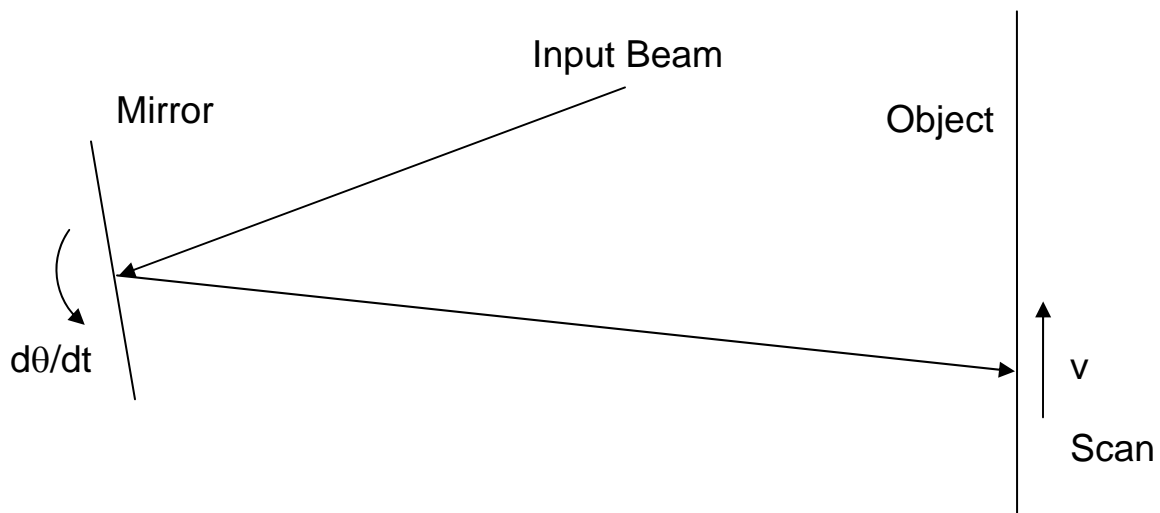
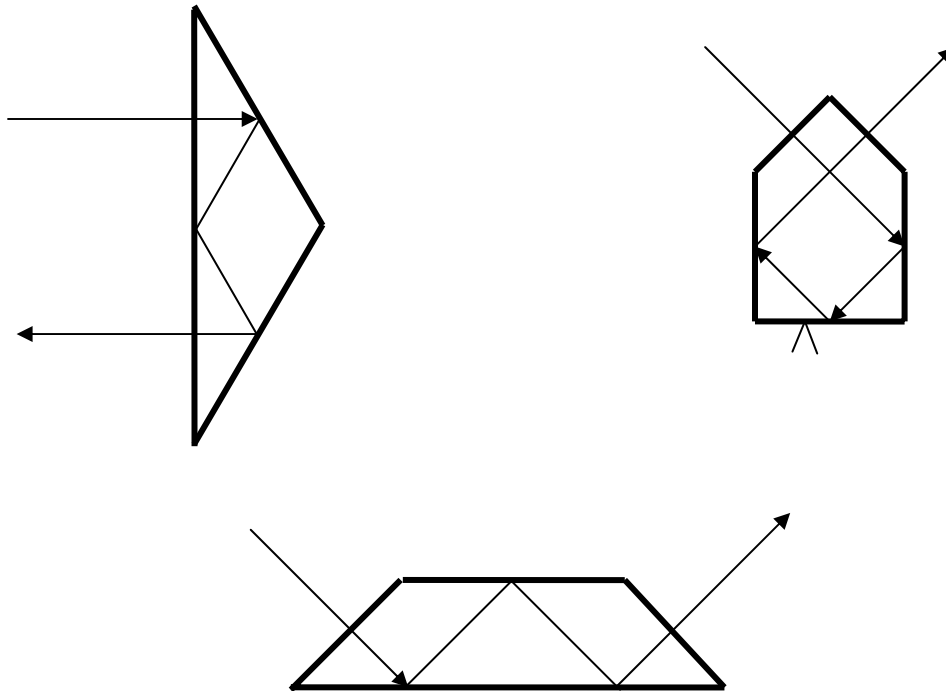


Assigned: 8/30/11 Lecture 3
Due: 9/6/11 Lecture 5

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 object is 25 cm. If the spot must scan at 100 cm/sec, how fast must we rotate the mirror? Assume small angles.



2-2) Sketch the tunnel diagrams for the following prisms:



2-3) For small angles, Snell's law is approximated by $n\theta = n'\theta'$.

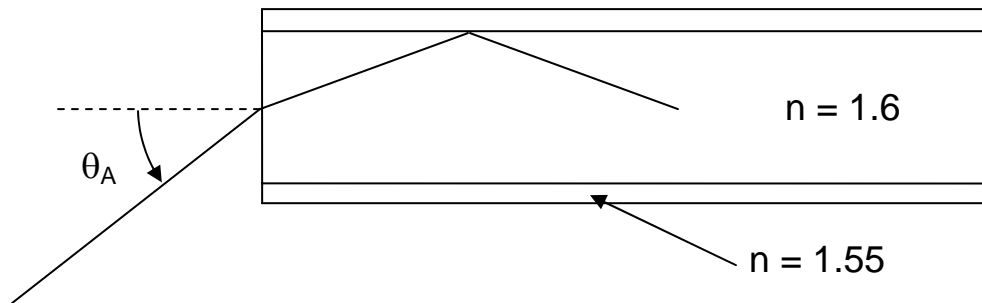
- For $n = 1$ and $n' = 1.5$, compare and graph the approximate and exact results for θ' . Also compute the % error.
- For what range of θ 's is the approximation good to 0.1%, 1% and 10%? You can do this part by interpolation of your tabulated values.

2-4) We have a 100 mm focal length lens (the distance from the rear surface of the lens to the image plane can be assumed to be 100 mm), and we want to place a pentaprism in the path following the lens to bend the optical axis 90° . The index of the prism is 1.5.

- If the image plane is required to be outside the prism, what is the largest pentaprism that we can use? (Determine the size of the entrance face of the prism.)
- What is the largest diameter lens that would make sense to use with this prism?

2-5) 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?



2-6) 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 .

