## REMEMBER TO HAND BEFORE THE TUTORIAL STARTS

- Asymptotes.
- Maximum minimum problems

Problem 1 Determine the horizontal and vertical asymptotes of the function

$$f(x) = \frac{3x - 6}{2x^2 - 2x - 4}$$

**Problem 2** Determine the horizontal and vertical asymptotes of the function

$$f(x) = \frac{6x^3 + 3x + 1}{x^2 - 3x + 2}$$

**Problem 3** Light travels at different speeds in different mediums (i.e. the light traveling trough water is  $\approx 25\%$  slower than in air). When light changes from one medium to another, it "bends" (this is called refraction), according to the Snell law (see figure 2)

$$v_2 \sin \theta_1 = v_1 \sin \theta_2$$

This nice figure (source Wikipedia) shows Snell law in action



Figure 1: Light bends when traveling through different materials according to Snell law. The path is chosen so that the travel time of light is minimum!.

Prove that Snell law is a result of the fact that light travels following a path that requires **minimum time**. In other words, imagine that a ray of light wants to go from A to B (see figure 2). Show that the path that minimizes the time of travel obeys Snell Law.

(Bonus question: How the hell does light know the path of minimum time?? If this still does not surprise you, have a look at this: https://phys.org/news/2013-04-ants-fermat-principle.html)



Figure 2: Light travelling from A to B uses the path that minimizes the travel time.