Geometrical Optics v1.0

Introduction

Hi! Well if you've downloaded the file and since you're reading these lines obviously you must need this library for its use in some exam or test. I hope you find it useful and handy, or at least that it helps you to learn this topic… good luck!

What it does

This library consists in three programs:

Dioptrics

Given 'n1', 'n2', 'o' and 'R' the program returns the following:
-Type of image: Real or virtual, upright or inverted, magnified or reduced.
-I: Image distance from the Dioptric's vertex.
-A: Magnification of the image.
-Fo: Object's focal length.
-Fi: Image's focal length.
-x: Object distance according to Newton's formula (distances measured from the focus).
-x': Image distance according to Newton's formula.
- Principal Ray Tracing.

Thin Lens

Given 'o' and 'F' the program returns the following:
-Type of image: Real or virtual, upright or inverted, magnified or reduced.
-I: Image distance from the Dioptric's vertex.
-A: Magnification of the image.
-x: Object distance according to Newton's formula (distances measured from the focus).
-x': Image distance according to Newton's formula.
-Principal Ray Tracing.

Spherical Mirrors

Given 'o' and 'F' the program returns the following:
-Type of image: Real or virtual, upright or inverted, magnified or reduced.
-I: Image distance from the Dioptric's vertex.
-A: Magnification of the image.
-x: Object distance according to Newton's formula (distances measured from the focus).
-x': Image distance according to Newton's formula.
-Principal Ray Tracing.

Installation

First off, this library is written in USER-RPL for the HP50g calculator. Surely it works on the HP49g+ calculator though I'm uncertain if it does on older models.
The attached file is a library so it's installed like so: It's transferred to the calculator, it's stored in the memory and then a warm restart is necessary for the library to appear on the library soft menu (right shift + 2). Example: LIB 2 STO ON+F3

Ray Tracing

The 3 programs work the same way so their use is also the same. I'll give a short briefing for Dioptrics.
The ray tracing requires some attention from the user. It's somehow limited, so you're warned not to directly copy&paste what you see in the calc's screen to your exam paper… you'll have to pay a little of attention to the plotting.

Scale factors

In the input screen there are two variables 'a' and 'b' which control the scale factor of the plot that it's about to be drawn. By default the values of these variables are the same and they're equal to 1. This means that the graphic will be made according to the real distances that where inputted and it won't be shrunk or enlarged.
It can happen that with these standard values the graphic shows up properly and in a readable way. However it'll frequently happen the opposite… that is to say, the plotting will be out of range, it'll be cut, too small, too big, etc.
Unfortunately the scale adjusting must be done manually and it's a somehow tedious procedure of testing until the better combination of 'a' and 'b' is found. This is an issue that must be improved.

The scale factors work this way:

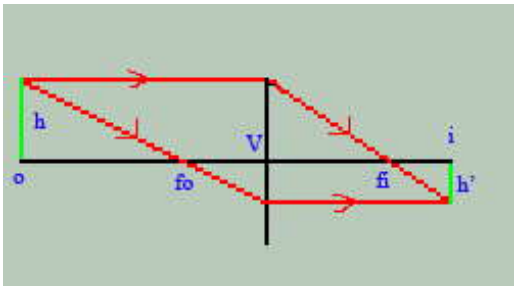
a: It controls the horizontal scale. A number larger than 1 shrinks the plot horizontally, while a number smaller than 1 (but non negative of course) expands the scale horizontally.
b: It controls the vertical scale. A number larger than 1 shrinks the plot vertically, while a number smaller than 1 (but non negative) expands the scale vertically.

Finding the best combination is just a matter of testing. As a general rule, if the distances are big numbers (larger than 10, independently of its unit and prefix) you should increase the horizontal scale and reduce the vertical one. (ex: a=5 y b=0.5).

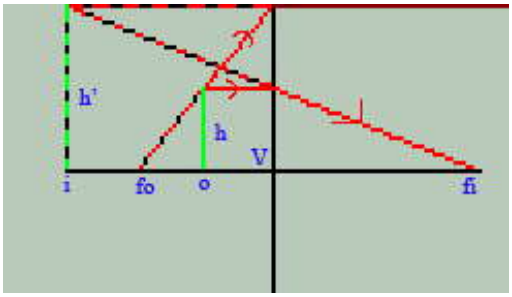
Tip: If you don't mind too much about the numerical results (I, A,fo,fi) then instead of changing 'a' and 'b' you can "play" with 'o' and 'R' so that the ray tracing fits in the screen. (Example: If originally it was o=50 and R=10 you can try with o=5 and R=1 since the ray tracing will be the same).

Ray Tracing

If you are not in the topic the drawing will look like to you as a bunch of lines going and coming in several directions. However if you've seen a ray tracing before you won't have too much trouble understanding what the calculator has drawn in the screen though a bit of advice is needed.
For example in Dioptrics you input: n1=1 ,n2= 1.5 ,o=30, R=5, a=5, b=0.5 you'll get what it's seen in figure 1. To help you understand I've added colors and text.
The upper ray enters parallel to the dioptric so according to the Optics' laws it must go thru the image focus. The second ray goes thru the object focus so it must come out parallel from the dioptric. The intersection of these two rays gives you the location and height of the image.



That is the simplest case. Let's see a harder one which involves a virtual image.
In the original ray tracing, you won't see the colors of course, also there won't be distinction between real rays (continuous lines) and non real rays (non continuous lines). Besides, the upper ray (brown) will be missing.



These "details" force the user to pay some attention to the picture, you must think a bit in order to understand it correctly

You are warned not to copy&paste the ray tracing to your paper as you see it in the screen since it's incomplete! It's just a guide but you'll to realize about the missing details!

These kinds of programs are really helpful but they won't do all your work…

Credits

Created by Jorge Pires. Student of Electronics Engineering at the "Universidad Nacional de la Patagonia San Juan Bosco". Comodoro Rivadavia, Chubut, Argentina
The first version of this program was written around February 2008 for its personal use in Physics II's final exam.

Though the programs have been exhaustively tested with all the possible cases of dioptrics, lens and mirros one could never be sure of the no existence of bugs or flaws. Reports of such things as well as suggestions will be appreciated:
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Hope you find it handy!