**Optimize:** Determine the best solution while adhering to given constraints

**Concept 1: Maximum Deck Size – *MAXIMIZING THE AREA***

Complete the table below:

**OBSERVATION:**

The rectangles above have the same \_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Rectangle \_\_\_ has the greatest area.

**CONCLUSION:**

When enclosing **FOUR SIDES**, the maximum rectangular area for a fixed perimeter is obtained by forming a \_\_\_\_\_\_\_\_\_\_\_\_.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Rectangle** | **Length (m)** | **Width (m)** | **Perimeter (m)** | **Area (m2)** |
| A | 15 | 5 | 2(15+5) = 40 | 15 x 5 = 75 |
| B | 12 | 8 |  |  |
| C | 10 | 10 |  |  |
| D | 18 | 2 |  |  |
| E | 9 | 11 |  |  |

|  |
| --- |
| **Solved Example:** Find the maximum area for a rectangular four-sided area you can enclose with a 60 m rope at a beach. [Hint: Recall that the four-sided shape will be a SQUARE.]**Solution:** The square will provide the maximum area. We need to form a square that has a 60m perimeter.1 side of the square = 60 / 4 = 15The enclosed area will by 15 by 15; thus, its area is 15 x 15 = 225 m2.  |

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

|  |  |
| --- | --- |
| a) 48 m | b) 100 m |
| c) 36 m | d) 144 m |

**Concept 2: Minimum Perimeter for a Fixed Area – *MINIMIZING THE PERIMETER***

Complete the table below:

**OBSERVATION:**

The rectangles above have the same \_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Rectangle \_\_\_ has the least perimeter area.

**CONCLUSION:**

When enclosing **FOUR SIDES**, the minimum perimeter for a given rectangular area is obtained by forming a \_\_\_\_\_\_\_\_\_\_\_\_.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Rectangle** | **Length (m)** | **Width (m)** | **Area (m2)** | **Perimeter (m)** |
| A | 2 | 18 | 2 x 18 = 36  | 2(2 + 18) = 40 |
| B | 3 | 12 |  |  |
| C | 4 | 9 |  |  |
| D | 6 | 6 |  |  |
| E | 9 | 4 |  |  |

|  |
| --- |
| **Solved example:** Find the dimensions of the rectangle that will provide the least perimeter if the area is 81 m2.**Solution:** The square will provide the least perimeter. We know the area of this square which is 81.One side of the square is = $\sqrt{81}=9$Therefore, it is a 9 by 9 square that will give the least perimeter. |

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

|  |  |
| --- | --- |
| a) 36m2 | b) 100 m2 |
| c) 144 m2 | d) 256 m2 |

**Concept 3: MAXIMUM 3-SIDED AREA**

**CONCLUSION:**

When enclosing **THREE SIDES**, the **maximum area** for a given rectangular area is obtained by forming a rectangle whose length is twice its width.

Let “w” represent the width “2w” represent the length.

w

w

2w

|  |
| --- |
| **Solved example:** Your manager asked you to create a three-sided rectangular area at the beach with a 100 m rope that will have the greatest area. What are the dimensions? **Solution:** Since this is a three-sided enclosing, we will use the following figure: w + 2w + w = 4w ww2w 4w is the perimeter because that is how much rope we have 4w = 100 divide both sides by 4  4w / 4 = 100 / 4 w = 25 width = 25 length = 50Therefore; it is 25 by 50 rectangle with its three sides enclosed. |

**Your turn:**

Organizers of an outdoor music festival want to enclose a rectangular dining area against a large barn. They have 80 m of rope to use as a fence. Determine the length and width of a fence that will provide the maximum dining area. Use words and diagrams in your answer.



**PRACTICE**

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 lookout 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.