Land to Build a Home

A Learning Situation for MTH-4153

Produced by Suzie Asselin

6/24/2016

Source: pixabay.com

In this learning situation, students will learn the four steps of problem solving: understanding the problem, devising a plan, carrying out the plan and looking back. The steps are briefly described and the student is guided through them to a solution. This approach is recommended for the DBE program in Mathematics.

The Learning Situation

From what is currently known, geometry originated in Ancient Egypt 2000 years ago. As the River Nile flooded its bordering lands every summer, the Egyptian surveyors had to continually redo property boundaries. This led them to develop a unit of measurement for distances, known as the cubit, and to develop techniques for calculating area. They also learned how to calculate volume so as to measure their crop production. Through their commercial trading activities, their know-how was passed on to the Greeks and eventually spread to all civilizations. The Egyptians have left us with an essential mathematical tool which can be used in a number of different fields of study.

Apart from surveying, geometry is used in architecture, astronomy, mechanics, optics, cristallography, industrial design, computer graphics, etc. Geometry can even help you to plan your own maintenance or renovation projects. Whether you are buying wallpaper, floor coverings or soil for landfill, you'll be able to make the necessary calculations to find out how much material will be needed.

 In addition to applying your knowledge of geometry, this learning situation provides you with the opportunity to look back over your work and review the strategies you used. The first exercise guides you through the 4 steps of problem solving:

1. **Understanding the problem**
2. **Devising a plan**
3. **Carrying out the plan**
4. **Looking back**

Suggested strategies for steps 1, 2 and 4 will be provided, while step 3 provides you with detailed information on how to formulate your solution. This will help you develop your problem-solving skills.

The second exercise is unguided. You will be able to arrive at a complete solution to the problem by following the proposed method to test its validity. Here and there, a few questions are included so that you take a moment to question the usefulness of certain strategies.

EXERCISE 1 – BUYING LAND ON THE TIP OF AN ISLAND

You are looking for a plot of land on which to build a house. A triangular plot of land at the tip of the Island has attracted your attention. In this area, the average sale price of plots is $1.90 a square foot. You may have consulted a grid map of the area where each square corresponds to a distance of 20 feet. The vertices of the plot are approximately located on the map at coordinates (10.5; 12.5), (8, 6) and (2.5; 9.5).
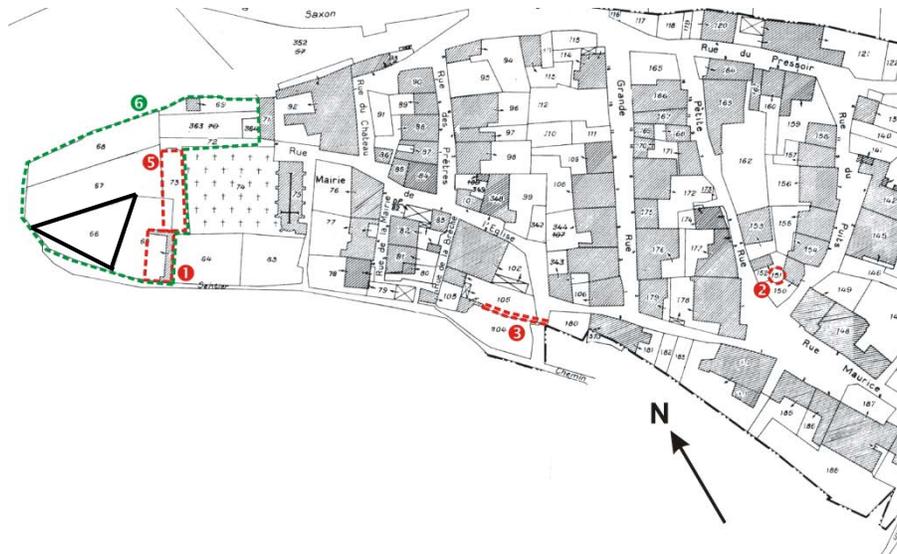

Source : Wikimedia.org

The real estate broker is asking for $30,000 for the plot. Is this a fair price?

The 4 steps for solving a situational problem

1) Understanding the problem

Begin by taking the time to read and reread the situational problem. Pay particular attention to the question being asked. Underline useful information and get rid of useless information. Put the question into your own words to better understand what it is you are being asked to do. If possible, draw a diagram. Take care to include all the relevant data.

a) **In the Cartesian plane below, graphically represent what you will need to solve the problem.**
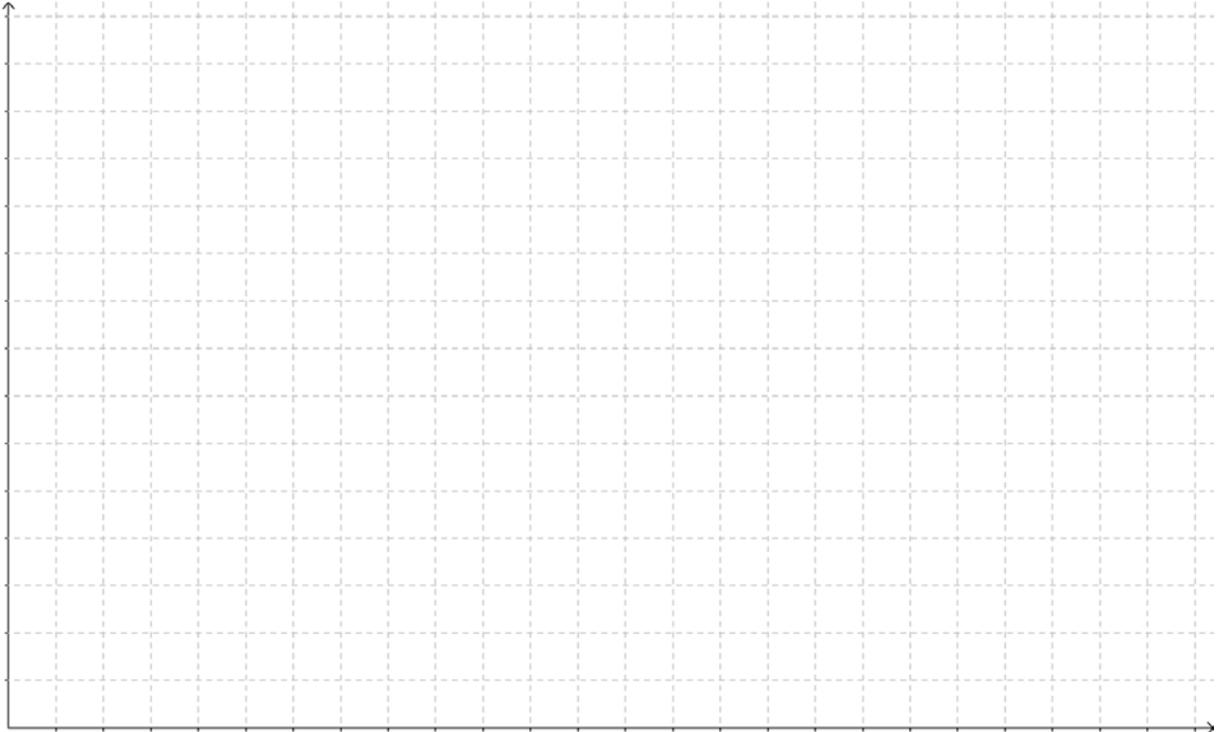
b) Put the question into your own words.

_____

_____

_____

c) What do you need to know to be able to determine the value of the plot of land? Explain your answer.

_____

_____

_____

2) Devising a plan

Before launching into the calculations, take the time to devise a plan to solve the situational problem. By doing this, you will avoid making unnecessary calculations and ending up with a convoluted solution that will be difficult to complete.

To succeed, you must focus on the question being asked. With the information you've been given, go over the concepts you've previously learned and that may help you to answer the question. If it looks as if some information is missing, think about how you might find it.

Once you have thought this through, put your ideas in order. Breaking down your solution into steps will hep you produce the most efficient and cost effective solution.

a) **What calculation techniques must you use to determine the value of the plot?**

b) **How will you work out the actual dimensions of the plot from the coordinates provided in the problem statement?**

c) **Provide a detailed plan for your solution. Before continuing, have your teacher validate this plan.**

d) **Did the graphic representation you drew in the first step help you?**
   - If you answered YES, explain why it helped you.
   - If you answered NO, could representing the situation another way help you? Explain how.

3) Carrying out the plan

Now that you have a plan to produce a well-formulated solution, you can start your calculations. Begin each new calculation with the formula or relationship being used. Show the appropriate unit of measurement in the final result. Use short sentences to guide the reader through each step of the solution. Respect the symbols and writing conventions of mathematical language.

a) **Now, write your solution. Take care to respect all requirements.** (Use lined or squared paper, if needed.)

b) **Did underlining all the useful information in the situational problem help you to write your solution?**

4) Looking back

If possible, use a different method to verify your answer. Answer the question with a complete sentence. Take into consideration the context and include the appropriate units of measurement in your result.

   a) **Check if your result is correct.**

   b) **Formulate the answer according to the context.**

EXERCISE 2 – PREVENTING WATER INFILTRATION

Your house has now been built. The contractor has backfilled the foundations and has taken care to create a ground slope that allows the water to drain well away from your house. As the soil level sinks during winter months, he advises you that you will need to add soil to maintain the slope at an angle of 5°.

Ground with a slope of 5° to allow for drainage of rain water.

House

Cement Foundation
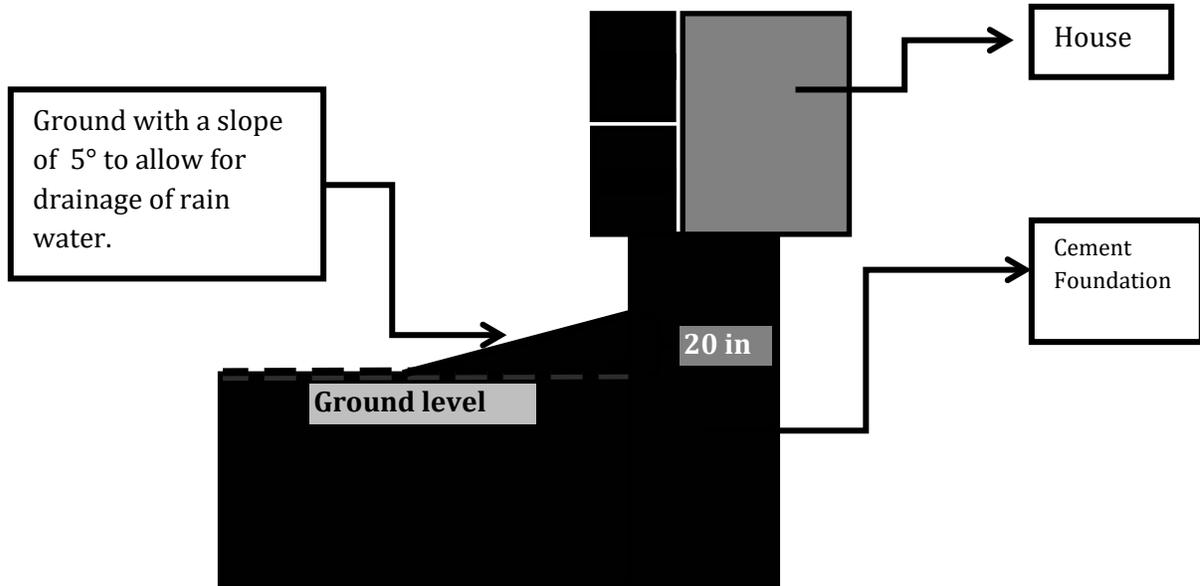
20 in

Ground level

At the end of winter, you notice that the slope at the front of your house is only at a 2° angle. You plan to add soil to increase the slope as per the contractor's recommendations. The soil around your foundation must be 20 inches higher than ground level.

Over the winter months, you have managed to put aside $500 for this project. However, you are worried that it might not be enough. The Nursery will sell you 27 cu.ft of soil for $30 and charge $50 for delivery. The front of your house is 40 ft. long. **Do you have enough money for this project?**

This procedure is part of normal maintenance and prevents the foundation from cracking due to water accumulation. Check the situation every year and take remedial action, if necessary.

Follow the 4 problem-solving steps described in Exercise 1 to write your solution. Validate your work plan with your teacher before writing your solution. (Lined or squared paper can be used, if needed.)

You will find a list of strategies on the next page. Identify the ones you found useful. (Tick the appropriate boxes.)

Did you use strategies other than those listed? If yes, what were they? Consult the list of strategies in the annexe.

_____

_____

LIST OF STRATEGIES

☐ Reformulating the question in one's own words

☐ Highlighting (underlining, rewriting) elements that seem to be relevant

☐ Representing the situational problem, mentally or diagrammatically

☐ Reviewing concepts learned during the course and identifying those that relate to the situation

☐ Recording relevant information on a diagram

☐ Making a list of missing information

☐ Thinking of similar problems that have already been tackled

☐ Breaking down the situational problem into smaller steps

☐ Making a plan for solving the problem

☐ Illustrating its solution in a diagram

☐ Working backwards to solve the problem when the solution has several steps, or when the data is incomplete

☐ Ensuring that strategies specific to rectangular triangles have not been used for any other types of triangles (Pythagorean theorem and definition of trigonometric functions)

☐ Checking the result by redoing the calulations with another technique

☐ Checking to see if the result is plausible by doing an approximation