2-1) You are given the task of designing a laser scanner. You will move the beam by tilting a mirror with a galvanometer as shown. The input laser beam is fixed. The distance from the mirror to the image plane is 25 cm. If the spot must scan at 100 cm/sec, how fast must we rotate the mirror? Assume small angles or a small scan distance.

2-2) For small angles, Snell’s law is approximated by \( n\theta = n'\theta' \).

a) For \( n = 1 \) and \( n' = 1.5 \), compare and graph the approximate and exact results for the refracted angle \( \theta' \). Also compute the fractional or percent error.

b) For what range of \( \theta' \) is the approximation good to 0.1%, 1% and 10%? You can do this part by interpolation of your tabulated values.
2-3) Sketch the tunnel diagrams for the following prisms:

![Prism Diagrams]

2-4) Light propagates down an optical fiber by repeated TIR at the sides of the fiber core (this is the simple, ray-based model). An important quantity is the acceptance angle of the fiber. This angle is the largest angle of incidence at the end of the fiber that will propagate by TIR down the length of the fiber.

The fiber core is modeled as a cylinder of index 1.6. In order to protect the fiber core from dirt and damage and to allow it to be handled and packaged in a cable, the central core is surrounded by a glass cladding layer of lower index. What is the acceptance angle if the cladding index is 1.55?
2-5) The diagram below shows a number of directed distances. Using the sign conventions of the class, determine equations for the tangent of the angle $u$ and the directed distance $z$ in terms of $a$, $b$, $c$, $d$, $e$, $f$, $g$ and $h$. 