***Optimization*** is the process of finding values that make a given quantity the greatest (or least) possible given certain conditions.

**Maximum Area for a Fixed Perimeter**

**Problem 1**: Farmer Brown wants to build a rectangular pen for his ostriches. He has **24 metres** of fencing available; therefore, the perimeter should be 24m. Determine the **maximum** (largest) area, he can enclose.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Rectangle** | **Width (m)** | **Length (m)** | **Perimeter (m)** | **Area (m)** |
| 1 |  |  | 24 |  |
| 2 |  |  | 24 |  |
| 3 |  |  | 24 |  |
| 4 |  |  | 24 |  |
| 5 |  |  | 24 |  |
| 6 |  |  | 24 |  |
| 7 |  |  | 24 |  |
| 8 |  |  | 24 |  |
| 9 |  |  | 24 |  |
| 10 |  |  | 24 |  |
| 11 |  |  | 24 |  |

1. Which rectangular area is the largest? \_\_\_\_\_\_\_\_\_\_\_

What are the dimensions of this rectangle? \_\_\_\_\_\_\_

1. Which rectangular area is the smallest? \_\_\_\_\_\_\_\_\_

What are the dimensions of this rectangle? \_\_\_\_\_\_\_

3. Which rectangular pen is the optimal one for farmer Brown? Why?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_-

**CONCLUSION**:

A \_\_\_\_\_\_\_ will always produce the **largest** area for a given perimeter.

**Try these**: Find the dimensions (integer values) of the largest rectangular area that can be made given the following perimeters:

|  |  |  |  |
| --- | --- | --- | --- |
| 1. 48m | b. 100m | c. 38m | d. 47m |

**Minimum Perimeter for a Fixed Area**

**Problem 2**: Mrs. Jones would like to build a garden shed. The shed must have an area of 36 m2 to provide the necessary space. Mrs. Jones wants to keep her cost of materials as low as possible.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Rectangle** | **Width (m)** | **Length (m)** | **Perimeter (m)** | **Area (m)** |
| 1 |  |  |  | 36 |
| 2 |  |  |  | 36 |
| 3 |  |  |  | 36 |
| 4 |  |  |  | 36 |
| 5 |  |  |  | 36 |
| 6 |  |  |  | 36 |
| 7 |  |  |  | 36 |
| 8 |  |  |  | 36 |
| 9 |  |  |  | 36 |

1. What are the dimensions of the rectangle with the largest perimeter?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

What is the perimeter of that rectangle?\_\_\_\_\_\_

1. What are the dimensions of the rectangle with the smallest perimeter?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

What is the perimeter of that rectangle?\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Which one should Mrs. Jones choose? Why?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**CONCLUSION**:

A \_\_\_\_\_\_\_ will always produce the smallest perimeter for a given area.

**Try these**: Find the dimensions (integer values) of the smallest rectangular area that can be made given the following areas:

|  |  |  |  |
| --- | --- | --- | --- |
| 1. 36m2 | b. 100m2 | c. 30m2 | d. 143m2 |

**3-SIDED FENCE**

**Problem 3**: Jessica has 16 m of fencing to enclose a dog pen against the side of a house. She wants to maximize the area for her dog, while using only the 16 m of fencing,

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Rectangle** | **Width (m)** | **Length (m)** | **Perimeter (m)** | **Area (m)** |
| 1 |  |  | 16 |  |
| 2 |  |  | 16 |  |
| 3 |  |  | 16 |  |
| 4 |  |  | 16 |  |
| 5 |  |  | 16 |  |
| 6 |  |  | 16 |  |
| 7 |  |  | 16 |  |

What are the dimensions of the rectangle with the maximum or optimal area? \_\_\_\_\_\_\_\_\_\_\_

The maximum area is \_\_\_\_\_\_\_\_\_\_\_ The length is \_\_\_ times the width.

How can you predict the maximum area if you know the perimeter of an area enclosed on 3 sides?

Predict the dimensions of a rectangle with maximum area and a perimeter of 60 m, enclosed on only 3 sides. State the dimensions.

**Questions**

1. An inbox tray has 3 walls and an open side on one of the longer sides. Determine the maximum area of the tray if all three walls total to a length of 812 mm.

2. The perimeter of a rectangular piece of cardboard is 46 centimetres. Determine the dimensions that maximize the area.

3. The maximum area of a fenced in pool deck is 1024 m2. Determine the length of fencing that is required.

4. Three sides of a look-out deck have a railing, while the fourth side is open. Determine the maximum area if there is 648 cm of railing.

5. The area of a rectangular box is 722 500 mm2. Determine the dimensions that minimize the perimeter.