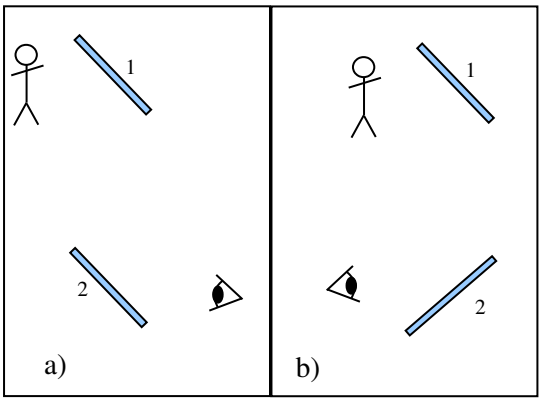
Year 3 General Physics -- Optics

1. Two mirrors are used to construct two different types of periscope, a) and b) shown below. The two different periscopes are used to observe a person who has a T-shirt with the word "BEN" written on the front. In each case light is reflected from mirror 1, to mirror 2 and then to the observer. Draw the ray diagrams for both a) and b) illustrating the orientation of the image of the person. Does the word "BEN" on the T-shirt observed in mirror 2, in both cases a) and b), read left-to-right or right-to-left?



2. A thin film of oil (refractive index $n_{oil} = 1.5$) floats on the surface of water (refractive index 1.333). White light is reflected from the film at normal incidence. The reflected light is observed to be red in colour ($\lambda = 700$ nm). What is the minimum thickness of the film?

3. An object is placed 30 cm outside the surface of a convex spherical mirror with a radius of 90 cm. Calculate the position of the image and the magnification. Is the image real or virtual? Draw the associated ray diagram.

4. What is the law of Malus? Unpolarised light of intensity I_0 is incident on a polarising filter. What is the intensity of light transmitted through a second similar filter having its polarising axis oriented at an angle of 25 degrees with respect to the first?

5. How are the primary and secondary rainbows formed?

6. Two flat mirrors are angled at 90 degrees to one another. How many images does this arrangement produce? If someone with BEN on their T-shirt stands in front of the mirrors, from which of the images does the person read BEN the correct way round, and which back to front?

7. Sketch the diffraction patterns you would get for plane wave light incident on a single slit and on two slits of equal width. If the slits are separated by 0.1 mm and have a slit size of 0.01 mm what is the separation of the minima formed on a screen 1 m away for light of 650 nm?

8. A narrow beam of white light passes through a glass prism. The light is dispersed into its constituent colours. Can these rays be recombined into white light by passing them through a second prism?