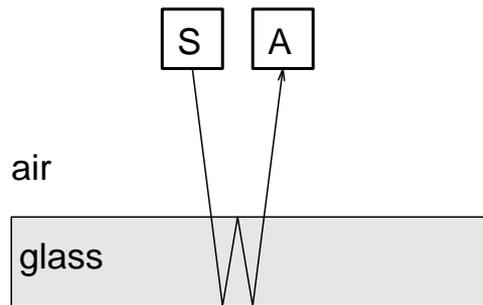


1. Why do we see patterns of color on soap bubbles (like the picture on the cover of *QED*)? Consider the following questions as you construct your explanation:

- What color is the light from an ordinary light bulb or from the sun? (*Hint*: what colors make up “white” light, as described on page 13 of your text.)
- What effect does changing the color of light have on the partial reflection of light by a thin film such as the soap bubble? (Think about the graph on the final page of the tutorial.)
- Why would different parts of the bubble reflect light of different colors?
- Why do the patterns on a bubble change as you watch it for a period of time?

Be sure to write a coherent essay that describes your answer clearly and precisely, integrating the above ideas into a coherent “story”. Do not simply provide short answers to the four questions given above.

2. In the computer tutorial, we considered two possible paths for a photon to arrive at A: one involving a reflection at the top surface, and one involving a reflection at the bottom surface of the glass. In fact, as Beavis hypothesized on the tutorial, there are many other alternatives, including:



Using the same rules as we used in the tutorial, determine the length of the arrow associated with this path. Keep track of numbers to at least 3 decimal places, and show your work.

The rules for determining the probability of an event require us to consider all the alternative ways that the event can happen. Consider the experiment described above (light leaves the source and enters the detector after reflecting off the “surface” of the glass). In the tutorial you determined two ways this can occur and here there is a third way. Find the lengths of each of the three arrows associated with each way. Suppose you also knew the direction of the three arrows; explain how you would find the probability for a photon to be detected at A. (A diagram that has three arrows *drawn to scale*, and which shows what you would do with the three arrows, would be helpful here.)

Discuss the why it was a reasonable approximation to neglect the third path in calculating the total probability for reflection, as Butthead said we should in the tutorial. Are there any circumstances where it is not a good approximation to neglect this third arrow?