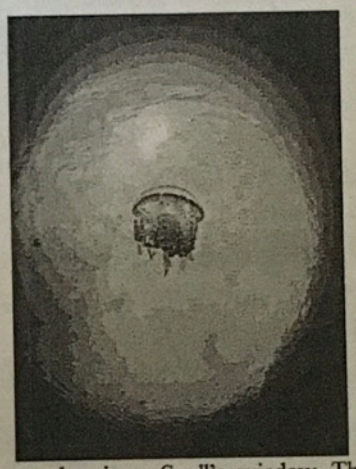

Figure 1. Picture showing a Snell's window. The picture was taken by a diver located under a jellyfish and turning his camera to the water surface (Mario Vitalini http://www.scubatravel.com).

1) Explain what the diver sees by studying the path of different rays coming to or from him.

2) Considering the optical index of seawater is 1.34, show that the cone angle is indeed around 97°.

Remarks: define and represent the physical quantities used. Make a scheme and write a well-structured reasoning.

II – Ray-tracing and calculations (7 points)

An object AB is placed at a distance $\overline{OA} = 350$ mm of a thin lens (L) of center O and focal length f' = -250 mm, see figure 2.

1) Complete figure 2 and find the image A'B' of the virtual object AB. Trace at least three rays. **Do not forget to hand it in with your paper.**

2) Give the characteristics of the image A'B'.

3) By calculation, check the position of A'B' and the value of the magnification γ.

4) How is it possible to create the virtual object AB during an experiment? Propose scheme that illustrate the creation of a virtual object AB for (L). **No calculation needed.**

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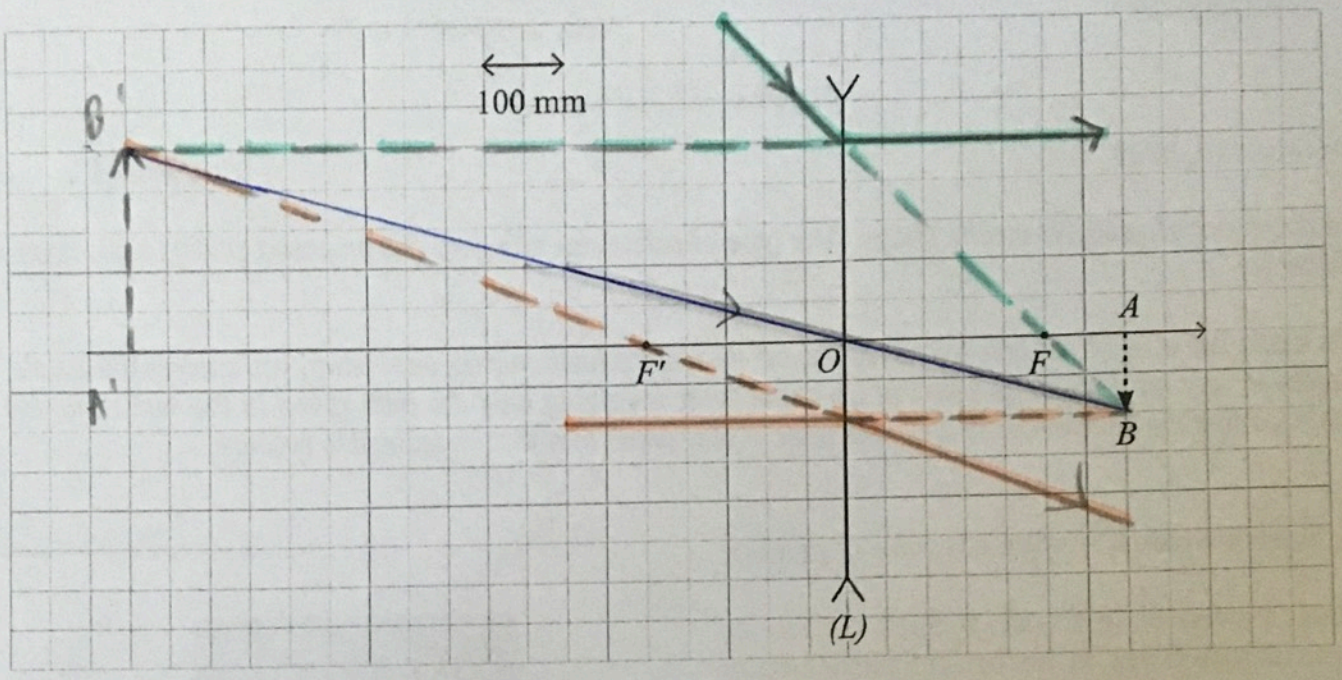

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Figure 2.

III – Mirror in the film studio (6 pts)

During a shooting, a camera films the reflection of an actress in a mirror. The cameraman has to avoid seeing his own camera in the mirror. The actress is placed at point A and the camera is at point C, as indicated in figure 3.

The paths of the rays can directly be traced on figure 3.

1) By tracing the path of some rays, find the position of the image of the actress.

2) When the camera shoots the actress in the mirror, does the actress see the image of the camera ?

3) Does the camera see its own image under the conditions indicated in figure 3 ?

1 Grey rays are for (2), black rays for (1)

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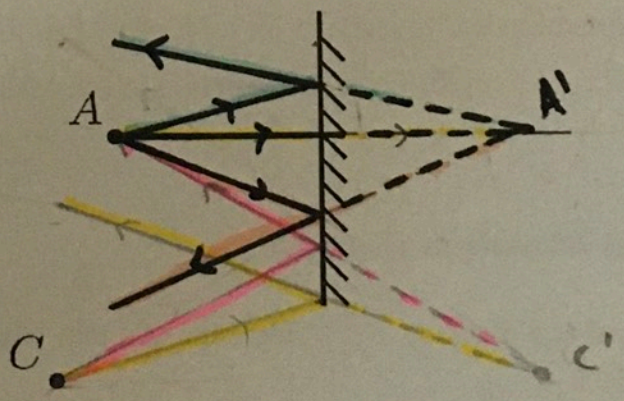

Figure 3.