U8D3_T Perimeter and Area Relationships of Rectangl

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U8D3_T
Perimeter...

MPM 1DI U8D3

Perimeter & Area Relationships of Rectangles (4-sided)

KEY TERM:
Optimization: **the process of finding values that make a given quantity the greatest/maximum (or least/minimum) possible amount given certain conditions.**

EX. Ian has a summer job at a fencing company. A customer has purchased 32 sections of prefabricated fencing, each 1 m in length, and wants Ian to create a rectangular pigpen with the largest area possible.

This problem is an example of an optimization problem because it asks us to find the dimensions that would MAXIMIZE the rectangular playpen given a fixed perimeter of 32 m. This is called optimizing the area.

Investigation A: **How can you model the maximum area of a rectangle with a fixed perimeter?**

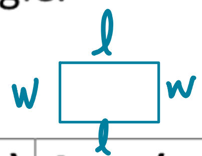
1. Complete the table below, testing different possible dimensions. To complete the table.

a) Determine the dimensions of 4 different rectangles that Ian could use for this fence.

$\boxed{\text{Recall: } Perimeter = 2\,(l + w)}$

b) Calculate the area of each rectangle.

$\boxed{\text{Recall: } Area = lw}$



Width (m)	Length (m)	Perimeter (m)	Area (m^2)
2	14	32	28
4	12	32	48
6	10	32	60
8	8	32	64

2. **REFLECT:** What did you find?

a) What are the dimensions of the rectangle with the maximum, or optimal value? 8 m x 8m

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b) What is the maximum area? $64\ m^2$

c) What happened to the area as the length and width became closer in value?

The area increases **as the dimensions get closer in value.**

d) Describe the shape of the rectangle with maximum area. A SQUARE has the optimal area

e) How can you predict the dimensions of a rectangle with a maximum area if you know the perimeter?

$W = \frac{P}{4}$, $l = w$

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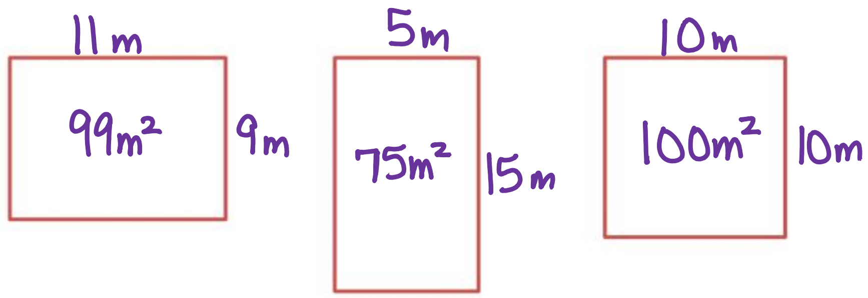
3. Suppose the customer decides to use 40 m of fencing instead of 32 m.

b Predict the dimensions of the rectangular pen with the maximum area.

$W = \frac{P}{4}$ $\quad W = \frac{40}{4}$ $\quad l = 10$ $\quad \boxed{10m \times 10m}$

$W = 10$

b Draw rectangles and find their areas to test your hypothesis.



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Investigation B: **How can you model the minimum perimeter of a rectangle with a fixed Area?**

Ian has another customer who needs 36 ft^2 to comply with regulations for his free-range chickens, but wants to keep his cost for fencing to a minimum.

1. Complete the table below, testing different possible dimensions that comply with the given criteria.

   a. Determine the dimensions of 5 different rectangles that Ian could use for this fence.

   b. Calculate the perimeter of each rectangle.

$l = \frac{A}{w}$ $A = lw$ $P = 2(l+w)$

Width (m)	Length (m)	Area (m^2)	Perimeter (m)
1	36	36	2(37) = 74m
2	18	36	2(20) = 40m
3	12	36	2(15) = 30m
4	9	36	2(13) = 26m
6	6	36	2(12) = 24m

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2. REFLECT: What did you find?

a. What are the dimensions of the rectangle with the minimum, or optimal value?

6 m x 6m

b. What is the minimum perimeter? 24m

c. What happened to the perimeter as the length and width became closer in value?

The perimeter _decreases_ as length and width get closer in value.

d. What is the ideal shape for minimizing the perimeter of a rectangle when given a fixed area? A SQUARE minimizes (optimizes) perimeter.

e. How can you predict the dimensions of a rectangle with a minimum perimeter if you know the area?

$w = \sqrt{A}$, $l = w$

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EX. 1. a. Determine the dimensions of a rectangle with maximum area that has a perimeter of 60 m.

$P = 60m$

$w = \frac{P}{4}$

$w = \frac{60}{4}$

$\boxed{w = 15m, \ l = 15m}$

b. Determine the minimum perimeter of a rectangle that has an area of 49 cm^2.

$\boxed{49m^2}$

$W = \sqrt{A}$

$W = \sqrt{49}$

$W = 7\text{ cm}, \ l = 7\text{cm}$

$P = 4w$

$P = 4(7)$

$P = 28$

$\therefore$ the minimum perimeter is 28cm

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EX. 2. Sir Adam Beck PS is adding a rectangular kindergarten playground to the yard. The area of the playground is to be 72 m². Minimizing the perimeter will minimize the cost of the fence. What whole number dimensions use the minimum length of fence?

$W = \sqrt{A}$

$W = \sqrt{72}$

$W = 8.48$ ← not a whole number.

$\boxed{72\,m^2}$

↑

find dimensions for rectangle as close to 8.48×8.48 as possible with no decimals

* two numbers as close to each other as possible with a product of 72.

The optimal rectangular playground satisfying the given conditions is $8m \times 9m$.

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