Optimization: One problem-solving strategy

1. <u>Read</u> the problem and <u>draw</u> a picture.

2. Name the <u>variables</u>.

3. Identify the <u>function that needs to be maximized or minimized</u>. Write down an expression for that function.

4. <u>Write down the relationships</u> between the variables.

5. <u>Reduce the function to be optimized to one variable</u> using the relationships from above.

6. <u>Find the critical values of the function</u>. Note that to do this you also have to determine the domain of the function.

7. <u>Use these critical points to maximize or minimize</u>. Use the first or second derivative test.

8. Write down the final answer. <u>Check:</u> does your answer make sense?

---

1. Ornithologists have determined that some species of birds tend to avoid flights over large bodies of water during daylight hours. It is believed that more energy is required to fly over water than land because air generally rises over land and falls over water during the day.

   A bird with these tendencies is released from an island that is 5 km from the nearest point B on a straight shoreline, flies to a point C on the shoreline, and then flies along the shoreline to its nesting area D. Assume that the bird instinctively chooses a path that will minimize its energy expenditure. Points B and D are 13 km apart.

   In general, if it takes 1.4 times as much energy to fly over water as land, to what point C should the bird fly in order to minimize the total energy expended in returning to its nesting area?