Example 1. The formula for the output P for a battery is given by

$$P = VI - RI^2.$$

where V is the voltage, I is the current, and R is the resistance. Find the current for which the output is a maximum if V = 12 volts and R = 5 ohms.

P =
$$12I - 5I^2$$

Find the max. pt. of the function.
P' = $12 - 10I \Rightarrow P'' = -10 < 0$
Critical pts of $P' = 0 \Rightarrow 12 - 10I = 0$
 $\Rightarrow I = \frac{12}{10} = 1.2$ Amperes.
Since, $P'' < 0$, $I = 1.2$ is a max. pt.
(By and derivative test)

Example 2. A rectangle has an area of 100 square meter. What should be the dimensions so that the perimeter will be as small as possible.

Let the length be
$$x$$
 and width be y .

$$\Rightarrow xy = 100 \Rightarrow y = \frac{100}{x}$$

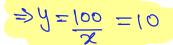
$$P = 2x + 2y = 2x + 2\left(\frac{100}{x}\right)$$

$$\Rightarrow P(x) = 2x + \frac{300}{x}$$
Need to find min. Pt. for $P(x)$.
$$\Rightarrow P(x) = 2 - \frac{300}{x^2} \Rightarrow P^{11}(x) = \frac{400}{x^2}$$

$$(rifical Pts: 2 - \frac{200}{x^2} = 0 \Rightarrow \frac{300}{x^2} = 2 \Rightarrow x^2 = 100$$

$$P^{11}(10) = \frac{400}{1000} > 0$$

$$P^{11}(-10) = -\frac{400}{1000} < 0 \Rightarrow x = 10$$
 is the regulation. Pt.



Solving minimum-maximum problems.

- 1. Write the expression for the quantity *F* to be minimized or maximized, using appropriate variables. (Drawing a figure may help.)
- 2. If the expression contains two variables, eliminate one of them using the information in the problem.
- 3. Minimize or maximize F.

Example 3. Find the number which exceeds its square by the greatest amount.